



Submission to the Legislative Assembly Committee on Environment and Planning

Inquiry into sustainability of energy supply and resources in NSW Terms of reference

That the Committee on Environment and Planning inquire into and report on the sustainability of energy supply and resources in NSW, including:

1. The capacity and economic opportunities of renewable energy.
2. Emerging trends in energy supply and exports, including investment and other financial arrangements.
3. The status of and forecasts for energy and resource markets.
4. Effects on regional communities, water security, the environment and public health.
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.
6. Any other related matters.

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Thank you for the opportunity to comment on the Inquiry into sustainability of energy supply and resources in NSW.

About the Centre for Air pollution, energy and health Research (CAR)

[CAR](#) is a Centre of Research Excellence funded by the National Health and Medical Research Council. The centre brings together more than 30 researchers at the forefront of their fields, based in seven of Australia's leading universities.

CAR is the only group of its kind nationally to bring together researchers focusing on health impacts of air pollution, and new versus traditional forms of energy. The centre supports teams of researchers in the fields of epidemiology, exposure assessment, toxicology, chemistry, biostatistics and clinical respiratory medicine to pursue collaborative projects and to develop their capacity. Our centre's vision for a healthier community is the driving force behind our research.

CAR is facilitating and translating research on moving to alternative, renewable forms of energy that have the most beneficial (or least detrimental) impacts on economy, environment and health, considering a technology's life cycle. For example, CAR is assessing how a transition in domestic energy use (from solid-fuel combustion to solar-generated electricity) may reduce household air pollution and therefore reduce childhood mortality rates in some Pacific Island Countries. Conversely, CAR plans to assess the potential for negative impacts from energy transitions, such as the environmental health impacts of disposal of photovoltaic (PV) solar panels at the end of their life cycle.

General comments

CAR includes the study of the health implications of energy transitions as one of its research agendas. The impetus for this, is the rapid change needed to combat climate change, by implementing new and emerging low-carbon based technologies and energy production methods. Many of these transitions are urgently required to help combat climate change and as such are strongly supported by CAR to minimise the risk of health impact from such change. However, concurrently there is a need to determine the potential for associated health impacts from various energy transition changes. Examples might include the study of potential health impacts of waste to energy schemes or whether solar panel end of life disposal methods requires specific health consideration, due to the materials used and related by-products or emissions. Yet, preliminary research by CAR has indicated that there is a lack of consideration and data on the health aspects of energy transitions.

The World Economic Forum also sees major changes with the electrification of large sectors in the economy including transport and heating sectors, decentralisation of energy resources (distributed generation and storage, flexibility in demand and energy efficiency), and digitalisation of the grid using smart metering and sensors, automation and the Internet of Things (IoT) (WEF, 2017, Future of Electricity). This is echoed in Australian documents with projections of substantially greater electrification of the energy system, an increase in distributed energy systems and digital transformation (Watt et al, 2017). This is not however, reflected in the current situation.

In 2015-2016 in Australia, *energy consumption* by fuel type was dominated by: oil (37%), coal (32%), gas (25%) with a minority from renewables (6%) (Department of the Environment & Energy 2017). *Energy production* figures for the same period were: 70% black coal, 4% brown coal, 20% natural gas, 4% oil and natural gas liquids (NGL), 0.5% liquefied petroleum gas (LPG), and 2.1% renewables. These figures highlight that oil, coal and gas dominate both consumption and production of energy in Australia. Both black and brown coal and gas also represented the major fuel types for electricity generation in Australia in 2016 at 45%, 18%, and 19% respectively. Of the renewable energies proportion, hydro contributed 6.9%, wind 5%, solar PV 2.9%, and bioenergy (wood, bagasse (sugar cane fibre), landfill biogas, others - 1.4%) (Department of the Environment & Energy 2017).

Despite Australia's reliance on carbon intensive fuels for energy, the 2017 International Energy Agency's (IEA) report 'Perspectives for the Energy Transition' stated that to meet the Paris Accord objective of limiting temperature rises to below 2°C with 66% probability "*would require an energy transition of exceptional scope, depth and speed.....*". Of note, the IEA report stated that "*Reducing the impact on human health and mitigating climate change would save between two- and six- times more than the cost of decarbonisation*".

The cost of electricity production using renewable energies such as wind and solar power has decreased more than 50% since 2011 (Dept of Environment and Energy; Better Energy Future, 2017). New build technologies in Australia for wind, solar and combined gas turbines are now cheaper to build than coal technologies. At the same time, we have an ageing coal-based electricity sector with a number of power stations recently retired or earmarked for retirement.

All these factors have significant ramifications for our energy and it is clear that the need for continued emissions reductions will drive innovation and research into newer, more efficient and cleaner energy sources, regardless of government policy. CAR strongly advocates for greater investment and uptake of renewable technologies to help drive the cleaner electrification of our economy, and also advocates that carbon intensive sources of energy such as coal be phased out as soon as possible. Urgent action to transition to cleaner non-polluting energies is required to help halt climate change. However, adoption of new technologies or processes can also present new challenges, pollutants, and by-products which require careful consideration to provide an informed debate and ensure that public health is not compromised.

To help inform CAR's work in energy transitions, CAR researchers carried out a review. The work included a scoping review on the health impacts of energy transitions. Our aim was to synthesise the evidence from published scientific literature on the health impacts of transitioning from traditional fossil fuel use (predominantly coal combustion) to other cleaner forms of energy, with specific reference to Australia and similar high-income countries. It also aimed to describe the trends and developments in the transition to cleaner energy generation in Australia, and related research activity by industry and research organisations, with specific reference to the potential and real health co-benefits. The aim of this work was to determine the existence of industry, NGO and research agencies involved in energy use and transition activities in the Australian context which consider, or have considered, health impact in their work. CAR searched the internet for research agencies, Australian government departments, energy industry associations and non-government agencies to identify relevant documents, policies and reports. The intent of this work was to determine potential gaps in public health knowledge and the potential for contribution in this field. While CAR is yet to publish this review, we offer our findings here as part of our submission to the Inquiry.

CAR scoping review findings

The review work revealed that there are many agencies in Australia involved in energy supply, distribution and energy transition work, including regulators, renewable energy companies, research institutes, industry associations, and non-government organisations (NGOs). Few of these agencies directly consider health externalities or co-benefits in their work and those that do, mainly do so in the context of co-benefits associated with climate change mitigation. The central roles and activities of many of these agencies relate to governance, provision of energy and/or associated infrastructure, driving innovation in energy generation, emissions reductions, energy markets and economics, or research in these areas. A small number of Australian research institutes consider the social impacts associated with energy provision, with particular reference to improving community acceptance and adoption of new technologies, and a few conduct research on the health

impacts and externalities of climate change mitigation measures. As far as we can determine, none of these research institutes have a focus on investigating the direct health impacts of energy transitions.

Our literature review on the health aspects of energy transitions identified 5026 peer reviewed scientific articles (after removal of duplicate papers) that met our search criteria. Of these, 4911 papers were excluded after abstract review; and 47 further papers excluded after full-text review; leaving 39 papers for review. Two papers were subsequently added during the review period.

The review found that there are very few epidemiological studies of health effects or health impacts related to energy transitions. The majority of the papers that met the search criteria focussed on the following fields of research:

- modelling health impacts of increased energy demands;
- modelling the health impacts of climate change policies;
- modelling the health impacts of improved air quality due to change in climate change policies;
- energy conservation;
- residential energy efficiency; and
- the health impacts of using alternative energy sources (namely biofuels; solar panels; wind turbines; electric vehicles).

Our search of the literature on modelling climate change policies, changes in air quality and increased energy demands indicated the following:

- The range of modelling methodologies determined that greenhouse gas reductions resulting from changes in energy use and transitions will contribute to reduced air pollution which may result in substantial human health co-benefits.
- Other health co-benefits were associated with active transport, cleaner cars, healthy diets and improved household energy efficiency. The degree of health benefit varied greatly with the choice of energy technologies and sectors.

Key findings of the scoping review are grouped as follows:

Bioenergy, biofuels & waste to energy schemes

There has been substantial investment in bioenergy and liquid fuel energy with the Clean Energy Finance Corporation (CEFC) investing \$150 million, along with \$280 million from private sector investment, into bioenergy and energy from waste projects. The CEFC projects have resulted in investments of \$3.5 billion in bioenergy and energy from waste projects, *“including projects to produce wood pellets, to convert sugarcane to ethanol, to build a biofuels plant, and to convert municipal solid waste and animal waste to energy”*. The US Energy Information Administration projected that world liquid fuel demand is projected to increase 38% by 2040, and the CEFC predicts that Australia will be well placed to meet this demand.

- There are a range of biofuels in existence which are being used as potentially cleaner substitute fuels to petroleum and diesel fuel and these include bioethanol and biodiesels.
- There are a range of organic sources used or being investigated for use in biofuel production including: corn; sugar cane; sugar beet; soy bean; rapeseed/canola. They are composed of widely varying organic matter with differing chemical composition.
- Many of these biofuels are currently being researched and tested, with very little health-based testing having taken place to date.
- There is a widespread assumption that the use of stabilised biofuels will result in reduced air pollutants which in turn will lead to a decrease in the detrimental effects of fuels on human health, at the population level, however there is a dearth of data available on the health impacts of biofuel use.
- Possible by-products of biofuel use include: respirable compounds, carcinogens, ionizing radiation, UV-B radiation, and endotoxins.
- There is a need for toxicological assessment of biofuels.
- There may be a range of health effects related to production depending on the source of the biofuel.
- We conclude that there is a need for Health Impact Assessments (HIA) on biofuel production and use.
- Differing approval processes are being used by the varying jurisdictions to determine approval and operational aspects of waste to energy schemes, with little coordination across states. The potential for health risk is also not being assessed consistently across jurisdictions. There is a need to develop and implement a standardised approach for waste to energy facilities including emissions testing and reporting.

Photovoltaic cells (PVC) (solar panels)

In Australia the solar industry is targeting greater uptake of solar systems by commercial premises with strong projected growth in systems sized 30-100 kW (CEC, 2016). There has also been an increase in the approval of large-scale solar farms. For example, 11 solar farms were approved in NSW during 2017 (CEC, 2018). Battery technology costs are projected to decrease by 40%-60% by 2020 and by 70% by 2030 (Dept of Environment and Energy; Better Energy Future, 2017) leading to projections for a greater uptake of battery energy storage systems.

CAR strongly supports the uptake of renewable energy sources and PVC uptake and battery storage systems but believes:

- There is a need to identify and assess potential environmental and health burdens across all phases of the PVC life cycles: production, end-of-life, and disposal (take-back, recycling).
- That Life Cycle Assessment (LCA) is one method used to assess 'cradle to grave' impacts of PVC, including health impacts as health considerations have largely been absent in the LCAs published to date.
- Battery storage of energy produced by PVC should be included in LCAs.

Transition to gas-fired power plants

- Although particulate matter (PM₁₀) and nitrogen dioxide (NO₂) emissions from natural gas burning power plants are significantly lower compared with fossil fuels, they may still represent a potential health threat to vulnerable people residing nearby.

Electrification of vehicles

As of 2017 there were more than 2 million electric vehicles (EVs) in service globally and EVs represent an increasing proportion of new car sales. CAR supports the uptake and transition to electric vehicles. However, there is a need to consider the following:

- Although the use of EVs is associated with improved air quality (from vehicle emissions) and lower running costs, there will still be particulate matter (PM) pollution from EVs because of emissions from brake and tyre wear.
- Consideration needs to be given to the production of electricity used by the EVs— with respect to the sources that will be used. That is, reliance on electricity production needs to shift from coal fire power stations in NSW to renewable sources for health benefits to be fully realised.
- Research and development is needed on EV batteries used to store energy and lengthen distances that can be travelled, and also on battery life, cost, potential recycling and disposal.
- EVs will not solve the issue of congestion in cities especially in Sydney where there is substantial commuting time spent in transit. This has implications on health with respect to increased sedentary behaviour and time unable to spent in meaningful activities at home, work or other chosen activities. To alleviate congestion there is also a need to increase opportunities for public, active and other forms of community-based transport.
- Electrification of the public transport system could contribute significantly to improved air quality.
- Environmental justice issues are apparent, whereby the geographic location and source of electricity production may lead to the unequal burden of pollution in areas where the benefits of EVs are not experienced.
- We conclude that there is a need for a Life Cycle Analysis (LCA) on the uptake of and use of EVs so that the issues raised above can be fully considered.

Hydrogen fuel cells in automobiles

- Conversion of fossil-fuel to hydrogen fuel-cell vehicles is likely to lead to reduced health costs related to improved air quality due to eliminating emissions from fossil fuel exhaust (particulate matter, NO_x). However, there is uncertainty related to future health costs per unit of emission, how emissions may actually change, and how climate change may affect biogenic emissions.
- CAR suggests that a HIA on hydrogen fuel cells in automobiles be conducted.

Wind turbines

- There is currently more health-related research on wind turbines than on other renewable energy sources. However, much of this research is of low quality.
- There has been much contested community concern over alleged health effects associated with being in close proximity to wind farms and that they cause negative health effects.
- Overall, research is indicating that there are stronger adverse health effects associated with pre-existing negative attitudes towards wind turbines. These include concerns over property devaluation, visual impacts, and noise sensitivity.

- The NHMRC has funded two major studies which include objective measures of health effects from exposure to wind turbines. These studies are due to be completed in two years.

Conclusions & recommendations

Given the findings of our scoping review, we make the following observations:

- The impact of energy transitions on health is important. However, this impact has not been adequately considered in existing analyses of the costs and benefits of energy transitions.
- Accordingly, there is a need for: 1) expert guidance on the inclusion of health considerations into existing policy processes and research programs; 2) implementation of health impact assessments (HIA) within or alongside life cycle analyses (LCA); 3) exploring the potential health impacts of individual renewable energy technologies.
- We highlight the following recommendations as opportunities for public health input into policy development for energy transitions:
 - LCA for solar PV and wind farm components to incorporate the impacts arising from production, disposal or reuse of the components;
 - LCA for electric vehicles and their related components;
 - Toxicological assessment of biofuels;
 - HIA/health risk assessment guidance for bioenergy-waste to energy proposals;
 - HIA/LCA of transitioning from conventional vehicles to electric vehicles;
 - Determining the impacts (if any) of small scale energy generation;
 - Conducting HIA for specific waste to energy streams;
 - Exploring tools and methods to increase uptake of short- and long-term health impact considerations into economic modelling of energy changes (energy sources and prices);
 - HIA related to residential energy efficiency. This could include residential energy sources, such as the impacts of burning wood as fuel in preference to cleaner energy sources; or building design and construction;
 - Research into exposure to specific renewable technology sources such as windfarm exposures; batteries for storing energy;
 - Determining whether there are unintended impacts of hydrogen fuel cell vehicles.

References

Will be available upon request.

For more information

This submission has been produced by the Centre for Air pollution, energy and health Research (CAR).

For more information about CAR and our work in energy transitions as well as the health impacts of air pollution: contact us at car@sydney.edu.au or visit our website: www.car-cre.org.au

