

Submission NSW Department of Planning and Environment - Draft Wind Energy Planning Framework

The NSW draft wind energy planning framework is substantially flawed, favours the development application over the property rights of NSW landowners and is corrupted by a systemic failure of public officers to protect the rights, health and well-being of rural Australians. These guidelines discriminate against rural communities and support a flawed and terminal public policy.

I am a farmer from Boorowa whose family has been subjected to the imposition of having wind farm developers scouring our landscape for personal economic gain. The amount of my personal time that I have had to spend ensuring that my community is properly informed and my environment/landscape is protected from these wind farm bandits has come at a tremendous personal cost and taken my time away from primary production and providing for my family. I will continue relentlessly to expose the deceitful behaviour of these unscrupulous parasites and the public officers that support them.

- [Wind Energy: Assessment Policy, Draft for Consultation August 2016](#)

Comment on the Strategic Context which underpins the draft guidelines: 1.3 Strategic context

While I appreciate that the NSW Government recognises the importance of reducing greenhouse gas emissions within the electricity sector, the strategy contained in these guidelines has failed to take into consideration a recent data analysis of the National Electricity Market (NEM) which shows that wind energy is incapable of reducing emissions within the electricity sector. It is well known in the electricity generation sector that wind energy electricity is of poor quality, destabilises the grid and is intermittent in supply. The supply and demand for electricity in the grid has to be balanced at any point in time and wind energy disrupts this balance. Reliable and consistent base-load electricity supply has to be maintained at all times. This means that scheduled generators must maintain base-load generation to be able to meet consumer demand. These base-load generators are forced into ramping their generation up and down to match the intermittent supply of energy from wind turbines. It takes up to 24 hours for a coal-fired power plant to get up to temperature (to build up the steam) to supply reliable base-load electricity onto the electricity grid. When intermittent supply from wind turbine generators enters the grid, the coal-fired power stations are unable to reduce the amount of coal they are burning (and therefore reduce emissions within the electricity sector) as they are a scheduled generator and must be available to the grid manager as per their scheduling contracts.

Wind turbines are classified as a semi-scheduled generator. This allows them to have access to the grid when they fit neither a non-scheduled or scheduled (reliable) classification. This

new classification has been invented to try and fit an unreliable and semi (meaning half or incomplete) generator into a reliable and currently stable electricity grid.

*[The NSW Renewable Energy Action Plan (2013) commits NSW to increasing the use of energy from renewable sources **at least cost** to the energy consumer and with maximum benefits to the State.]*

The *Renewable Energy (Electricity) Act 2000* is delivering a corporate subsidy to the wind energy sector on a massive scale. The scale of these subsidies are paid by electricity consumers; every household, school, hospital and business in NSW. At a current Renewable Energy Certificate (Large-scale Generation Certificate) market price of \$88, developers are pocketing upwards of \$850,000 PER TURBINE PER YEAR UNTIL 2031. When compared to the average payment to the host landholder (whom carries all of the legal liability for noise nuisance from the turbines) the \$12,000 payment per turbine per year is unequivocally disproportionate.

All retail electricity providers will pass on the cost of the subsidy plus a retail margin to all of their consumers. Facetious arguments regarding the effect of wind energy generation on wholesale prices are therefore irrelevant. Assuming an 11% retail margin the actual cost of this federally mandated subsidy (Renewable Energy Target) would be in the order of \$103 per MWh which in 2021, based on a 23.5% target the additional cost per MWh may be upwards of \$24 which would equate to an economy wide cost of approximately \$4.8 billion per year every year. NSW is the largest consumer of electricity in Australia and bears the proportional cost of this subsidy.

As an example, the state of South Australia is contributing the highest proportion of wind energy in the NEM and SA consumers also have the highest price of electricity in Australia and nearly the highest price in the world.

“Energy prices spiked above \$10,000 a megawatt hour in South Australia, causing a crisis for big business and leading to threatened shutdowns at BHP Biliton’s Olympic Dam mine, Arrium and Adelaide Brighton Cement... Along with the Heywood interconnector outages, the report also blamed the state’s increasing reliance on gas and at times unreliable wind... While there is in the order of 1200 MW of semi-scheduled wind installed in SA, on the day it was generating below 20 MW as forecast the report says.” *Poor winds and shutdown bear blame for SA crisis*, Verity Edwards, The Australian, 15 September 2016.

While this scheme is mandated by federal legislation, the state of NSW is supporting the payment of this subsidy out of their people’s pockets by approving wind farm developments in rural areas.

- [Wind Energy: Noise Assessment Bulletin, Draft for Consultation August 2016](#)

This draft noise guideline will not protect the health and well-being of the people neighbouring the developments. Current wind turbine noise guidelines are not protecting 90% of the people 90% of the time.

On-going sleep disturbance is a health issue.

The methodology to measure wind turbine noise and vibration is currently flawed. The only recourse for affected people will be through taking actions against the host landowner or through civil disobedience to stop the source of the disturbance/nuisance.

[The requirements of SA 2009 and this bulletin subsequently do not apply where there is a current noise agreement with a landowner.]

The above exclusion from the State guideline in a private agreement sets a precedent for **all** developments and should be noted by those involved in proceedings in the Land and Environment Court.

[However, the applicant's EIS should clearly identify the expected noise levels at all receiver (resident) locations including host properties to ensure that affected persons can make informed decisions regarding the proposal.]

In practice, the wind farm proponent signs the landowners to a binding private agreement before they submit the EIS. This means that the person(s) entering the contract cannot make an informed decision regarding the proposal. These agreements are lodged as a caveat on the affected land.

The guideline only measures audible noise and does not include an acceptable measurement of low frequency noise, infrasound and vibration all of which are known to cause harm to health in neighbouring residents.

The guideline does not incorporate the important findings of the world first pilot study undertaken by accomplished acoustician, Mr Steven Cooper, on behalf of the developer, Pacific Hydro, that has found that wind turbine noise has a unique sound signature which contains characteristics that have known adverse effects on human health.

The wording of the bulletin misrepresents the findings of the NHMRC's literature review.

- [Wind Energy: Visual Impact Assessment Bulletin, Draft for Consultation August 2016](#)

Wind turbines that are 150m plus in height and width on a ridgeline have a significant visual impact. Multiple turbines compound the impact.

In terms of the impact of neighbouring residents, visual impacts are secondary in importance to the chronic adverse health impacts caused by excessive noise and vibration from turbines. However, neighbouring landowners must be fully compensated by the developer for the substantial fall in property value caused by the visual impacts.

Wind turbine operators Infigen have previously submitted in their development applications:

“It is in the professional opinion of Moir Landscape Architecture Pty Ltd that the proposed development will **visually integrate into the landscape** resulting in a low visual impact on the existing landscape character and visual amenity.”

Now that’s a stretch if ever there was one.

- [Wind Energy Framework: Standard Secretary’s Environmental Assessment Requirements, Draft for Consultation August 2016](#)

All land included in an industrial wind energy development must be zoned industrial and rated as such.

Aviation exclusion zones need to be defined on the turbulence created by cumulative operations of unprotected turbines. This is an aviation safety issue that will lead to more deaths that are preventable. Wind monitoring towers must be painted so that they are properly visible and marked on maps.

Blade throw (component liberation) exclusion zones must be fenced off and signage erected. For example: “Danger component liberation landing zone.”

- [Review of the Impact of Wind Farms on Property Values, Urbis, 21 July 2016](#)

Urbis has been commissioned by the office of Environment and Heritage. Urbis has also been commissioned by Proponents Infigen Energy (formerly Babcock and Brown) on a number of occasions to write their visual impact assessments. So the NSW Department Planning and Environment has accepted a report commissioned by the Office of Environment and Heritage that enlisted a consultancy, Urbis, to undertake a study when Urbis has previously been commissioned by Proponents to write reports submitted to the NSW Department of Planning and Environment. Sir Humphrey Appleby would be proud.

The Urbis report is biased, false, and deceitful as their study has excluded all of the following:

- neighbouring properties that have been bought out by the proponents in gagging compensation agreements;

- neighbouring properties that have been compensated for loss in property value and for loss of production; and
- Neighbouring properties that have been rendered completely unsaleable due to excessive noise

[To the extent permitted by applicable law, Urbis expressly disclaims all liability...]

H-Urbis has infiltrated many areas of government including making donations to political parties (\$30,000).

- [Wind Energy Framework Frequently Asked Questions](#)

The information contained in the frequently asked questions is largely misleading, misrepresentative, incorrect and deceptive.

Please read the following attachments:

- Senate Select Committee on Wind Turbines Report to the Federal Parliament.
 - Document describing a Power Purchase Agreement tabled by Senator Dr Chris Back in Federal Parliament.
 - Dr Wheatley study: *CO2 Emissions Savings from Wind Power in the National Electricity Market (NEM)*.
 - ARREA, *Researching Australia's Renewable Energy Future*.
 - Peter Lang, *Wind's effectiveness and CO2 avoidance cost*.
 - Infigen Energy, *2014 Bodangora wind turbines indicative royalty calculations*.
- N.B. These calculations are based on a 2014 LGC price of \$37.00, the LGC price is currently \$88.**

The Senate

Select Committee on
Wind Turbines

Final report

August 2015

© Commonwealth of Australia 2015

ISBN 978-1-76010-260-9

Secretariat

Ms Jeanette Radcliffe (Committee Secretary)

Ms Jackie Morris (Acting Secretary)

Dr Richard Grant (Principal Research Officer)

Ms Kate Gauthier (Principal Research Officer)

Ms Trish Carling (Senior Research Officer)

Mr Tasman Larnach (Senior Research Officer)

Dr Joshua Forkert (Senior Research Officer)

Ms Carol Stewart (Administrative Officer)

Ms Kimberley Balaga (Administrative Officer)

Ms Sarah Batts (Administrative Officer)

PO Box 6100

Parliament House

Canberra ACT 2600

Phone: 02 6277 3241

Fax: 02 6277 5829

E-mail: windturbines.sen@aph.gov.au

Internet: www.aph.gov.au/select_windturbines

This document was produced by the Senate Select Wind Turbines Committee Secretariat and printed by the Senate Printing Unit, Parliament House, Canberra.

This work is licensed under the Creative Commons Attribution-NonCommercial-NoDerivs 3.0 Australia License.



The details of this licence are available on the Creative Commons website: <http://creativecommons.org/licenses/by-nc-nd/3.0/au/>

MEMBERSHIP OF THE COMMITTEE

44th Parliament

Members

Senator John Madigan, Chair	Victoria, IND
Senator Bob Day AO, Deputy Chair	South Australia, FFP
Senator Chris Back	Western Australia, LP
Senator Matthew Canavan	Queensland, NATS
Senator David Leyonhjelm	New South Wales, LDP
Senator Anne Urquhart	Tasmania, ALP

Substitute members

Senator Gavin Marshall for Senator Anne Urquhart (from 18 May to 18 May 2015)	Victoria, ALP

Participating members for this inquiry

Senator Nick Xenophon	South Australia, IND
Senator the Hon Doug Cameron	New South Wales, ALP

TABLE OF CONTENTS

Membership of the Committee	iii

Tables and Figures	xi

Abbreviations	xiii

List of Recommendations	xv

Chapter 1

Introduction	1

The inquiry	2

The interim report and its recommendations	2

The federal government's response	3

The purpose of this report.....	4

The need for a broader mix of renewable energy sources.....	4

Science and public policy	5

Improving compliance and the duty of care	5

Acknowledgements	6

A note on procedure	7

Structure of this report.....	8

Chapter 2

The need for more evidence-based health advice on the impact of wind turbines on human health	11

Introduction and context.....	11

Structure of the chapter	12

Wind turbines and ill-health	13

The views of the Australian Medical Association.....	24

The role of the NHMRC and evidence-based health advice	27

The NHMRC's reviews	28

Submitters' views of the NHMRC.....	34
Criticism of the 2015 NHMRC Review	40
Acousticians' views and the need for properly funded research	42
The committee's view on further research and the body to conduct it.....	49

Chapter 3

Planning issues	51
Introduction	51
Implementation of planning processes	51
Capacity of local councils	62
Consultation.....	66
Improvements to planning processes	76
National wind farm guidelines	78
Committee view.....	79

Chapter 4

The monitoring and compliance of windfarms.....	81
Structure of the chapter	81
Current noise monitoring standards and the need to monitor infrasound	82
The role of State Governments and local councils in monitoring wind farms.....	88
The view of local Councils on current monitoring arrangements	89
State Governments' views on current monitoring arrangements.....	92
Residents' view of monitoring and compliance.....	94
The view of wind companies on monitoring and compliance	99
The Clean Energy Regulator and its legislative requirements	100
The need to ensure independent and competent monitoring of wind farms	104
The case for State EPAs to take over wind farm monitoring.....	109
A fee for service system	111
The case for greater transparency in monitoring and compliance.....	111
The need for a wind farm Ombudsman.....	113

Committee view.....	115
Chapter 5	
Fauna and aircraft.....	117
Introduction	117
Fauna	117
Aerial activities.....	128
Chapter 6	
Committee view and recommendations on the issues raised in chapters 2–5.....	137
The Independent Expert Scientific Committee on Industrial Sound.....	137
National Wind Farm Guidelines.....	142
Enhancing the powers of the Clean Energy Regulator.....	143
Shifting responsibility to State Environment Protection Authorities.....	144
A fee-for-service licencing system.....	145
Oversight of the IESC and State Environment Protection Authorities	147
The National Health and Medical Research Council	148
The need for political cooperation and corporate endorsement	149
Chapter 7	
The effect of wind power on retail electricity prices	151
Structure of the chapter	151
Wind power in the renewables market.....	152
The impact of the RET on wholesale and retail electricity prices	159
The impact of wind energy on retail prices	165
The merit of the RET cross-subsidy.....	167
The Clean Energy Finance Corporation.....	175
Long-term Power Purchase Agreements.....	175
Committee view.....	177
Renewables and the Emissions Reduction Fund.....	177

Committee view.....	180
Australian Labor Party Senators' Dissenting Report	183
(a) the effect on household power prices, particularly households which receive no benefit from rooftop solar panels, and the merits of consumer subsidies for operators	192
(b) how effective the Clean Energy Regulator is in performing its legislative responsibilities and whether there is a need to broaden those responsibilities	199
(c) the role and capacity of the National Health and Medical Research Council in providing guidance to state and territory authorities	203
(d) the implementation of planning processes in relation to wind farms, including the level of information available to prospective wind farm hosts	235
(e) the adequacy of monitoring and compliance governance of wind farms	244
(f) the application and integrity of national wind farm guidelines	250
(g) the effect that wind towers have on fauna and aerial operations around turbines, including firefighting and crop management	255
(h) the energy and emission input and output equations from whole-of-life operation of wind turbines.....	264
 Appendix 1	
Submissions and additional information received by the Committee	275
 Appendix 2	
Public hearings.....	307
 Appendix 3	
<i>Environment Protection and Biodiversity Conservation Act 1999.....</i>	<i>319</i>
Division 2B— Establishment and functions of the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development.....	319
 Appendix 4	
Wind Farms in Australia (Operational, Proposed and Under Construction): Document prepared by the Parliamentary Library	323

Appendix 5

Picture of Sapphire Wind Farm provided by CWP Renewables (supplied by Mr Robert Allen, Submission 410)	327

TABLES AND FIGURES

Chapter 5

Figure 5.1: One of four dead koalas allegedly found by local residents at a construction site associated with the Bald Hills Wind Farm	122

Chapter 7

Figure 7.1—Electricity generation by renewable energy source	152
Figure 7.2: Wind output as a percentage of regional output	153
Figure 7.3—Annual change in electricity generation by energy source	155
Figure 7.4—Profile of annual targets under the RET	157
Figure 7.5—LGCs created by fuel source, 2001–2013	157
Figure 7.6—RET induced renewable generation and the number of LRET Large-scale Renewable Energy Target (LRET) and Small-scale Renewable Energy Scheme (SRES) certificates created	158
Figure 7.7—Weekly LGC spot price, October 2014 to May 2015	159
Table 7.1—Impact of the RET by jurisdiction.....	162
Figure 7.8—Sensitivity of wind power generation to changes in the RET.....	165

Abbreviations

AAAA	Aerial Agricultural Association of Australia
AAAC	Association of Australian Acoustical Consultants
AEMO	Australian Energy Market Operator
AETA	Australian Energy Technology Assessment
AMA	Australian Medical Association
AWA	Australian Wind Alliance
BWTAG	Bodangora Wind Turbine Awareness Group
CASA	Civil Aviation Safety Authority
CEFC	Clean Energy Finance Corporation
CER	Clean Energy Regulator
CWP Renewables	Continental Wind Partners Renewables
DPA	Development Plan Amendment
enHealth	Environmental Health Standing Committee
EPA	Environment Protection Authority
EPHC	Environment Protection and Heritage Council of Australia
ICAC	Independent Commission Against Corruption (NSW)
IESC	Independent Expert Scientific Committee on Industrial Sound
IPART	Independent Pricing and Regulatory Tribunal
LGCs	large-scale generation certificates
LRET	Large-scale Renewable Energy Target
MAV	Municipal Association of Victoria
MWh	megawatt hour
NEM	National Electricity Market

NEPM	National Environment Protection Measure
NHMRC	National Health and Medical Research Council
NSW RFS	New South Wales Rural Fire Service
PAC	Planning Assessment Commission (New South Wales)
PMLG	Parkesbourne/Mummel Landscape Guardians
REE Act	<i>Renewable Energy (Electricity) Act 2000</i>
REC	Renewable Energy Certificate
RET	Renewable Energy Target
SARA	State Assessment and Referral Agency (Queensland)
SDAP	State Development Assessment Provisions (Queensland)
TRC	Tablelands Regional Council
TVCG	Tarwin Valley Coastal Guardians
TWTAG	Tablelands Wind Turbine Action Group
WIRV	Wind Industry Reform Victoria

FULL LIST OF RECOMMENDATIONS— INTERIM AND FINAL REPORT

Recommendation 1: interim

1.5 The committee recommends the Commonwealth Government create an *Independent Expert Scientific Committee on Industrial Sound* responsible for providing research and advice to the Minister for the Environment on the impact on human health of audible noise (including low frequency) and infrasound from wind turbines. The IESC should be established under the *Renewable Energy (Electricity) Act 2000*.

Recommendation 1: final

6.5 The committee recommends that an *Independent Expert Scientific Committee on Industrial Sound* (IESC) be established by law, through provisions similar to those which provide for the *Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development*.

6.6 The provisions establishing the IESC on Industrial Sound should state that the Scientific Committee must conduct 'independent, multi-disciplinary research into the adverse impacts and risks to individual and community health and wellbeing associated with wind turbine projects and any other industrial projects which emit sound and vibration energy'.

Recommendation 2: final

6.9 The committee recommends that the federal government assign the *Independent Expert Scientific Committee on Industrial Sound* with the following responsibilities:

- develop and recommend to government a single national acoustic standard on audible noise from wind turbines that is cognisant of the existing standards, Australian conditions and the signature of new turbine technologies;
- develop and recommend to government a national acoustic standard on infrasound, low frequency sound and vibration from industrial projects;
- respond to specific requests from State Environment Protection Authorities for scientific and technical advice to assess whether a proposed or existing wind farm project poses risks to individual and community health;
- provide scientific and technical advice to the relevant State Health, Environment and Planning Minister to assess whether a proposed or

existing wind farm or industrial project poses risks to individual and community health;

- provide advice to the Clean Energy Regulator on whether a proposed or existing wind farm project poses health risks to nearby residents;
- provide advice to the federal health minister on whether a proposed or existing wind farm or industrial project poses health risks to nearby residents;
- publish information relating to the committee's research findings; and
- provide to the federal Minister for Health research priorities and research projects to improve scientific understanding of the impacts of wind turbines on the health and quality of life of affected individuals and communities; and
- provide guidance, advice and oversight for research projects commissioned by agencies such as the National Health and Medical Research Council and the Commonwealth Scientific and Industrial Research Organisation relating to sound emissions from industrial projects.

Recommendation 2: interim

1.6 The committee recommends that the National Environment Protection Council establish a *National Environment Protection (Wind Turbine Infrasound and Low Frequency Noise) Measure* (NEPM). This NEPM must be developed through the findings of the *Independent Expert Scientific Committee on Industrial Sound*. The Commonwealth Government should insist that the ongoing accreditation of wind turbine facilities under the *Renewable Energy (Electricity) Act 2000* in a State or Territory is dependent on the NEPM becoming valid law in that State or Territory.

Recommendation 3: final

6.12 The committee recommends that the following provision be inserted into a new section 14 of the *Renewable Energy (Electricity) Act 2000*:

If the Regulator receives an application from a wind power station that is properly made under section 13, the Regulator must:

- seek the advice of the *Independent Expert Scientific Committee on Industrial Sound* whether the proposed project poses risks to individual and community health over the lifetime of the project; and
- confer with the federal Minister for Health and the Commonwealth Chief Medical Officer to ascertain the level of risk that the proposed project poses to individual and community health.

If the *Independent Expert Scientific Committee on Industrial Sound* finds that the wind power station does pose risks to human health, the Regulator must not accredit the power station until such time as the federal Minister for Health is satisfied that these risks have been mitigated.

Recommendation 4: final

6.15 The committee recommends that a provision be inserted into *Renewable Energy (Electricity) Act 2000* stipulating that wind energy generators operating in states that do not require compliance with the National Environment Protection (Wind Turbine Infrasound and Low Frequency Noise) Measure (NEPM) are ineligible to receive Renewable Energy Certificates.

Recommendation 5: final

6.20 The committee recommends that the *Independent Expert Scientific Committee on Industrial Sound* (IESC) establish a formal channel to communicate its advice and research priorities and findings to the Environmental Health Standing Committee (enHealth). The IESC should explain to enHealth members on a regular basis and on request:

- **the national acoustic standards for audible noise and infrasound and how these standards are set and enforced to monitor industrial projects;**
- **the methodology of its research and findings relating to how infrasound and vibration can impact on human sensory systems and health; and**
- **research priorities and possible strands of research that the National Health and Medical Research Council (a member of enHealth) could fund and commission.**

Recommendation 3: interim

1.7 The committee recommends that the Commonwealth Government introduce *National Wind Farm Guidelines* which each Australian State and Territory Government should reflect in their relevant planning and environmental statutes. The committee proposes these guidelines be finalized within 12 months and that the Commonwealth Government periodically assess the Guidelines with a view to codifying at least some of them.

Recommendation 6: final

6.25 The committee recommends that the proposed *Independent Expert Scientific Committee on Industrial Sound* develop National Windfarm Guidelines addressing the following matters:

- a national acoustic standard on audible sound (see recommendation 2);
- a national acoustic standard on infrasound, low frequency sound and vibration (see recommendation 2);
- a national standard on minimum buffer zones (see recommendation 6);
- a template for State Environment Protection Agencies to adopt a fee-for-service licencing system (see recommendation 9, below);
- a Guidance Note proposing that State Environment Protection Authorities be responsible for monitoring and compliance of wind turbines and suggesting an appropriate process to conduct these tasks;
- a Guidance Note on best practice community engagement and stakeholder consultation with the granting and holding of a licence conditional on meeting this best practice;
- a Guidance Note that local councils should retain development approval decision-making under the relevant state planning and development code for local impact issues such as roads;
- national standards for visual and landscape impacts;
- aircraft safety and lighting;
- indigenous heritage;
- birds and bats;
- shadow flicker;
- electromagnetic interference and blade glint; and
- the risk of fire.

6.26 As per recommendation 4 of the committee's interim report, eligibility to receive Renewable Energy Certificates should be made subject to general compliance with the National Wind Farm Guidelines and specific compliance to the NEPM.

Recommendation 4: interim

1.8 The committee recommends that eligibility to receive Renewable Energy Certificates should be made subject to general compliance with the *National Wind Farm Guidelines* and specific compliance with the NEPM. This should apply immediately to new developments, while existing and approved wind farms should be given a period of no more than five years in which to comply.

Recommendation 7: final

6.29 The committee recommends that the Australian Government amend the *Renewable Energy (Electricity) Act 2000* and the *Renewable Energy (Electricity) Act Regulations 2000* to enable partial suspension and point in time suspension of renewable energy certificates for wind farm operators that are found to have:

- breached the conditions of their planning approval;
- had their operating licence suspended or cancelled;
- establish powers to be used when breaches of statutory obligations occur that require energy generators to 'show cause' ; and
- link the issuing of renewable energy certificates with certified net greenhouse gas reduction in the electricity sector.

6.30 The committee recommends that the Clean Energy Regulator cannot accredit a power station until it is wholly constructed, fully commissioned and all post construction approval requirements have been met.

Recommendation 5: interim

1.9 The committee recommends that the Commonwealth Government establish a *National Wind Farm Ombudsman* to handle complaints from concerned community residents about the operations of wind turbine facilities accredited to receive renewable energy certificates. The Ombudsman will be a one-stop-shop to refer complaints to relevant state authorities and help ensure that complaints are satisfactorily addressed.

Recommendation 6: interim

1.10 The committee recommends that the Commonwealth Government impose a levy on wind turbine operators accredited to receive renewable energy certificates to fund the costs of the *Independent Expert Scientific Committee on Industrial Sound*—including the funding of additional research—and the costs of a National Wind Farm Ombudsman.

Recommendation 7: interim

1.11 The committee recommends that the data collected by wind turbine operators relating to wind speed, basic operation statistics including operating hours and noise monitoring should be made freely and publicly available on a regular basis. The proposed *Independent Expert Scientific Committee* should consult with scientific researchers and the wind industry to establish what data can be reasonably made freely and publicly available from all wind turbine operations accredited to receive renewable energy certificates.

Recommendation 8: final

6.37 The committee recommends that all State Governments consider shifting responsibility for monitoring wind farms in their jurisdiction from local councils to the State Environment Protection Authority.

Recommendation 9: final

6.46 The committee recommends that State Governments consider adopting a fee-for-service licencing system payable by wind farm operators to State Environment Protection Authorities, along the lines of the system currently in place in New South Wales.

Recommendation 10: final

6.53 The committee recommends that the federal Department of the Environment prepare a quarterly report collating the wind farm monitoring and compliance activities of the State Environment Protection Authorities. The report should be tabled in the federal Parliament by the Minister for the Environment. The Independent Expert Scientific Committee on Industrial Sound should coordinate the receipt of State data and prepare the quarterly report. The Department of the Environment should provide appropriate secretarial assistance.

Recommendation 11: final

6.57 The committee recommends that the National Health and Medical Research Council (NHMRC) continue to monitor and publicise Australian and international research relating to wind farms and health. The NHMRC should fund and commission primary research that the Independent Expert Scientific Committee on Industrial Sound identifies as necessary.

Recommendation 12: final

6.61 The committee recommends that under circumstances where the regulatory framework provided for pursuant to recommendations 8 and 9 cannot be enforced due to a lack of cooperation by one or more states, a national regulatory body be established under commonwealth legislation for the purpose of monitoring and enforcing wind farm operations.

Recommendation 13: final

7.84 The committee recommends that the Australian National Audit Office (ANAO) conduct a performance audit of the Clean Energy Regulator's (CER) compliance with its role under the legislation. In particular, the committee recommends that the CER examine:

- the information held by the CER on wind effectiveness in offsetting carbon dioxide emissions at both 30 June 2014 (end of financial year) and 3 May 2015;
- the risk management and fraud mitigation practices and processes that are in place and whether they have been appropriate;
- whether all public monies collected in respect of the *Renewable Energy (Electricity) Act 2000* are appropriate;
- whether there are financial or other incentives, including but not limited to, the collection of public monies under the *Renewable Energy (Electricity) Act 2000* that are distorting the CER's role in achieving the objectives of the Act; and
- whether the expenditure of public monies by the CER has been appropriately focused on achieving the *Renewable Energy (Electricity) Act 2000* objectives.

Recommendation 14: final

7.88 The committee recommends that the Australian Government direct the Productivity Commission to conduct research into the impact of wind power electricity generation on retail electricity prices.

Recommendation 15: final

7.105 The Renewable Energy Target should be amended so that all new investments in renewable energy between 2015 and 2020 will be eligible to create renewable energy certificates for a period of no more than five years. Existing investments in renewable energy should be grandfathered so that they continue to receive renewable energy certificates under the Act subject to annual audits of compliance.

7.106 The Government should develop a methodology for renewable energy projects so that they can qualify for Australian Carbon Credit Units. The Government should develop this methodology over a five year period in consultation with the renewable energy industry and the methodology should consider the net, lifecycle carbon emission impacts of renewable energy.

7.107 If the Government does not adopt the above changes, the Government should instead limit eligibility for receipt of Renewable Energy Certificates to five years after the commissioning of turbines.

Chapter 1

Introduction

1.1 It is nearly 30 years since Australia's first wind farm was built near Esperance in Western Australia. Currently, there are 82 wind farms accredited under the *Renewable Energy (Electricity) Act 2000*. They consist of 2,077 wind turbines with total installed capacity of approximately 4,180 MW.¹ Appendix 4 shows their location.²

1.2 Current policy settings in Australia provide strong financial incentives to invest and develop capacity in renewable energy sources. Most notably, the Renewable Energy Target (RET) creates a market for renewables, requiring electricity retailers to purchase a set annual amount of renewable energy certificates (RECs).

1.3 Among renewables, wind is a major player in Australia. It has benefitted greatly from the financial incentives of the RET. In 2013, wind sources received nearly 60 per cent of the 14 million RECs.³ That year, wind power accounted for around 63 per cent of the total renewable generation supported by the RET.⁴

1.4 It is anticipated that wind power will drive much of the growth in electricity generation in Australia over the next 20 years. In South Australia alone, proposed wind farm developments will nearly triple the State's existing capacity from wind.⁵ Companies are seeking efficiencies through larger turbines. The Australian Energy Market Operator (AEMO) noted in a 2013 report that several recent wind farm developments in the National Electricity Market (NEM) have been built using 3 MW wind turbines, compared to the 1.5–1.75 MW turbines typically used in earlier NEM projects. AEMO noted that turbine manufacturers are continuing to offer larger turbine sizes and that turbines up to 5 MW are expected in the NEM.⁶

1 Clean Energy Regulator, answer to question on notice, 19 May 2015 (received 10 June 2015).

2 Requested from the Parliamentary Library, *received 12 February 2015*

3 Clean Energy Regulator, *Register of Large scale Generation Certificates*, as of 3 June 2014. See Australian Government, *RET Review Report*, August 2014 <https://retreview.dpmc.gov.au/212-generation> (accessed 20 June 2015).

4 In 2013, the LRET accounted for around 13 100 GWh. Wind accounted for 8 233 GWh. See Australian Government, *RET Review Report*, August 2014 <https://retreview.dpmc.gov.au/212-generation> (accessed 20 June 2015).

5 Australian Energy Market Operator, *South Australian Electricity Report*, August 2014, p. 28.

6 See: Australian Energy Market Operator, *Wind Turbine Plant Capabilities Report*, 2013. Also, Mr John McMahon, President, Wind Industry Reform Victoria, *Proof Committee Hansard*, 9 June 2015, p. 66.

1.5 Given the scale of proposed investment and technology and continuing government assistance for wind power, it is concerning that the industry continues to face persistent and widespread complaint and criticism. As this inquiry amply demonstrates, there is continuing disquiet about the lack of transparency and consultation in planning processes, and the lack of rigorous, independent research into possible health impacts of turbines. This report draws the attention of the Australian Parliament and the Australian public to these issues.

The inquiry

1.6 This is the second and final report of the Senate Select Committee on Wind Turbines. The committee's interim report, tabled on 18 June 2015, contained seven 'headline recommendations'.⁷ These recommendations were based on the evidence of the committee's 490 submissions and eight public hearings held in Portland, Cairns, Canberra, Melbourne, Adelaide and Sydney.

1.7 Since then, the committee has held a further three public hearings in Canberra (twice) and Sydney. It has also put many questions on notice to witnesses, the answers to which are on the committee's website.

1.8 As noted in the interim report, this represents a substantial body of evidence. In terms of the detail of evidence and the range of issues covered by submitters and witnesses, this is arguably the most complete Australian parliamentary inquiry into wind farms.⁸ Appendix 1 contains a full list of submissions. Appendix 2 contains a list of witnesses for each public hearing.

The interim report and its recommendations

1.9 The purpose of the recommendations in the interim report was twofold. First, it was important to know more about the impact and the operation of wind farms in Australia. The committee proposed establishing an *Independent Expert Committee on Industrial Sound* (IESC) to research the impact on human health of audible noise and infrasound from wind turbines (recommendation 1). It also recommended making publicly available various data collected by wind turbine operators, so as to facilitate the work of the proposed IESC (recommendation 7).

1.10 The second purpose of the interim report was to strengthen the regulatory governance of wind farms. To this end, the committee recommended introducing *National Wind Farm Guidelines*, which each State and Territory Government should

7 Senate Select Committee on Wind Turbines, Interim Report, June 2015, pp vii–viii, http://www.aph.gov.au/Parliamentary_Business/Committees/Senate/Wind_Turbines/Wind_Turbines/Interim_Report (accessed 20 July 2015).

8 The 2012 Senate Environment Legislation Committee inquiry into the provisions of the *Renewable Energy (Electricity) Amendment (Excessive Noise from Wind Farms) Bill 2012* held one public hearing and received 217 submissions. The 2011 Senate Community Affairs References Committee inquiry conducted five public hearings and received 1018 submissions.

reflect in their relevant planning and environmental statutes (recommendation 3), and establishing a *National Environment Protection (Wind Turbine Infrasound and Low Frequency Noise) Measure* (NEPM) (recommendation 2). The NEPM is automatically reflected in States' and Territories' statutes.

1.11 The committee also recommended stricter requirements for the receipt of RECs. Specifically, wind turbine operators seeking RECs should have to:

- comply with *National Wind Farm Guidelines* (recommendation 4);
- comply with the NEPM (recommendation 4); and
- pay a levy to fund the costs of the proposed IESC and a proposed National Wind Farm Ombudsman (recommendation 6).

The federal government's response

1.12 The committee is delighted that the federal government has agreed to the recommendations in the committee's interim report. The federal Minister for the Environment has committed to:

- establish, by 1 September 2015, an IESC to examine (among other matters) the impact of wind turbines on human health;
- publish research on the development of Australian methodologies and frameworks in sound measurement and standards for wind farms to improve planning and compliance decisions by state and territory authorities;
- publish research on options for wind farm operators to maximise transparency such as by providing information on wind speed, operational statistics, operating hours and sound monitoring;
- establish a National Wind Farm Commissioner to resolve complaints from concerned residents about the operation of wind farm facilities. The Commissioner will publish documents on:
 - the location of existing and proposed wind farms in Australia;
 - planning and environmental approvals in place for each wind farm;
 - RECs received by each wind farm; and
 - data on wind farm operators including operating times, wind speed, power output and sound monitoring and emissions reductions in the electricity sector;
- seek agreement from the States and Territories to implement National Wind Farm Guidelines as recommended by the IESC which each state and territory government should reflect in their relevant planning and environmental frameworks; and

- seek to obtain agreement of state and territory Environment Ministers through the National Environment Protection Council to develop sound measures.⁹

The purpose of this report

1.13 This report presents evidence that further substantiates the need for these recommendations. It highlights submitters' and witnesses' concerns with the impact of wind turbines on human health. It identifies various concerns with state planning processes that have facilitated wind farm developments, and with inadequacies in the way that wind farms are monitored and through which wind companies are eligible for RECs. In assessing the committee's evidence on these matters, the report directly addresses key terms of reference relating to the role of the National Health and Medical Research Council (NHMRC) and the Clean Energy Regulator (CER).

1.14 This report also addresses two terms of reference not covered in the interim report, namely:

- the effect on household power prices, particularly households which receive no benefit from rooftop solar panels, and the merits of consumer subsidies for operators; and
- the effect that wind towers have on fauna and aerial operations around turbines, including firefighting and crop management.

The need for a broader mix of renewable energy sources

1.15 The committee acknowledges the need for Australia's renewable energy sector to develop and prosper. It also recognises that a properly regulated wind industry should be an important part of the sector's future growth. However, the committee has been concerned that not enough is being done to promote the development of other renewable technologies. The committee is encouraged that the Australian Government has committed to consider various options to further support solar technologies and develop a solar technology information package.¹⁰

1.16 This report does not deal in any detail with the development of solar technologies or renewable technologies other than wind. However, the report does note that the RET is promoting an unbalanced market for renewables in Australia, with an over-reliance on wind.

9 The Hon. Greg Hunt MP, Minister for the Environment, 'Attachment A: Addressing community concerns about wind farms', Tabled in the Senate, 23 June 2015.

10 The Hon. Greg Hunt MP, Minister for the Environment, 'Attachment B: Measures to enhance the uptake of large scale solar, other renewable energy technologies and energy efficiency', Tabled in the Senate, 23 June 2015.

Science and public policy

1.17 The interplay of science and public policy is a complex matter. For policy-makers, there are some fundamental but difficult questions in how science is interpreted for purposes of decision-making. These questions include:

- how well the science is 'settled';
- what were the assumptions and the methodology for reaching the existing findings;
- what new evidence would cast doubt on an existing consensus;
- what is the likelihood that it will evolve, particularly in new directions and with new outcomes;
- what are the risks of basing public policy on 'the current science'; and
- what constitutes a satisfactory solution to these risks?

1.18 As the committee's interim report made clear, the committee believes that the science on the possible impact of wind turbines on human health is evolving. By agreeing to establish an IESC to research wind turbine sounds, it is clear that the Australian Government shares this view.

1.19 This report highlights the evidence of several eminent acousticians as to the audible and sub-audible sounds made by wind turbines and the possible impact of these sounds on human health. This evidence is notable for several reasons:

- the subject matter is highly complex and technical;
- there is disagreement among acousticians as to the correct methodology for testing wind turbine sounds and for simulating the operation of turbines;
- while there is dispute among acousticians as to what has, and has not, been scientifically established in this area, there are various areas of possible scientific inquiry for the IESC; and
- the acoustical evidence is only part of the equation—multi-disciplinary work with medical researchers is also needed.

Improving compliance and the duty of care

1.20 Many wind power companies have engaged constructively with this inquiry, making written and verbal submissions. They have noted their efforts to connect with, and contribute to, their local community. They have also noted that they are generally compliant with current laws. But does compliance adequately meet their 'duty of care' to the community? Does compliance alone mean that wind companies have a 'social licence' to operate?

1.21 The committee makes a distinction between a wind company meeting compliance and its 'duty of care': the second is broader than the first. Wind executives seemed to believe that existing standards represented the limits of the company's 'duty

of care'. Pacific Hydro executive, Mr Andrew Richards, told the committee that the company's initiative to fund the Cape Bridgewater study with residents affected by its turbines was an effort '...to try and understand why a compliant wind farm, with current regulations, is still creating complaints of that nature...' ¹¹ He added:

We are reliant on the standards to meet our duty of care and to ensure that they are operating within parameters. As far as our duty of care is concerned, again, I point to the report that we have funded to try to understand this issue better. There was nothing in that report, in our view, that was actionable beyond what we have currently done. ¹²

1.22 In this context, the committee reiterates two points made in its interim report. The first is that there are considerable gaps in understanding about the impact of wind turbines on human health. The second point is that there is a regulatory lag in the wind sector. The sector has to date avoided some of the regulations, guidelines and frameworks that apply to other energy producing sectors. The recommendations in the interim report reflect the committee's view that it is time that the wind sector 'caught up'.

1.23 The committee believes the higher bar set by implementing the recommendations in the interim report will improve public confidence in how the sector operates. Importantly, however, regulation and oversight will not absolve wind power companies from a continuing duty of care.

1.24 This inquiry has also highlighted that a duty of care exists for government and regulators. The medical dictum, *primum non nocere*, ¹³ should also apply to governments, particularly where the effect of investments on community health and safety is uncertain. As this report notes, submitters and witnesses have complained that the NHMRC, the CER and State Environment Protection Authorities have abrogated their duty of care. ¹⁴

Acknowledgements

1.25 The committee is grateful to all the individuals and organisations that have made a submission and provided verbal evidence to this inquiry. It acknowledges that a decision to become involved in a parliamentary committee inquiry of this nature can be difficult to make. For many rural communities, wind farm developments have been emotive community issues and decisions to speak out either in favour or in opposition to a development can strain and even break relationships.

11 Mr Andrew Richards, Chief Executive Officer, Pacific Hydro, *Proof Committee Hansard*, Portland, 30 March 2015, p. 16.

12 Mr Andrew Richards, Chief Executive Officer, Pacific Hydro, *Proof Committee Hansard*, Portland, 30 March 2015, p. 19.

13 —first do no harm.

14 See, for example: Ms Jackie Rovensky, *Submission 89*, p 8; Mrs Lee Schwerdtfeger, *Submission 459*, p. 10; Mr Richard Paltridge, *Submission 367*, p. 1.

A note on procedure

1.26 The committee has, throughout this inquiry, provided information to submitters and witnesses on procedural matters. In written evidence to prospective witnesses and at public hearings, the Committee Chair has routinely drawn attention to the following privilege resolutions:

A person shall not, by fraud, intimidation, force or threat of any kind, by the offer or promise of any inducement or benefit of any kind, or by other improper means, influence another person in respect of any evidence given or to be given before the Senate or a committee, or induce another person to refrain from giving such evidence.¹⁵

A person shall not inflict any penalty or injury upon, or deprive of any benefit, another person on account of any evidence given or to be given before the Senate or a committee.¹⁶

1.27 The committee reiterates that these actions may be considered contempt of the Senate. It may constitute a criminal offence under Section 12 of the *Parliamentary Privileges Act 1987*.

1.28 The committee also highlights the following advice from the Clerk of the Senate to the 2011 inquiry into the impact of wind farms:

If a person who is covered by a confidentiality provision in an agreement gives evidence to a parliamentary committee about the contents of that agreement, they cannot be sued for breaching that confidentiality agreement. If they are subject to any penalty, threat or intimidation as a consequence of their having given evidence to a committee, Privilege Resolution 1(18) provides that a committee must inquire into the circumstances, ascertain the facts and, if those facts disclose that a person may have been improperly influenced or subject to or threatened with penalty of injury in respect of their evidence, the committee shall report the matter to the Senate. The Senate may then deal with the matter as a potential contempt which may attract penalties including fines and imprisonment. The action may be prosecuted as an offence under section 12 of the *Parliamentary Privileges Act*.¹⁷

1.29 While the committee itself will cease operating upon tabling of this report, the Senate and its Privilege Committee have the capacity to examine matters of contempt relating to the evidence that has been received by the committee.

15 The Senate, Standing Orders and other orders of the Senate, February 2014, Privilege Resolution 6(10)

16 The Senate, Standing Orders and other orders of the Senate, February 2014, Privilege Resolution 6(11)

17 Dr Rosemary Laing, Clerk of the Senate, Advice to the Senate Community Affairs References Committee, 12 November 2010.

Structure of this report

1.30 This report has seven chapters:

- chapter 2 focuses on the role and the capacity of the National Health and Medical Research Council to advise on the possible impacts of wind turbines on human health. It presents the view of many contributors to this inquiry that the NHMRC's processes and findings to date have been flawed;
- chapter 3 examines issues relating to the planning processes for wind turbine developments including:
 - current planning processes in the various State jurisdictions;
 - standards for community engagement and consultation at each stage of the application and development process;
 - the capacity of local councils to implement a robust planning approval process for wind farms; and
 - the need for national wind farm guidelines;
- chapter 4 looks at the current standards for monitoring noise and environmental impacts of wind farms in Australia. It is interested in:
 - the current role of State Governments and local councils in monitoring noise;
 - the view of local Councils and State Governments on their monitoring responsibilities;
 - the role of the CER; and
 - the need to improve the system and the funding to monitor wind farm operations.
- chapter 5 examines the effect that wind turbines and wind towers have on fauna and aerial operations around turbines, including firefighting and crop management;
- chapter 6 presents the committee's views and recommendations on research into the impact of wind turbines on human health (chapter 2), the processes for planning wind farm developments and engaging with communities on these plans (chapter 3), and systems for monitoring and ensuring compliance (chapters 4 and 5); and
- chapter 7 considers various issues relating to the first term of reference including:
 - how the RET supports wind power and the impact of the RET on wholesale and retail prices;
 - the impact of renewables, and wind energy in particular, on retail prices;
 - the merit of consumer subsidies for wind farm operators; and

- the evidence on the impact of wind power on wholesale and retail electricity prices and the merit of providing RECs.

Chapter 2

The need for more evidence-based health advice on the impact of wind turbines on human health

Introduction and context

2.1 There has been considerable conjecture and controversy worldwide about the health impact of wind turbines. Australia has been no exception. Here, as in many other countries, there is a clear disconnect: between the official position that wind turbines cause no harm to human health and the strong and continuing empirical, biological and anecdotal evidence of many people living in proximity to turbines suffering from similar physiological symptoms and distress.

2.2 In the course of this inquiry, as in others conducted by the Australian Parliament, the committee has received considerable anecdotal evidence that those living in close proximity to wind turbines have suffered adverse health impacts from the operation of these turbines. These complaints have not been isolated to a particular wind farm or a particular region. While evidence to the committee suggests that some wind turbines may not have had the alleged health impact that others seem to have caused, the committee has received health complaints from dozens of submitters living near wind turbines at various locations across several States.

2.3 The committee believes that these complainants deserve to be taken seriously. Those who have labelled 'wind turbine syndrome' as a communicated disease or a psychogenic condition have been too quick to judge. In so doing, they have unnecessarily inflamed the debate on the issue. This has understandably caused those who suffer adverse symptoms even greater distress.

2.4 Since the last Senate Committee reported on this matter in November 2012, there have been some important developments:

- in March 2015 the peak government health advisory body, the National Health and Medical Advisory Council (NHMRC), committed to conduct further research. In the past the NHMRC has dismissed health concerns associated with wind turbines; and
- in December 2014, acoustician Mr Steven Cooper found a correlation between infrasound emitting from turbines at Cape Bridgewater and 'sensations' felt, and diarised, by six residents of three nearby homes.

Significantly, the report identified a unique infrasound 'wind turbine signature'.¹

2.5 The possible effect of infrasound from wind turbines on human health has been a theme of this inquiry. Acousticians have provided different perspectives to the committee on the possible effect of infrasound from turbines. What is most striking is the lack of any professional consensus on this issue and the range of arguments as to what would constitute an acceptable research project to test the hypothesis. Accordingly, the committee's interim report recommended the need for independent research into both audible and sub-audible sound from turbines and for this research to inform national sound standards.²

Box 2.1: Interim report recommendations relating to human health

Recommendation 1

The committee recommends the Commonwealth Government create an *Independent Expert Scientific Committee on Industrial Sound* responsible for providing research and advice to the Minister for the Environment on the impact on human health of audible noise (including low frequency) and infrasound from wind turbines. The IESC should be established under the *Renewable Energy (Electricity) Act 2000*.

Recommendation 2

The committee recommends that the National Environment Protection Council establish a *National Environment Protection (Wind Turbine Infrasound and Low Frequency Noise) Measure* (NEPM). This NEPM must be developed through the findings of the *Independent Expert Scientific Committee on Industrial Sound*. The Commonwealth Government should insist that the ongoing accreditation of wind turbine facilities under the *Renewable Energy (Electricity) Act 2000* in a State or Territory is dependent on the NEPM becoming valid law in that State or Territory.

Structure of the chapter

2.6 This chapter begins by presenting some of the evidence to the committee on the alleged adverse health effects of wind turbines. It then considers the following:

- the Australian Medical Association's 2014 Position Statement;
- the role of the NHMRC and evidence-based health advice;
- the NHMRC's reviews of the evidence relating to wind turbines and health;
- submitters' and witnesses' views of the NHMRC;

1 The Acoustic Group, *The results of an acoustic testing program Cape Bridgewater Wind Farm*, 44.5100.R7:MSC, prepared for Energy Pacific (Vic) Pty Ltd, <http://www.pacifichydro.com.au/files/2015/01/Cape-Bridgewater-Acoustic-Report.pdf> (accessed 20 July 2015). Other submitters to this inquiry, in addition to Mr Steven Cooper, have recognised the importance of identifying the unique wind turbine signature. See for example: Professor Robert McMurtry, *Proof Committee Hansard*, Sydney, 29 June 2015, p. 10.

2 Senate Select Committee on Wind Turbines, Interim Report, June 2015, pp vii–viii, http://www.aph.gov.au/Parliamentary_Business/Committees/Senate/Wind_Turbines/Wind_Turbines/Interim_Report (accessed 20 July 2015).

- criticism of the forthcoming 2015 NHMRC review;
- the views of acousticians and the need for properly funded research; and
- the committee's view on the need for future research and body that should conduct this research.

Wind turbines and ill-health

2.7 The committee has taken evidence from a number of people who reside in proximity to wind turbines who have complained of a range of adverse health impacts. These include tinnitus, raised blood pressure, heart palpitations, tachycardia, stress, anxiety, vertigo, dizziness, nausea, blurred vision, fatigue, cognitive dysfunction, headaches, nausea, ear pressure, exacerbated migraine disorders, motion sensitivity, inner ear damage and worst of all, sleep deprivation.

2.8 Dr Sarah Laurie told the committee:

The human cost of the failure to protect people from excessive noise pollution, especially at night, is terrible. I have personally helped to prevent a number of suicides of people who were utterly desperate because of the consequences of excessive noise pollution and who reached out for help...³

From my experience there is a subset of people who are terribly impacted very early on. Those people are the ones who tend to present with acute vestibular disorder type of symptoms—dizziness and motion sickness, which can be accompanied by extreme anxiety. Those people often just cannot last very long, and they move if they can.⁴

2.9 Ms Janet Hetherington, an adjacent landholder to the Macarthur wind farm in south-west Victoria, relayed her own experience:

At my farm, I experience severe adverse health effects such as vibration, heart palpitations, tinnitus, head pressure, headaches, sleep deprivation, anxiety, night sweats, nausea, itchy skin, cramps, and ear, nose and throat pain. Twice now I have experienced horrendous pain in my chest stabbing through to my backbone in between my shoulder blades. I contemplated calling an ambulance both times but could not move to do so because of the severity of the pain. Ten minutes later it had dissipated, leaving me with great stress and anxiety and feeling washed out. All these sensations leave me drained in the morning. I find it very hard to start work that day.⁵

2.10 Ms Anne Gardner also attributed her and her husband's ill health to the nearby Macarthur wind farm. She described the following symptoms:

My husband experienced bolts of pressure which tallied up with pressure peaks measured by Les Houston (sic) 86 per cent of the time while my husband was blind to the acoustic measurements of the time. Refer to his recap statement. I suffer day and night from headaches, nose and ear

3 Dr Sarah Laurie, *Proof Committee Hansard*, Sydney, 29 June 2015, p. 40.

4 Dr Sarah Laurie, *Proof Committee Hansard*, Sydney, 29 June 2015, p. 42.

5 Ms Janet Hetherington, *Proof Committee Hansard*, Portland, 30 March 2015, p. 48.

pressure, nausea, heart palpitations and chest burning from vibrations through the floor, couch, chair and in bed all night.⁶

2.11 Mr Clive Gare and his wife host 19 towers from the North Brown Hill wind farm located 17 kilometres from Jamestown in South Australia. Mr Gare told the committee:

After a short period of living with an operating wind farm, we had these products installed. I find that, because I work and reside in close proximity to the wind farm, I suffer sleep interruption, mild headaches, agitation and a general feeling of unease; however, this occurs only when the towers are turning, depending on the wind direction and wind strength. My occupation requires that I work amongst the wind towers during the day which means I suffer the full impacts of noise for days at a time without relief. The impacts are that we are not able to open our windows because of the noise at night and we are not able to entertain outside because of the noise.

In conclusion, if we did not have soundproof batts in VLam Hush windows [special window laminate designed to dampen noise], our house would not be habitable. In my opinion, towers should not be within five kilometres of residences, and I would personally not buy a house within 20 kilometres of a wind farm.⁷

2.12 The committee notes that the Gares have received payment of \$2 million over five years to host turbines and have reported serious adverse impacts. The committee notes, therefore, that their evidence is an 'admission against interest' and as such represents highly reliable evidence.

2.13 Mr John Pollard, a resident of Glenthompson near the Oaklands Hill wind farm in Victoria, told the committee:

The wind farm guidelines on health issues of this very serious problem have to be assessed. They will not acknowledge infrasound. I will relate one incident that happened in our home one night. My wife was sleeping in the chair beside me and I was watching television. This is after they had turned the turbines off. She was dead to the world and I was just watching the television. All of a sudden she woke up, completely startled and disorientated, and I was really worried about her because I thought she had had a stroke or something. Eventually she came to her senses and she said the turbines must be on. I said, 'No, they're not. It's 10.30. They turn off at nine o'clock.' I went outside and they were still running. So I thought that next day I would ring AGL. When I was about to ring, they rang me and said, 'I'm sorry, John. We forgot to turn the turbines off last night.'⁸

6 Ms Anne Gardner, *Proof Committee Hansard*, Portland, 30 March 2015, p. 47.

7 Mr Clive Gare, *Proof Committee Hansard*, Adelaide, 10 June 2015, p. 57. See also: Mr and Mrs Clive and Trina Gare, *Submission 222*.

8 Mr John Pollard, *Proof Committee Hansard*, Portland, 30 March 2015, p. 48.

2.14 Waubra resident Mr Donald Thomas identified hearing difficulties from the nearby Waubra wind farm turbines.⁹ He claimed that these difficulties disappeared when he left the area:

I went to the doctor with what I kept saying was a lot of ear pressure and earaches. I went to see a specialist, and my ears came back as being in good health and functioning pretty well, even though I have lost a lot of hearing. Basically, my left ear does not work too good...

My ears—especially when I go to my Stud Farm Road property, I have ear pressure that can develop into a headache and rapid heartbeat. If I leave that area and go back to one of my other properties, that can settle back down.¹⁰

2.15 Mr Peter Jelbart, a 25 year old who had lived with his family nearby the Macarthur wind farm in south-west Victoria, noted the difficulty of sleeping in the family home. He told the committee he had worked and slept unaffected in noisy environments outside of the family home in Victoria:

While I was working in Western Australia I used to do three weeks on, one week off and come home for a week. Over in Western Australia I was sleeping at times on the sides of busy highways and in the back of trucks with ice packs running...

At home, I noticed pretty much from day one that there is a serious problem there. Something is completely different when sleeping. I would wake up after a couple of hours of sleep—at times, not even after a couple of hours—and have disrupted sleep that I have had nowhere else. There is a proper problem...

Whether it is low-frequency noise and the infrasound combining with it, it seems worse when it is quiet. Around our house the yard is pretty well protected by trees. When it is relatively quiet around the house yard there is still a really soft drone that comes through and just gets into you. It is pretty hard to explain. There are probably a lot of people going through the same thing who will have the same trouble trying to explain it, especially to people who have not experienced it. The problem with it is, it also seems to affect different people over different periods of time.¹¹

2.16 The committee has had the opportunity to take evidence from researchers in the United States and Canada who expressed their concern with the health effects of turbines. Ms Lilli-Ann Green is the Chief Executive Officer of a healthcare consulting firm in the United States. In 2012, Ms Green and her husband conducted interviews with people living near wind turbines in 15 different countries. As she told the committee:

We have interviewed people on three continents who live more than five miles from the nearest wind turbine and are sick since wind turbine

9 Waubra is 33 kilometres north-west of Ballarat.

10 Mr Donald Thomas, *Proof Committee Hansard*, Melbourne, 9 June 2015, p. 17.

11 Mr Peter Jelbart, *Proof Committee Hansard*, Portland, 30 March 2015, pp 71–72.

construction. I contend that we need honest research to determine how far wind turbines need to be sited from people in order to do no harm. People report to us that over time their symptoms become more severe. Many report not experiencing ill effects for some time following wind turbine construction, meanwhile their spouse became ill the day the wind turbines nearby became operational. They speak of thinking they were one of the lucky ones at first, but after a number of months or years they become as ill as their spouse. Not one person who stayed near wind turbines reported to us that they got used to it or got better; they all became more ill over time...

I really believe that we just do not have enough information yet. But throughout the interviews, country by country, people described the same symptoms. Many times they used the same phrases to describe them and the same gestures—and they were not speaking English. There is a common thread here.¹²

2.17 Dr Jay Tibbetts, a medical practitioner and vice chair of the Brown County Board of Health in Wisconsin, drew the committee's attention to the board's October 2013 finding that the Shirley wind farm was a 'human health hazard'. Dr Tibbetts described how the declaration came about:

The [Board of Health] has been studying adverse health effects for the past 4 ½ years in the Shirley Wind Project. We have reviewed many peer reviewed studies, at least 50 medical complaints including ear pain, pressure, headache, tinnitus, vertigo, nausea, chest pain, chest pressure, loss of concentration, sleep deprivation and more, as well as more than 80 other complaints from citizens of Shirley Wind. There have been 2 formal studies of infrasound/low frequency noise by acousticians in 2012 and 2014. The latter study revealed symptom generating [Infrasound/Low Frequency Noise] at a distance of 4 ½ [miles].¹³

2.18 The committee also heard of detailed research by Professor Emeritus Robert McMurtry from Western University in Ontario, Canada. Professor McMurtry made a number of points to the committee:

- adverse health effects have been reported globally in the environs of wind turbines for more than 30 years with the old design of turbines and the new;
- the wind energy industry has denied adverse health effects, preferring to call it 'annoyance'. Annoyance is recognised and was treated by the World Health Organization as an adverse health effect, which is a risk factor for serious chronic disease including cardiovascular and cancer;
- the regulations surrounding noise exposure are based upon out-of-date standards ETSU-97, which fail to evaluate infrasound and low-frequency

12 Ms Lilli-Ann Green, *Proof Committee Hansard*, Sydney, 29 June 2015, p. 3. See also: Ms Lilli-Ann Green, *Submission 467*.

13 Mr Jay Tibbetts, *Submission 64*, p. 1.

noise, preferring instead to use dBA.¹⁴ The issue of Infrasound and Low Frequency Noise (ILFN) is a problem and it has been confirmed by numerous acousticians including Dr Paul Schomer, a leading international acoustician;

- the setbacks for wind turbines are highly variable across jurisdictions with no evidence base in human health research for the setbacks;
- there is an urgent need for human health research to provide evidence based guidelines for noise exposure. Proposals for third-party research and evaluation were made by the Academy of Medicine of France in 2006 and by Professor McMurtry in Canada. Professor McMurtry has published peer-reviewed papers on the criteria for diagnosis of illness from wind turbines;¹⁵ and
- there is an urgent need to monitor the health effects of people exposed to turbines over time and that has been missing virtually in all jurisdictions.¹⁶

The need for civility in public debate

As the committee noted in its interim report (paragraph 1.13), it is disappointed that renewable energy advocates, wind farm developers and operators, public officials and academics continue to denigrate those who claim that wind turbines have caused their ill-health.

Even elected representatives seeking to inquire into these effects have been the target of derision. The committee draws attention to comments from RATCH Australia Pty Ltd at the public hearing in Cairns (see *Committee Hansard*, Mr Hallenstein, 18 May 2015, p. 14) and from Vestas Pty Ltd at the public hearing in Melbourne (see *Committee Hansard*, Mr McAlpine, 9 June 2015, p. 24). Mr McAlpine had tweeted prior to the hearing: 'Happy World Environment Day to all the delightfully nutty anti-wind activists out there.'

The committee notes that RATCH Australia provided a formal apology to the committee for comments made at the public hearing. This apology was accepted.

-
- 14 Institute of Acoustics, *A good practice guide to the application of ETSU-R-97 for the assessment and rating of wind turbine noise*, June 2013, <http://www.ioa.org.uk/sites/default/files/IOA%20Good%20Practice%20Guide%20on%20Wind%20Turbine%20Noise%20-%20May%202013.pdf> (accessed 13 July 2015). dBA is an 'abbreviation for the decibel level of a sound that has been A-weighted'. A-weighting is 'a filter that represents the frequency response of the human ear'.
- 15 Professor Robert McMurtry, *Submission 146*, pp 19–20.
- 16 Professor Robert McMurtry, *Proof Committee Hansard*, Sydney, 29 June 2015, pp 6–7; Professor Robert McMurtry, *Submission 146*, pp 10 and 12.

Professor Chapman and his critics

2.19 Professor Simon Chapman AO, Professor of Public Health at the University of Sydney, has been an outspoken critic of those who suffer ill-effects from wind turbines. In both his written and oral submissions, Professor Chapman cited many of his own publications in support for his view that:

...the phenomenon of people claiming to be adversely affected by exposure to wind turbines is best understood as a communicated disease that exhibits many signs of the classic psychosocial and nocebo phenomenon where negative expectations can translate into symptoms of tension and anxiety.¹⁷

2.20 Several highly qualified and very experienced professionals have challenged this argument. Dr Malcolm Swinbanks, an acoustical engineer based in the United Kingdom, reasoned:

The argument that adverse health reactions are the result of nocebo effects, ie a directly anticipated adverse reaction, completely fails to consider the many cases where communities have initially welcomed the introduction of wind turbines, believing them to represent a clean, benign form of low-cost energy generation. It is only after the wind-turbines are commissioned, that residents start to experience directly the adverse nature of the health problems that they can induce.¹⁸

2.21 The committee highlights the fact that Professor Chapman is not a qualified, registered nor experienced medical practitioner, psychiatrist, psychologist, acoustician, audiologist, physicist or engineer. Accordingly:

- he has not medically assessed a single person suffering adverse health impacts from wind turbines;
- his research work has been mainly—and perhaps solely—from an academic perspective without field studies;
- his views have been heavily criticised by several independent medical and acoustic experts in the international community; and
- many of his assertions do not withstand fact check analyses.

2.22 Professor Chapman has made several claims which are contrary to the evidence gathered by this committee. First, he argues that the majority of Australia's wind turbines have never received a single complaint.¹⁹ There are various problems with this statement:

- (i) wind turbines located significant distances from residents will not generate complaints;

17 Professor Simon Chapman, *Proof Committee Hansard*, Sydney, 29 June 2015, p. 28.

18 Dr Malcolm Swinbanks, *Submission 189*, p. 6.

19 See: Professor Simon Chapman, *Committee Hansard*, Sydney, 29 June 2015, p. 28.

- (ii) many residents suffering adverse health effects were not aware of any nexus between their health and the impact of wind turbines in order to make a complaint;
- (iii) just because residents do not lodge a formal complaint does not mean they are not suffering adverse health effects;
- (iv) data obtained by Professor Chapman from wind farm operators of the numbers of complaints lodged cannot be relied upon; and
- (v) the use of non-disclosure clauses and 'good neighbour agreements' legally restricts people from making adverse public statements or complaints.

2.23 Second, Professor Chapman has argued that complaints of adverse health effects from wind turbines tend to be limited to Anglophone nations.²⁰ However, the committee has received written and oral evidence from several sources directly contradicting this view.²¹ The German Medical Assembly recently submitted a motion to the executive board of the German Medical Association calling for the German government to provide the necessary funding to research adverse health effects.²² This would not have happened in the absence of community concern. Moreover, Dr Bruce Rapley has argued that in terms of the limited number—and concentrated nature—of wind farm complaints:

It is the reporting which is largely at fault. The fact is that people are affected by this, and the numbers are in the thousands. I only have to look at the emails that cross my desk from all over the world. I get bombarded from the UK, Ireland, France, Canada, the United States, Australia, Germany. There are tonnes of these things out there but, because the system

20 See: Professor Simon Chapman, *Committee Hansard*, Sydney, 29 June 2015, p. 28.

21 There are various relevant sources:

- Ms Lilli Green's slides and oral evidence, *Proof Committee Hansard*, Sydney, 29 June 2015 and *Submission 467*;
- The following Danish sources: Mr Mauri Johansson, *Submission 385*; Ms Greta Gallandy-Jakobsen, *Submission 380*; and Mr Bak Olesen, *Submission 416*;
- There is also scientific evidence from studies conducted in Scandinavia which illustrate that 'annoyance' and sleep deprivation are reported as issues in residents exposed to wind turbine noise. These are referenced in the NHMRC's literature reviews. See: https://www.nhmrc.gov.au/files_nhmrc/publications/attachments/eh54_systematic_review_of_the_human_health_effects_of_wind_farms_december_2013.pdf (accessed 5 July 2015). See also: NHMRC, *Information Paper: Evidence on Wind Farms and Human Health*, 2015 www.nhmrc.gov.au/guidelines/publications/eh57; and
- Inagaki, T., Li, Y., Nishi, Y., 'Analysis of aerodynamic sound noise generated by a large-scaled wind turbine and its physiological evaluation', *International Journal of Environmental Science and Technology*, Vol. 12, Issue 6, pp 1933–1944.

22 Correspondence from Dr Ramin Parsa-Parsi, Head of International Affairs, German Medical Association, received 15 June 2015.

does not understand the problem, nor does it have a strategy, many of those complaints go unlisted.²³

2.24 Third, Professor Chapman has queried that if turbines are said to have acute, immediate effects on some people, why were there no such reports until recent years given that wind turbines have operated in different parts of the world for over 25 years.²⁴ Several submissions to the committee have stated that adverse health effects from wind turbines do not necessarily have an acute immediate effect and can take time to manifest.

2.25 Fourth, Professor Chapman contests that people report symptoms from even micro-turbines. The committee heard evidence that once people are sensitised to low frequency infrasound, they can be affected by a range of noise sources, including large fans used in underground coal mines, coal fired power stations, gas fired power stations and even small wind turbines. As acoustician Dr Bob Thorne told the committee:

Low-frequency noise from large fans is a well-known and well-published issue, and wind turbines are simply large fans on top of a big pole; no more, no less. They have the same sort of physical characteristics; it is just that they have some fairly unique characteristics as well. But annoyance from low-frequency sound especially is very well known.²⁵

2.26 Fifth, Professor Chapman contends that there are apparently only two known examples anywhere in the world of wind turbine hosts complaining about the turbines on their land. However, there have been several Australian wind turbine hosts who have made submissions to this inquiry complaining of adverse health effects. Paragraphs 2.11–2.12 (above) noted the example of Mr Clive Gare and his wife from Jamestown.²⁶ Submitters have also directed attention to the international experience. In Texas in 2014, twenty-three hosts sued two wind farm companies despite the fact that they stood to gain more than \$50 million between them in revenue.²⁷ The committee also makes the point that contractual non-disclosure clauses and 'good neighbour' agreements have significantly limited hosts from speaking out. This was a prominent theme of many submissions.

2.27 Sixth, Professor Chapman claims that there has been no case series or even single case studies of so-called wind turbine syndrome published in any reputable medical journal. But Professor Chapman does not define 'reputable medical journal' nor does he explain why the category of journals is limited to medical (as distinct, for

23 Dr Bruce Rapley, *Proof Committee Hansard*, Canberra, 19 June 2015, p. 9.

24 See: Professor Simon Chapman, *Committee Hansard*, Sydney, 29 June 2015, p. 28.

25 Dr Robert Thorne, *Proof Committee Hansard*, Cairns, 18 May 2015, p. 44. See also the evidence of Mr Norman Allan, *Proof Committee Hansard*, Sydney, 29 June 2015, p. 63.

26 See also the evidence of Mr David Mortimer, *Submission 24*; Mr William Quinn, *Submission 118*, p. 3; Mr Luke and Leonie Martin, *Submission 356*, p. 2; Mr Colin Schaefer, *Submission 165*, p. 1;

27 See: Ms Jenny Holcombe, *Submission 336*, p. 2.

example, from scientific or acoustic). The committee cannot therefore challenge this assertion. However, the committee does note that a decision to publish—or not to publish—an article in a journal is ultimately a business decision of the publisher: it does not necessarily reflect the quality of the article being submitted, nor an acknowledgment of the existence or otherwise of prevailing circumstances. The committee also notes that there exist considerable published and publicly available reports into adverse health effects from wind turbines.²⁸

2.28 The committee also notes that a peer reviewed case series crossover study involving 38 people was published in the form of a book by American paediatrician Dr Nina Pierpont, PhD, MD. Dr Pierpont's *Report for Clinicians* and the raw case data was submitted by her to a previous Australian Senate inquiry (2011) to which Dr Pierpont also provided oral testimony. Further, at a workshop conducted by the NHMRC in June 2011, acoustical consultant Dr Geoffrey Leventhall stated that the symptoms of 'wind turbine syndrome' (as identified by Dr Pierpont), and what he and other acousticians refer to as 'noise annoyance', were the same. Dr Leventhall has also acknowledged Dr Pierpont's peer reviewed work in identifying susceptibility or risk factors for developing wind turbine syndrome / 'noise annoyance'.²⁹ Whilst Dr Leventhall is critical of some aspects of Dr Pierpont's research, he does state:

Pierpont has made one genuine contribution to the science of environmental noise, by showing that a proportion of those affected have underlying medical conditions, which act to increase their susceptibility.³⁰

2.29 Seventh, Professor Chapman claims that no medical practitioner has come forward with a submission to any committee in Australia about having diagnosed disease caused by a wind farm. Again, Professor Chapman fails to define 'disease'. Nonetheless, both this committee, and inquiries undertaken by two Senate Standing

28 Google Scholar lists 23 300 results

29 Leventhall, G, "Wind Turbine Syndrome, An appraisal", 26 August 2009, pp. 10-11, Exhibit 18 in the Application of Wisconsin Electric Power Company for a Certificate of Public Convenience and Necessity to Construct a Wind Electric Generation Facility and Associated Electric Facilities, to be Located in the Towns of Randolph and Scott, Columbia County, Wisconsin, before the Public Service Commission Wisconsin, Docket Number 6630-CE-302, <http://psc.wi.gov/apps35/ERF_view/viewdoc.aspx?docid=122161>, (accessed 30 July 2015).

Evidence given by Dr Leventhall under cross-examination by Mr Gillespie, *Katie Brenda Erickson and Chatham-Kent wind Action Inc. and Director, Ministry of the Environment and Suncor Energy Services Inc. (Kent Breeze Wind Farms)*, Environmental Review Tribunal, Case Nos.: 10-121/122, transcript of proceedings, 11 March 2011, Vol 10, p. 79 et. seq.

30 Leventhall, G, "Wind Turbine Syndrome, An appraisal", 26 August 2009, pp. 10–11.

Committees, have received oral and written evidence from medical practitioners contrary to Professor Chapman's claim.³¹

2.30 Eighth, Professor Chapman claims that there is not a single example of an accredited acoustics, medical or environmental association which has given any credence to direct harmful effects of wind turbines. The committee notes that the semantic distinction between 'direct' and 'indirect' effects is not helpful. Dr Leventhall and the NHMRC describe stress, anxiety and sleep deprivation as 'indirect' effects, but these ailments nonetheless affect residents' health.

2.31 Finally, Professor Chapman queries why there has never been a complainant that has succeeded in a common-law suit for negligence against a wind farm operator. This statement is simply incorrect. The committee is aware of court judgements against wind farm operators³², operators making out of court settlements or withdrawing from proceedings³³, injunctions or shutdown orders being granted against operators³⁴, and properties adjacent to wind turbines being purchased by operators to avoid future conflict. The committee also reiterates its earlier point that contractual non-disclosure clauses have discouraged legal action by victims.

2.32 The committee also takes issue with evidence provided by Dr Leventhall. Dr Leventhall's presentation to the committee was notable for its selectivity and lack

31 Senate Environment and Communications Legislation Committee, Inquiry Into the Renewable Energy (Electricity) Amendment (Excessive Noise from Wind Farms) Bill 2012, November 2012, http://www.aph.gov.au/Parliamentary_Business/Committees/Senate/Environment_and_Communications/Completed%20inquiries/2010-13/renewableenergy2012/index (accessed 20 July 2015).

Senate Community Affairs References Committee Inquiry Into the Social and Economic Impact of Rural Wind Farms, June 2011, http://www.aph.gov.au/Parliamentary_Business/Committees/Senate/Community_Affairs/Completed_inquiries/2010-13/impactruralwindfarms/index (accessed 20 July 2015).

32 Judgement against Vestas in the amount of Dkr 500,000 (A\$93,439), High Court of Western Denmark, 2014.

33 Davis v Tinsley, Watts, Fenland Windfarms Ltd, EDF Energy PLC & Fenland Green Power Co-operative Ltd, before Mr Justice Hickinbottom in the High Court (Queens Bench Division), confidentially settled. Joint press release http://filesdown.esecure.co.uk/FenlandGreen/Fens_Co-op_-_Press_Release_301111.pdf_01122011-1009-38.pdf (accessed 13 July 2015).

Vannortwick, K. et. al., v Consumers Energy Company, 51st Circuit Court for the County of Mason, MI, before Judge Richard Cooper, settled out of court 2014.

34 Town of Falmouth vs Town of Falmouth Zoning Board of Appeals & others, Commonwealth of Massachusetts, Barnstable, ss Superior Court, November 21, 2013 before Justice Muse. Judgement of the Supreme Court of Justice (Portugal), 30 May 2013, 2209/08. 0TBTVD.L1.S1, <http://www.dgsi.pt/jstj.nsf/954f0ce6ad9dd8b980256b5f003fa814/4559d6d733d1589780257b7b004d464b> (accessed 13 July 2015).

Sowers v Forest Hills Subdivision & Ors, Supreme Court of Nevada, 14 February 2013, No. 58609.

of objectivity.³⁵ His understanding of Dr Neil Kelley's ground breaking research in 1985 and 1987 is incorrect. However, when asked about further studies that might be necessary, Dr Leventhall did acknowledge the adverse effects of sound waves on people, stating:

I think that the most important aspect of wind turbine noise—which I said in the paper I published nearly 10 years ago—is the amplitude modulation. Work is now developing on that, and I believe that that is where the main answer should be given, in amplitude modulation, because this is what upsets people.³⁶

A problem with infrasound from industrial and environmental noise pollution

2.33 The committee emphasises that it has, during the course of its inquiry, gathered evidence indicating that sources other than wind turbines, such as coal mine ventilator fans and gas driven electricity turbines, also emit large amounts of infrasound. The committee received correspondence from regulators to witnesses acknowledging the presence of sound emissions from industrial facilities. These emissions are not monitored or regulated. As Dr Sarah Laurie told the committee:

The systemic regulatory failure with respect to the way industrial and environmental noise pollution is regulated in Australia is not confined to wind turbine noise. As you would have seen from the submissions of the Wollar Progress Association; and residents living near the coalmines in the Upper Hunter region and residents of Lithgow impacted by coal fired power stations and extractor fan noise and vibration. Their stories, both with respect to the range and severity of symptoms and the way they are treated by the noise polluters and the government regulatory authorities, are all too familiar to the growing numbers of rural residents living near industrial wind power generators.

Once sensitised, residents affected by infrasound and low-frequency noise from coal fired power stations find they also react to wind turbines in the same way. The body and the brain do not care about the source of the sound and vibration. The reactions are involuntary and hardwired, and part of our physiological fight/flight response.

At the heart of this systemic regulatory failure of environmental noise pollution is the failure of the planning and noise pollution regulations, because they all fail to varying degrees to predict, measure and regulate the excessive noise and vibration in the lower frequencies—in the infrasound and low-frequency noise regions, specifically between 0.1 and 200 hertz. These regulations also permit levels of audible noise which are guaranteed to cause adverse impacts because they are so much higher than the very quiet background noise environments in rural areas. These rules are not fit for purpose, and guarantee that some residents will be seriously harmed.

35 See: Dr Geoffrey Leventhall, *Proof Committee Hansard*, Canberra, 23 June 2015, pp 9–14.

36 Dr Geoffrey Leventhall, *Proof Committee Hansard*, Canberra, 23 June 2015, p. 14.

There has been pretence that there is no evidence of harm at the levels of infrasound and low-frequency noise being emitted. This is untrue. There is an extensive body of research conducted by NASA and the US Department of Energy 30 years ago, which: established direct causation of sleep disturbance and a range of physiological effects euphemistically called 'annoyance'; acknowledged that people became sensitised or conditioned to the noise with ongoing exposure; and recommended exposure thresholds in order to ensure residents were protected from harm directly caused by this pulsing infrasound and low-frequency noise.³⁷

2.34 Dr Laurie also noted the following research that has identified adverse health effects on humans from low frequency sound:

- the 2004 report of Dr David Iser, a General Practitioner and Medical Officer of Health in South Gippsland. Dr Iser was the first General Practitioner in Australia to report adverse health effects from wind turbines;³⁸
- research conducted by Professor Alec Salt of Washington University in St Louis. Professor Salt is the leading expert in inner ear fluid physiology, detailing the effects of low frequency sound on the ear and how wind turbines can be hazardous to human health;³⁹ and
- the Inagaki study in Japan which found physiological effects from aerodynamic sound from wind turbines.⁴⁰

The views of the Australian Medical Association

2.35 The committee is disappointed that the Australian Medical Association (AMA) has not engaged with this inquiry. It has not accepted the committee's invitations to make a submission or to give evidence at a public hearing. Rather, the AMA has responded to comments made to the inquiry through a twitter post. It has been left to wind farm companies to confirm the AMA's current position.⁴¹

2.36 This is regrettable given the influence that the Association's views have on the Australian medical community. It is hardly surprising if general practitioners turn a blind eye to, or downplay, the complaints of those who claim to be suffering the

37 Dr Sarah Laurie, *Proof Committee Hansard*, Sydney, 29 June 2015, p. 39.

38 Iser, Dr DJ (Medical Officer of Health, South Gippsland), 2004, Local Wind Farm Survey, Waubra Foundation, Banyule <http://waubrafoundation.org.au/wp-content/uploads/2013/02/Dr-Iser-Submission-to-NHMRC.pdf> (accessed 8 July 2015).

39 Professor Alec Salt, Cochlear Fluids Research Laboratory, Department of Otolaryngology Washington University School of Medicine, August 2013, Washington University <http://oto2.wustl.edu/cochlea/resp.htm> (accessed 9 July 2015).

40 Inagaki, T., Li, Y., Nishi, Y., 'Analysis of aerodynamic sound noise generated by a large-scaled wind turbine and its physiological evaluation', *International Journal of Environmental Science and Technology*, Vol. 12, Issue 6, pp 1933–1944.

41 Pacific Hydro, *Additional Information no. 10*, received 24 April 2015, published on the committee's website.

effects of wind turbines when the peak body's assessment of the authenticity of these impacts is so dismissive.

2.37 The AMA continues to hold to its position statement, released in March 2014. The statement reads:

The available Australian and international evidence does not support the view that the infrasound or low frequency sound generated by wind farms, as they are currently regulated in Australia, causes adverse health effects on populations residing in their vicinity. The infrasound and low frequency sound generated by modern wind farms in Australia is well below the level where known health effects occur, and there is no accepted physiological mechanism where sub-audible infrasound could cause health effects.

Individuals residing in the vicinity of wind farms who do experience adverse health or well-being, may do so as a consequence of their heightened anxiety or negative perceptions regarding wind farm developments in their area. Individuals who experience heightened anxiety or diminished health and well-being in the context of local wind farms should seek medical advice.

The reporting of 'health scares' and misinformation regarding wind farm developments may contribute to heightened anxiety and community division, and over-rigorous regulation of these developments by state governments.

The regulation of wind farm developments should be guided entirely by the evidence regarding their impacts and benefits. Such regulation should ensure that structured and extensive local community consultation and engagement is undertaken at the outset of planning, in order to minimise misinformation, anxiety and community division.

Electricity generation by wind turbines does not involve production of greenhouse gases, other pollutant emissions or waste, all of which can have significant direct and indirect health effects.⁴²

2.38 Rightly, the AMA's statement received pointed criticism from submitters and witnesses in the course of this inquiry. Mr Geoff McPherson, for example, argued that it is not appropriate for the AMA to focus on wind renewable power systems with no consideration of any prospect of collateral damage that the medical community would normally call side effects for any other health issue.⁴³ He identified the peculiarity of the statement relative to AMA position statements on other health issues and to those made by overseas medical associations on the issue of wind turbines:

A cursory assessment of other AMA Position Statements generally suggests that the normal formula for any other Position Statement is to indicate what the relevant medical problems are, then to explain the issues and then perhaps offer suggestions for mitigation or guidelines to approach the

42 Australian Medical Association, *Wind farms and human health—2014*, <https://ama.com.au/position-statement/wind-farms-and-health-2014> (accessed 10 July 2015).

43 Mr Geoff McPherson, *Additional Information no. 16*, received 1 May 2015, p. 2.

problem. This was clearly not the case for the AMA Position Statement on wind farms. Why is this one so different?

One would also have to question the AMA as to how many of their Position Statements have been established on literature provided by an assessment document such as the uncited Draft NHMRC Review, by definition not Final, Review. Why are there no references to substantiate the Position Statement on Wind Farms and Health given that a thinly veiled political manifesto about climate change is not stand-alone science. The AMA Position Statement on Breastfeeding for instance has almost as many references as the Position Statement on Wind Farms and Health has text. Why absolutely nothing for wind farms and health?

...

The American AMA took a stand on the advantages of developing renewable energy extraction systems over existing oil and gas systems, not from an environmental stance, but because the mortality of workers in renewable energy construction was at least an order of magnitude lower than with oil and gas construction. In their final, not Draft it should be stressed, position statement the American AMA took an appropriate health and welfare first approach to renewable energy, not the other way around as the AMA has done. This health first approach by the American medical community should have been instructive for the AMA if they were concerned about the specific health of individual Australians.⁴⁴

2.39 Ms Gardner expressed her frustration that the AMA's 2014 position statement continues to be the basis on which her health complaints are dismissed by authorities. She provided the following excerpt from AGL Energy's Community Engagement Manager which she indicated is now a standard reply to her complaints:

The Australian Medical Association has concluded that 'the infrasound and low-frequency sound generated by modern wind farms in Australia is well below the level where known health effects occur.' The Victorian department of health have also released a report on wind turbines and infrasound which can be found here.... The South Australian Environmental Protection Agency has also released a report on wind turbines and infrasound which can be found here.... We encourage you to seek medical attention for any health-related matters.⁴⁵

2.40 Other witnesses have also noted AGL's use of the AMA's Statement to dismiss complainants.⁴⁶ The AMA's statement is indeed a point of reference for wind farm companies, some of whom have directed the committee to examine it. Acciona

44 Mr Geoff McPherson, *Additional Information no. 16*, received 1 May 2015, p. 1.

45 Mr Andrew and Mrs Ann Gardner, *Submission 208a*, p. [132].

46 Mr Ron and Mrs Chris Jelbart, *Submission 152*, p. 4.

even reproduced the Statement in its submission.⁴⁷ Infigen gave the committee a link to the Statement.⁴⁸

2.41 The committee is more interested in the lack of rigour behind this statement. Far from it being a considered and cautious assessment of primary evidence, it is simply slavish repetition of the findings of the NHMRC's reviews. This is both irresponsible and harmful:

The NHMRC review 'conclusions' have been used by the Australian Medical Association to justify them making a Public Statement that there is no health concerns relating to Industrial Wind Energy Installations...

The NHMRC and the AMA have in taking advice from the industry and in some instances that of non-medical academics have placed more people in danger of suffering adverse health effects.⁴⁹

The AMA Policy Statement came hot on the heels of the Draft NHMRC Review. The AMA Position Statement seems to side with aspects of the Draft NHMRC Review that effectively and arrogantly indicates that the rest of the world's medical and acoustic capability was basically at 'background' status in their eyes and there was insufficient medical, acoustic and psychoacoustic data in the world to suggest that noise from turbines did not generate some kind of side effect relevant to Australian conditions.⁵⁰

The role of the NHMRC and evidence-based health advice

2.42 The main source of official advice on the health impact of wind turbines is the NHMRC. The current legislative basis of the Council is the *National Health and Medical Research Council Act 1992* (the NHMRC Act). The NHMRC is responsible to the Commonwealth Minister for Health and explained its role as follows:

NHMRC does not undertake field based scientific research. That job is done by Australia's best researchers, many of whom are funded by NHMRC, whose proposals are selected through independent expert review and which contribute to building a body of scientific evidence. NHMRC's other function is to translate the outcomes of both domestic and international research into an easily digestible form. These can take the form of a guideline, a statement or an information paper and can be used by clinicians, policymakers or the Australian public to achieve improvements in health.

NHMRC has a mandate to promote and support evidence based health care. When developing advice, NHMRC aims to accumulate a body of evidence that is based on high-quality research with consistent outcomes. This

47 Acciona Energy Australia Global Pty Ltd, *Submission 294*, p. [4].

48 Infigen, *Submission 425*, p. 9.

49 Ms Jackie Rovensky, *Submission 89*, p. 4,

50 Mr Geoff McPherson, *Additional documents no. 16*, received 18 May 2015, pp 2–3.

enables health authorities to make a judgement with confidence about whether an exposure is likely to cause health effects.⁵¹

2.43 The advice of the NHMRC on wind farms and human health is influential. It is the basis not only for the advice given by medical practitioners to their patients (through the AMA), but also for State Government's in their decision-making. That said, some State Governments have publicly acknowledged the shortcomings of the NHMRC's advice. The committee highlights the following comment from Mr Greg Chemello of the Queensland Department of Infrastructure, Local Government and Planning:

There is a real dearth of scientific evidence that validates health research. I understand that there are concerns, and very valid concerns, from community groups, but, on the basis of where we are at this point in time, the department formed the view that we cannot say no to any wind farms.⁵²

2.44 The terms of reference for this inquiry direct the committee to consider the role and capacity of the NHMRC in providing guidance to state and territory authorities on matters relating to the regulatory governance of wind turbines. There are two main issues:

- the first relates to the robustness of the advice that the NHMRC provides and the process through which the evidence is gathered; and
- the second issue is how state and territory authorities interpret and use this advice.

2.45 In its submission to this inquiry, the NHMRC notes that its advice 'may assist the relevant states and territories to make policy and regulatory decisions about the development and operations of wind farms'. It adds that while the NHMRC is responsible for developing evidence-based health advice, it is the responsibility of state and territory authorities to determine how NHMRC advice is applied in their jurisdictions.⁵³

The NHMRC's reviews

2.46 The NHMRC's past reviews of the evidence relating to wind turbines and human health have been a key focus of this inquiry. There have been two past reviews—the findings of which were released in 2010 and 2014.

The 2010 Rapid Review

2.47 The NHMRC commenced its contribution to advising on health and wind farm issues in 2009. On the request of Chief Health Officers at the 179th session of

51 Ms Samantha Robertson, Executive Director, Evidence, Advice and Governance Branch, National Health and Medical Research Council, *Proof Committee Hansard*, Canberra, 19 June 2015, p. 13.

52 Mr Greg Chemello, Deputy Director General, Queensland Department of Infrastructure, Planning and Local Government, *Proof Committee Hansard*, 18 May 2015, p. 24.

53 NHMRC, *Submission 102*, p. 7.

Council, the Office of the NHMRC conducted a 'Rapid Review' of the published scientific literature on the issue of wind turbines and potential impacts on human health.⁵⁴ The Rapid Review covered the available evidence on the potential health impacts of infrasound, noise, electromagnetic energy, shadow flicker and blade glint produced by wind turbines.⁵⁵

2.48 In June 2010, the NHMRC released a *Public Statement on Wind Turbines and Health* in which the conclusion was that 'there is currently no consistent evidence that wind farms cause adverse health effects in humans'.⁵⁶ The committee notes that this document, available on the NHMRC's website, has been 'rescinded' after the integrity of the document was repeatedly questioned over the course of four years.⁵⁷

2.49 In June 2011, the report of the Senate Community Affairs References Committee recommended that the NHMRC's review of research should continue, with regular publication. The NHMRC reaffirmed its commitment to do so. The NHMRC hosted a scientific forum providing stakeholders with:

...an opportunity to present the latest international scientific evidence and canvass issues of public concern. One of the key objectives of the forum was to facilitate discussion and collaboration between the relevant state and territory health, planning and environment authorities and other key stakeholders, including environmental health experts and researchers, acoustic engineers, public interest groups involved in wind farms in Australia and international experts from countries with substantial experience in wind turbines.⁵⁸

2.50 The NHMRC noted in its submission that following the forum, the Chief Executive Officer of the Council accepted the recommendations of Council that the literature be reviewed in a systematic manner, especially focusing on the possible health impacts of audible noise and infrasound. Depending on the result of the review, the Council would consider a targeted call for research in the area.⁵⁹

54 NHMRC, *Submission 102*, p. 6.

55 *Wind Turbines and Health—A Rapid Review of the Evidence*, July 2010, https://www.nhmrc.gov.au/files/nhmrc/publications/attachments/eh53_evidence_review_wind_turbines_health_0.pdf (accessed 10 April 2015).

56 National Health and Medical Research Council, *NHMRC Statement: Evidence on Wind Farms and Human Health*, https://www.nhmrc.gov.au/files/nhmrc/publications/attachments/eh57_nhmrc_statement_wind_farms_human_health_0.pdf (accessed 10 July 2015).

57 National Health and Medical Research Council, *2010 NHMRC Public Statement: Wind Turbines and Health*, <https://www.nhmrc.gov.au/guidelines-publications/eh53> (accessed 10 July 2015).

58 NHMRC, *Submission 102*, p. 6.

59 NHMRC, *Submission 102*, p. 6.

The NHMRC's 'independent systematic review'

2.51 In 2011, the NHMRC commissioned an 'independent systematic review' ('the review') of the human health effects of wind turbines. The review aimed to widen the scope of the initial 2010 review. It was undertaken by independent reviewers from Adelaide Health Technology Assessment under the guidance of a Reference Group. The Reference Group operated from 1 February 2012 to 31 January 2015 with a brief to:

- guide the development of a systematic review to determine if new evidence exists in the scientific literature on possible health effects of wind farms;
- consider the outcomes of the review and use these findings to:
 - inform updating NHMRC's Public Statement: Wind Turbines and Human Health; and
 - identify critical gaps in the current evidence base; and
- provide the NHMRC's Prevention and Community Health Care Committee with a report on Wind Farms and Human Health.

2.52 The NHMRC explained to the committee how it selected the relevant evidence for the systematic review. The review was based on only 17 publications:

In examining the possible effects of exposure to wind farm emissions on human health around 95 per cent of the original papers—approximately 4,500 of those—were excluded because none of the excluded papers examined human health effects of exposure to wind farm emissions. The remaining publications, approximately five per cent, were considered in more detail against selection criteria. This was to ensure that papers which detailed research activity that directly examined and compared the frequency of health effects in people with different levels of exposure to wind farm emissions were identified. It is the outcomes of this comparative analysis that provide the essential information for the reference group in answering the question as to whether wind turbines affect human health.

In the direct analysis of the five per cent of papers that were considered in greater detail, half of those were excluded as they did not document a study of original research. They were mostly review articles, opinion pieces, narrative reviews or discussion papers. Some other papers were excluded because they did not examine population and setting, exposure and outcomes, or use an appropriate research design to provide a comparative analysis. Only four papers were excluded on the basis that they were not published in English. As a result of this detailed search for literature, *17 publications detailing 13 studies were considered by the reference group in drafting the information paper.* An additional background literature review was also conducted to establish whether the type and level of emissions coming from wind farms might affect the healthy functioning of the human body—the mechanistic evidence—and also if health effects have been observed from noise emissions from other non-wind farm sources—the parallel evidence. Evidence was identified by the independent reviewers

through key word searches and research databases, as well as considering publications that were submitted during consultation.⁶⁰

2.53 The NHMRC told the committee that its assessment of the best evidence aligns with international best practice—namely:

...independent review of the evidence review methodology, independent review of our draft advice by relevant experts to ensure that the reference group in this case has interpreted the evidence appropriately, and public consultation which gives interested parties the opportunity to input into the process.⁶¹

2.54 The NHMRC explained that having identified the relevant evidence, 'independent evidence reviewers' were assisted by the Reference Group to develop the research questions and finalise the reports. The Reference Group that then 'considered the scientific evidence, expert review and all public consultations, synthesising this information into a format and context relevant to the Australian community'⁶²

2.55 The outcomes of the systematic review were finalised in late 2013 and considered by the Reference Group. The outcomes informed the development of a draft Information Paper on the evidence on wind farms and human health. The independent review also identified gaps in the current evidence base to inform the Reference Group's recommendations for research.⁶³

2.56 In November 2012, a further Senate inquiry into wind turbine noise placed great store in the NHMRC's forthcoming systematic review. The Senate Environment Legislation Committee recommended that 'there should be no regulatory changes prior to the release of the NHMRC's assessment in 2013, as this would be premature'.⁶⁴

2.57 The findings of the independent review were released in February 2014 as a draft Information Paper titled *Evidence on Wind Farms and Health*. A final version of

60 Ms Samantha Robertson, Executive Director, Evidence, Advice and Governance Branch, National Health and Medical Research Council, *Proof Committee Hansard*, Canberra, 19 June 2015, p. 14. Emphasis added

61 Ms Samantha Robertson, Executive Director, Evidence, Advice and Governance Branch, National Health and Medical Research Council, *Proof Committee Hansard*, Canberra, 19 June 2015, p. 13.

62 Ms Samantha Robertson, Executive Director, Evidence, Advice and Governance Branch, National Health and Medical Research Council, *Proof Committee Hansard*, Canberra, 19 June 2015, p. 14.

63 National Health and Medical Research Council, *NHMRC Statement and Information Paper: Evidence on Wind Farms and Human Health*, <https://www.nhmrc.gov.au/guidelines-publications/eh57> (accessed 1 July 2015).

64 Senate Environment and Communications Legislation Committee, *Renewable Energy (Electricity) Amendment (Excessive Noise from Wind Farms) Bill 2012*, http://www.aph.gov.au/Parliamentary_Business/Committees/Senate/Environment_and_Communications/Completed%20inquiries/2010-13/renewableenergy2012/report/~media/wopapub/senate/committee/ec_ctte/completed_inquiries/2010-13/renewable_energy_2012/report/report.ashx (accessed 10 April 2015).

the document was formally released in February 2015. Prior to publication, the NHMRC sought input from state and territory planning and environment departments through chief health officers.

2.58 The Information Paper is intended to replace the 2010 *NHMRC Public Statement: Wind Turbines and Health* and supporting evidence *Wind Turbines and Health: A rapid review of the evidence*.⁶⁵ The Statement concluded:

There is no direct evidence that exposure to wind farm noise affects physical or mental health. While exposure to environmental noise is associated with health effects, these effects occur at much higher levels of noise than are likely to be perceived by people living in close proximity to wind farms in Australia. The parallel evidence assessed suggests that there are unlikely to be any significant effects on physical or mental health at distances greater than 1,500 m from wind farms.⁶⁶

It added:

There is consistent but poor quality direct evidence that wind farm noise is associated with annoyance. While the parallel evidence suggests that prolonged noise-related annoyance may result in stress, which may be a risk factor for cardiovascular disease, annoyance was not consistently defined in the studies and a range of other factors are possible explanations for the association observed.

There is less consistent, poor quality direct evidence of an association between sleep disturbance and wind farm noise. However, sleep disturbance was not objectively measured in the studies and a range of other factors are possible explanations for the association observed. While chronic sleep disturbance is known to affect health, the parallel evidence suggests that wind farm noise is unlikely to disturb sleep at distances of more than 1,500 m from wind farms.

There is no direct evidence that considered the possible effects on health of infrasound or low frequency noise from wind farms. Exposure to infrasound and low-frequency noise in a laboratory setting has few, if any, effects on body functions. However, *this exposure did not replicate all of the characteristics of wind farm noise* as it has generally been at much higher levels and of short duration.⁶⁷

Although individuals may perceive aspects of wind farm noise at greater distances, it is unlikely that it will be disturbing at distances of more than 1,500 m. Noise from wind farms, including its content of low-frequency

65 National Health and Medical Research Council, *NHMRC Statement and Information Paper: Evidence on Wind Farms and Human Health*, <https://www.nhmrc.gov.au/guidelines-publications/eh57> (accessed 10 July 2015).

66 National Health and Medical Research Council, *NHMRC Statement: Evidence on Wind Farms and Human Health*, February 2015, https://www.nhmrc.gov.au/files_nhmrc/publications/attachments/eh57_nhmrc_statement_wind_farms_human_health_0.pdf (accessed 10 July 2015).

67 Emphasis added

noise and infrasound, is similar to noise from many other natural and human-made sources.⁶⁸

The 2015 NHMRC Statement and the Targeted Call for Research

2.59 In the February 2015 Statement, the NHMRC recognised that the body of direct evidence on wind farms and human health is 'small and of poor quality'. It added that given reported experiences of health effects and the 'limited reliable evidence', 'further high quality research is warranted'.⁶⁹ Importantly, senior public health figures have also recognised that the quality of research of the NHMRC's systemic review was 'suboptimal'. As the South Australian Chief Medical Officer told the committee:

...a lack of evidence does not mean that there is no effect; it just means that we have no evidence of an effect. The quality of the research that has been done so far has been suboptimal, and the NHMRC felt that it was important to put out a call for research to try to improve the quality of that evidence to determine if there was any evidence to suggest there are health effects of wind farms.⁷⁰

2.60 In the February 2015 Statement, the NHMRC announced that there will be a Targeted Call for Research to stimulate applications for research that addresses the gaps in the evidence base. The process will 'encourage Australia's best researchers to undertake independent, high quality research investigating possible health effects and their causes, particularly within 1500 m from a wind farm'.⁷¹ The NHMRC told the committee that the targeted call for research (TCR) closed on 6 May 2015 with four applications:

These are currently being assessed by an independent expert review panel and I hope the committee understands we cannot comment further in detail on this process due to the competitive nature of our funding processes. There are obvious limitations in existing direct evidence on wind farms and human health outcomes, and, in funding the TCR, NHMRC intends to stimulate the research required to build a robust body of evidence to establish whether there are adverse health effects from exposure to wind turbine emissions.⁷²

The committee notes that the research findings may be reported too late to apply the precautionary principle.

68 National Health and Medical Research Council, *NHMRC Statement: Evidence on Wind Farms and Human Health*, February 2015.

69 National Health and Medical Research Council, *NHMRC Statement: Evidence on Wind Farms and Human Health*, February 2015.

70 Professor Paddy Phillips, *Proof Committee Hansard*, Adelaide, 10 June 2015, p. 44.

71 Professor Paddy Phillips, *Proof Committee Hansard*, Adelaide, 10 June 2015, p. 44.

72 Ms Samantha Robertson, Executive Director, Evidence, Advice and Governance Branch, National Health and Medical Research Council, *Proof Committee Hansard*, Canberra, 19 June 2015, p. 15.

2.61 The NHMRC expects that the annual expenditure for this Targeted Call for Research on Wind Farms and Human Health is 'up to \$0.5 million per annum', and will be 'dependent on submitted research proposals being assessed as high-quality by rigorous, independent peer review'. The grants will be available for up to five years, depending on the proposal, meaning the maximum allocation for funding is \$2.5 million.⁷³

2.62 In February 2015, *The Australian* reported the comments of the CEO of the NHMRC, Professor Warwick Anderson: 'it is important to say no consistent evidence does not necessarily mean no effect on human health'. This point is important because it would seem that the NMHRC's assessment of the lack of consistent evidence coexists with significant empirical, biological and anecdotal evidence that many people living nearby wind turbines suffer similar symptoms and identify the wind turbines as the cause for their symptoms. As the Chairman of the NHMRC's wind farm committee, Professor Bruce Armstrong, commented: 'it is difficult to "prove a negative"—that wind turbines do not harm health—and the decision to conduct further research should not be seen as a cause for alarm'. Professor Armstrong also said 'to not investigate would be negligent from a public health point of view'.⁷⁴

Submitters' views of the NHMRC

2.63 The committee received several submissions from people and organisations critical of the role of the NHMRC and its findings. These criticisms focus on the selective nature of the NHMRC's research, its failure to properly investigate the complaints of many people who allege harm from turbines, and its failure to apply the precautionary principle in giving its advice.

2.64 Dr Sarah Laurie was particularly scathing in her assessment of the membership and methodology of the NHMRC:

The National Health and Medical Research Council has gravely failed the Australian public and the governments it advises by failing to ensure that serious conflicts of interest were not prevented with their choice of experts for their literature reviews. These have had a material impact on the quality of the advice from the NHMRC and have led to dangerously optimistic predictions about the safe distance of impact from wind turbine noise, for example. This has been achieved by cherry-picking data, ensuring the goalposts for the inclusion of studies were extremely narrow, and even resorting to misclassification of studies. The only possible reason for it was to ensure these studies were never included because they would damage the commercial interests of the wind industry. Incompetence is another, perhaps less likely, explanation.⁷⁵

73 Graham Lloyd, 'Health research body to fund wind-farm studies', *The Australian*, 13 February 2015. See also: Mrs Angela Kearns, *Submission 40*.

74 Mrs Angela Kearns, *Submission 40*, p. 1.

75 Dr Sarah Laurie, *Proof Committee Hansard*, Sydney, 29 June 2015, p. 40.

2.65 Mr Peter Mitchell also criticised the composition of the NHMRC's Reference Group and in particular, the lack of acoustical expertise:

There was one acoustician and three epidemiologists. This is an acoustical problem and, until we understand the acoustics, forget the medical intricacies. We have to understand the acoustics. No-one else on the panel had any idea of acoustics. They could not tell when they were being misled or information was being withheld. I was an observer, and it was very hard for me to prompt. So that was one thing.

The epidemiologists were focused on narrowing, it seemed to me, the 4,000 papers that were found by the library that did the literature survey into as few as possible. So the hurdles that those studies had to jump were huge. I just think that had I been wiser and looked at the construction of that panel I would have refused to have been an observer. But once you understood the construction of that panel it was there to make sure that the NHMRC gracefully slipped out of their rapid review done three years earlier and did not create any waves for themselves. It is a disgrace.⁷⁶

2.66 Ms Jackie Rovensky argued in her submission that the NHMRC's role to date has been marked by bias, in terms of both the content of its reviews and the timing of their release. She put the following argument:

Research into reported adverse effects of these turbines on humans has been undertaken for some years covering different scientific fields, but the NHMRC does not recognise this work and has sat back, listening and appearing to take notice of non-medical academics and the [Industrial Wind Turbine] IWT and have let this influence whether research should be undertaken and funded or not, leaning towards not.

Even after a Senate inquiry in 2011 recommended research the NHMRC stayed silent and a forum conducted by them they did not recommend funding research.

They have conducted two reviews of literature, which cannot be considered research. In both cases they were selective over which research was relevant. The first review was a Rapid Review and their conclusions and process was condemned and held up to ridicule because of its lack of thoroughness and biased process.

The second review resulted in many reports, papers both published and not published, peer reviewed and not peer reviewed being dismissed as not meeting their criteria for inclusion.

...The NHMRC's latest literature review could have been a turning point, but it did not wait to include the results of acoustical testing being undertaken by Mr Steven Cooper, even after they were made aware of initial findings months before, when he reported the finding of infra-sound inside resident's homes. These residents who were selected by Pacific Hydro to take part in the study had complained of adverse effects since the turbines began operating. The NHMRC had already delayed publishing

76 Mr Peter Mitchell, *Committee Hansard*, Melbourne, 9 June 2015, p. 16.

their results, but on the eve of the release of Mr Cooper's research by Pacific-Hydro, they released their report. Could they have waited perhaps a month longer allowing time for them to fully evaluate this work which found a link between infra-sound inside homes and complaints from affected residents and the operation of the IWT's? They should have done, as his findings are at the root of residents' complaints and therefore the work is significant, the question is: Why didn't they? Was influence brought to bear and/or was bias a contributing factor?

2.67 Some submitters argued that responsibility for future research should be taken out of the NHMRC's hands. A New Zealand psychoacoustician, Dr Daniel Shepherd, was one to recommend that an organisation other than the NHMRC manage further inquiries into wind turbine noise and its relationship to health. As he wrote:

As an outsider looking in, I have been surprised as to how politicised the conduct of the NHMRC has been, to a point where health and medicine have been side-lined. The "Rapid Review" undertaken by the NHMRC in 2010 was just that, all speed and no accuracy. Their 2014 Information Paper was more comprehensive, albeit containing fundamental misunderstandings of the concepts that constitute their core business: direct health effects, indirect health effects, and adverse health effects. For example, the WHO (Salomon et al., 2003) explicitly categorises cognition and sleep as direct indicators of health. Agents modifying these two processes must therefore be considered direct health effects. Noise can impact both cognition and sleep, and noise must therefore be considered a direct health effect. The NHMRC appear, however, to not accept this logic.⁷⁷

2.68 Ms Rovensky was highly critical of what she saw as the NHMRC's neglect of the precautionary principle on the issue of wind turbines. She put the following arguments:

The NHMRC has made no effort to ensure the health of Australians; they have neglected their duty to ensure they are fully informed and aware of the dangers of this industry or ensure decision are made without influence of those with an 'axe to grind'. The NHMRC has for political and possibly individual personal reasons stood back from strongly advising a Precautionary approach be taken with respect to where these IWT's are installed, until full independent research can be undertaken to assess whether they are safe to be install in proximity to humans.

They have also failed in their duty to arrange research funding in a timely manner once complaints from residents were being reported soon after IWT installations were commissioned. They may have been under pressure from a Government which wholeheartedly supported the IWT industry and ignored all attempts to get them to consider this industries safety record in rural locations close to human habitation, but this should not have silenced the NHMRC with respect to their duty to the people of Australia. They have given meagre advice to the public, none to the health profession and ineffective and uneducated advice to Government.

77 Dr Daniel Shepherd, *Submission 75*, p. 1.

The role of the NHMRC is significant with respect to medical research funding, and for them to suggest that because there is little research to show a cause and effect while acknowledging people are suffering begs the question, why did they not seek earlier to fund medical research?

Is it because they lean on a very contradictory aspect of their role? They say they rely on robust scientific research to assess the acceptance of Research Applications for grants, but then say there is insufficient robust scientific research for them to consider offering grants to fund this research. Could the NHMRC explain how robust scientific research can be funded so researchers can apply for funding to do the work? With people reporting adverse health effects since 1979, and in Australia from the beginning of installation of industrial sized wind energy turbines were installed then should the NHMRC have funded research earlier to ensure no others suffered the same effects?⁷⁸

2.69 Similarly, Mr George Papadopolous, a Canberra pharmacist, complained that the NHMRC had not listened to the 'ordinary rural dwellers' and had dismissed their 'very distressing symptoms'.⁷⁹ He contrasted the NHMRC's approach on the issue of wind turbines to its review into water quality. He wrote:

Did the NHMRC decide to discount the value of individual complaints? The NHMRC does not appear to do so in relation to other matters, such as water quality:

Consumers are the ultimate assessors of water quality. Consumers may not be able to detect trace concentrations of individual contaminants, but their ability to recognise change should not be discounted. In some cases, consumer complaints may provide valuable information on potential problems not detected by testing water quality or monitoring treatment processes. Water quality testing has limitations and there are many possibilities for contamination of water in reticulation systems after treatment. All consumer complaints should be investigated to ensure that otherwise undetected problems that might compromise drinking water safety have not occurred. Meeting reasonable consumer expectations and maintaining confidence in the water supply is vitally important (NHMRC 2011).

If the value of the individual's perception is so valuable in relation to water quality, why is the individual's perception not so valuable in relation to noise, the loss of amenity, sleep deprivation, rattling home structures and sensations? The NHMRC does not call on wind developers to take action on noise complaints. Rather it suggests that people consult with their medical practitioners if they feel their health is affected. With reference to water quality, why didn't the NHMRC perform a rapid review of the evidence and decide that water quality complaints were associated with

78 Ms Jacqueline Rovensky, *Submission 89*, p. 3.

79 Mrs Angela Kearns, *Submission 40*, p. 1.

scare campaigns of technophobes, the anti-fluoridation lobby and/or irrational fears about aluminium or chlorine?

Given that most authorities do not permit wind turbines to be installed within two kilometres of homes, the "1.5km" research recommendations of the NHMRC for research are a little out of line with the current regulatory requirements of authorities on this issue, and are in sync with those presented by authors supportive of the wind industry.⁸⁰

2.70 Emeritus Professor Colin Hansen of the University of Adelaide argued that the NHMRC Information Paper is flawed. He gave the following reasons:

- papers by many well-known scientists published in internationally recognised journals were rejected. The included papers were labelled as 'poor in quality';
- the Paper assumes that wind farm noise is like any other noise of the same A-weighted decibel level. Professor Hansen argues that this is not the case and that based on his measurement, 'wind farm noise is very different to other environmental noise such as traffic noise at the same A-weighted noise level'. He noted that wind farm noise has low-frequency 'which is not quantified very well by the A-weighting metric';
- the Paper wrongly assumes that the A-weighting measure can be directly related to the effect that noise has on people. Whereas the A-weighted noise level is typically a level averaged over a period of time, wind farm noise 'varies considerably over short periods of time and the peak levels can be much greater than levels averaged over 10 to 15 minutes'; and
- background noise levels in rural areas in Australia are well below background noise levels in urban areas and wind farm noise has 'entirely different characteristics to traffic noise, which makes it more intrusive and annoying'.⁸¹

2.71 Dr Christopher Hanning was also critical of the research methodology and the lack of insight in the NHMRC's research findings. He made the following observations in his submission:

The NHMRC statement on wind turbine noise and human health fails in its duty to "build a healthy Australia" and to protect the public health by; reversing the burden of proof, applying an inappropriately high burden of proof and failing to properly apply the precautionary principle. They have, instead, applied the "reactionary principle" (Kriebel 2007), which is clearly not in the public interest. Had they correctly applied the precautionary principle, then, even using their present analysis, they would have called for an immediate moratorium on the construction of new wind turbines within at least 1.5km of residences and immediate reductions in noise emissions from existing wind turbines sited within 1.5km of residences. Had they applied a reasonable burden of proof, they would have called for a construction moratorium and noise emission reductions for turbines sited

80 Mr George Papadopolous, *Submission 28*, p. 2.

81 Emeritus Professor Colin Hansen, *Submission 50*, p. 2.

within 10km of residences. In addition, they would have mandated research by independent experts with relevant expertise in acoustics, sleep medicine and other relevant clinical disciplines, funded by the wind industry, as an urgent matter for the protection of public health.⁸²

2.72 Similarly, the Upper Hunter Landscape Guardians argued that the limits on the criteria used and the literature reviewed, the NHMRC 'has created a bias in favour of the wind industry'. The organisation did welcome the NHMRC's proposal to undertake further research and urged high participant rates than in the studies to date.

2.73 Mr Papadopolous also contrasted the context and the approach of the NHMRC in its 2010 review of wind turbines relative to its 2015 review.

What changed from 2010 to 2015? A large number of papers have been since written on the issue of low frequency noise, wind turbines and associated human impacts, with no shortage of complaints against the wind industry in the media. Likewise authorities, such as those of New South Wales and Victoria published new stricter wind farm guidelines, effectively banning wind turbine installations within 2km of homes (in spite of the 2010 Rapid Review recommendations).

In 2010, the majority of opinions, published literature etc, was in favour of the wind industry. In 2015, we find ourselves in a vastly different environment. The 2011 Senate Inquiry and subsequent Inquiries, updated government wind farm guidelines in NSW, SA and Victoria (all challenging past assumptions over wind turbines), no shortage of public complaints and media reports against wind turbines, and published papers discussing the role of low frequency noise, qualitative aspects of wind turbine noise, suggestions of non-audible mechanisms of harm etc.

The methodology of the 2010 and 2015 statements is very different. Had the NHMRC chosen the 2010 methodology for its 2015 statement, more likely than not, it would have been forced to produce a statement critical of the wind industry. It leaves one wondering whether the NHMRC has taken a stance that minimises the potential damage to the prospects for the wind industry, and one which allows the wind industry to proliferate meanwhile, whilst research is being recommended at close proximity to wind turbines – a distance effectively considered problematic by many state government planning departments.⁸³

2.74 Interestingly, some local councils argued the need for greater leadership from the NHMRC in terms of suggested buffer distances. The Pyrenees Shire Council stated in its submission:

There is a need for the NHMRC to provide leadership and direction at a national level to state planning authorities through undertaking or peer reviewing targeted medical studies based on Australian conditions and the possible health effects from wind farms on human health. This should

82 Dr Christopher Hanning, *Submission 55*, p. 3.

83 Mr George Papadopolous, *Submission 28*, p. 2.

include recommendations to state planning authorities on minimum buffer distances.⁸⁴

Criticism of the 2015 NHMRC Review

2.75 The committee draws attention to strong criticism of the proposed NHMRC review from submitters. Two in particular—Dr Michael Crawford and the Parkesbourne/Mummel Landscape Guardians (PMLG)—are forensic in their critique of past NHMRC reviews and cynical of the prospect that the 2015 review will be better conducted. Dr Crawford criticised the systematic review on the following grounds:

Its headline statements are inconsistent with the reasoned argument in the body of the review and are slanted to exonerate wind farms in a way not supported by the actual analysis in the review.

It presents its conclusions using vague words such as "generally" (but not "always") or "unlikely" (but not "never") without offering even indicative quantification of those terms, knowing they will be misinterpreted and misrepresented by wind farm proponents.

Despite surely being aware that wind turbines have been getting much more powerful and continue to do so, and their noise emissions consequently continue to increase, there is no reference to turbine power related to distance of effect or even the need to be conscious of it, as though the NHMRC thinks all wind turbines are the same.

It has adopted a methodology inappropriate for the task, given what it understands and actually acknowledges about both extant research and the peculiar propagation characteristics of wind turbine noise.

It is inconsistent in its rigour, applying restrictive conditions on the consideration of evidence that might support a conclusion of harm from wind farms, while not requiring the same rigour when it proposes arbitrarily restricted distances at which sleep deprivation and consequent harm to health may be caused by wind farm noise.

It states "the body of direct evidence was found to be small and of poor quality" (after applying its inappropriate methodology). In that case, within that framework, the unavoidable conclusion should be "there is little evidence whether wind farms do or do not have an adverse health effect" and in fact a paragraph buried in the main report says as much. However, instead of honestly reporting that assessment in its headline statements, it uses words that convey the impression there is little adverse effect when its own analysis has demonstrated no basis for doing so.

While recognising that there can be harm to mental as well as physical health, it manages to convey the impression that if the former occurs it is due to some defect on the part of the victim and thus unrelated to the wind farm that has actually been the stressor source.

84 Pyrenees Shire Council, *Submission 47*, p. [4].

While recognising the existence of potential harmful mechanisms (audible sound, ILFN, blade glint and flicker, electromagnetic radiation) it proceeds as though their impact on people is disconnected. Even the United States Department of Justice (US DOJ) evaluating the legality of Central Intelligence Agency (CIA) interrogation techniques understood that when you apply multiple stressors they can have compounding effects and that sleep deprivation in particular has multiple interactions with other stressors, including through increasing pain sensitivity. One has to wonder why, if this compounding effect was obvious to the US DOJ in 2005, it appears to have escaped the NHMRC in 2015.⁸⁵

2.76 PMLG argued that the 2015 NHMRC review needed to consider the following issues:

Will the commissioned research do any of the following?

- Consider the adequacy or inadequacy of the noise guidelines for wind turbines in use (or proposed) in Australia.
- Consider the research for the US Department of Energy, conducted in the 1980s and 1990s by NASA and by SERI.
- Consider the research of Professor Alec Salt and his colleagues on wind turbine infrasound and the potential for adverse health effects.
- Incorporate the methodology of Stephen Cooper (sic), as used in Mr Cooper's recent study of the Cape Bridgewater Wind Farm.
- Ensure that wind farm operators are compelled to turn turbines on and off, as necessary for the conduct of the research.
- Measure wind turbine infrasound out to 10 kilometres from turbines, in connection with the study of adverse health effects within that distance.

The PMLG concluded:

Unless the research does all of the above, its value will be correspondingly reduced, and yet more time and resources will have been wasted. Yet again, wind farm neighbours will have been let down.⁸⁶

2.77 Some submitters drew the committee's attention to the NHMRC's apparent backflip on the issue of wind turbines and human health. Dr Gary Hopkins questioned the NHMRC's motives for the latest call for targeted research:

It is also interesting to note the change in the NHMRC. The NHMRC are generally very conservative. In 2010, after their rapid review, they issued a statement saying there was no association. After their more formal review in 2014, they said there was poor evidence. Then in 2015 they start to ask for targeted research. They are changing their thoughts, and the question is:

85 Dr Michael Crawford, *Submission 316d*, pp 3–4. *Defects in 2015 NHMRC Review into Wind Farms and Human Health*, 23 March 2015.

86 Parkesbourne/Mummel Landscape Guardians, *Submission 119*, p. 88.

why? Why did AGL see the need to visit GPs? Why are the NHMRC changing their attitude?⁸⁷

2.78 Ms Rovensky put the following view:

With the NHMRC, I personally cannot see any difference in their recent review from the one they did previously. They have still wiped out a lot of information they should have included. But, in their call for research, they have said that the broader social circumstances should be researched. We all know what they mean by that. Anything to do with that should come later, once the research has been done to establish whether there are—and I believe there are—effects from industrial wind turbines on people's health. Why waste money on doing something that is irrelevant or could be irrelevant?⁸⁸

Acousticians' views and the need for properly funded research

2.79 The Association of Australian Acoustical Consultants (AAAC) is a body of acoustical consultants composed of 33 member companies. Its self-description is as 'a not for profit peak body representing professionals who are involved in delivering acoustic solutions to a wide range of clients and the community'.⁸⁹ In evidence to the committee, the AAAC set out its position in relation to wind farm infrasound:

Infrasound...is generated by both natural sources...and mechanical sources Investigations have found that infrasound levels around wind farms are no higher than levels measured at other locations where people live, work and sleep. Those investigations conclude that infrasound levels adjacent to wind farms are below the threshold of perception and below currently accepted limits set for infrasound. The AAAC encourages members to continue to contribute to new research and review research in the technical literature.

Generally our members are not experts in health and therefore primarily rely on the view of government bodies, such as the NHMRC, and conduct our assessments in accordance with state guidelines.⁹⁰

2.80 The committee does note that some of the AAAC's members have been extensively engaged by the wind farm industry. In response to a question on notice, the AAAC noted that one of its members had performed consultancy work at no fewer than 61 wind farms, another member had been engaged at 51 wind farms and another

87 Dr Gary Hopkins, *Proof Committee Hansard*, Adelaide, 10 June 2015, p. 62.

88 Ms Jacqueline Rovensky, *Proof Committee Hansard*, Adelaide, 10 June 2015, p. 64.

89 The Association of Australian Acoustical Consultants, <http://www.aaac.org.au/au/aaac/default.aspx> (accessed 3 July 2015).

90 Mr Chris Turnbull, Director, Sonus; and Chair, Wind Farm Subcommittee of the ACCC, *Proof Committee Hansard*, Adelaide, 10 June 2015, p. 1.

at 50 sites. The wind industry is clearly a lucrative area of employment for some of the AAAC's members.⁹¹

2.81 The committee has had the opportunity during this inquiry to take evidence from a range of Australian and international acousticians. As mentioned earlier, there is a considerable diversity of professional views as to the nature of sound from turbines and the potential for this sound to impact on human health. There was, however, a general consensus that more research is needed to test causal relationships between turbine sounds and ill-health.

2.82 Acoustician Dr Bruce Rapley explained the type of field research that is now needed:

Observational studies are urgently needed to study the low-frequency and infrasound emissions. It is of those people affected inside their homes—that is the priority. I have to stress this: laboratory studies cannot replicate the situation experienced by those people in close proximity to large wind turbines, and they cannot provide the study data we need. What we have to do, now that we are in a crisis situation in terms of public health and regulation, is do the first studies on sensitised individuals. We should not be looking at large cross-sectional population studies of non-exposed people, laboratory studies. No longer are a few A-weighted sound levels and wind speeds of any use in correlating environmental conditions to subjects' experiences. We need to look at sensitised individuals first, because that is where the most rich data can be obtained. Research that relates to full-spectrum and also narrow-band analysis with an objective physiological measure in the people that you are investigating, who are suffering the worst impacts in their homes and workplaces, is the only strategy that can produce the results that we urgently need. We cannot afford as a country to waste time on other issues. We must address those who are severely impacted in their homes, use the full-spectrum narrow-band analysis, and that needs to be combined not just with diaries of their experience but with real physiological measures. I have the technology to be able to do that; the technology has been invented. We can do this, but it has never ever been done. The technology is now available. Time is of the essence.⁹²

2.83 University of Sydney neuroscientist, Associate Professor Simon Carlile made two observations relating to the need for future research:

First, it is critical that the research be aimed at examining possible physiological mechanisms on the influences of infrasonic energy on the human nervous system. Research that examines this only on a population level misses a very important fact of human biology—that is, there are significant individual differences in every aspect of human function that we have studied scientifically to date.

91 See: AAAC, *Response to question on notice 1*, dated 1 June 2015. Available on the committee's website.

92 Dr Bruce Rapley, *Proof Committee Hansard*, Canberra, 19 June 2015, p. 8.

For example, we know the susceptibility of people to motion sickness such as sea sickness varies significantly across the population. If there are, say, 1,000 people on a ferry on Sydney Harbour, only one of those might be seasick. Viewed as a population, you might conclude then that the evidence that a Sydney Harbour ferry produces sea sickness is highly insignificant. But on an individual basis, it would be trivial to demonstrate that one person on that ferry had a very different physiological reaction than everyone else on the ferry...

In his recent scientific review published in the magazine of the Acoustical Society of America, Professor Alec Salt identifies several potential biological mechanisms by which infrasonic energy could stimulate the nervous system. Professor Salt has been studying the neurobiology of the inner ear for nearly four decades and has published countless scientific papers on the subject. I will summarise his review simply by saying that there is a clear *prima facie* case that infrasonic energy can influence the neural receptors in both the auditory system and the vestibular system—the system responsible for our sense of balance. I am happy to talk through the biology if there is interest in the committee, but the key message is that infrasonic energy does affect sensory cells of the nervous system and that this would provide the basis for any possible influence of infrasonic energy on the functions of the nervous system.⁹³

2.84 Psychoacoustician Dr Robert Thorne told the committee that the NHMRC's work has to date been inadequate and there is a need for properly funded research into the nature and cause of adverse health effects. He took aim at the methodology of the NHMRC's studies:

When they investigated and read 4,000 documents and, I think, in the end they came up with 13 that met their criteria, something is wrong. Earlier—I think it was in 2011–13—Professor Anderson of the NHMRC came and made the very valid point that anecdotal information—that is, residents' submissions and their viewpoints—was valuable in identifying issues, not necessarily cause and effect, but identifying the start point. But, whenever we look at any research, we go for observations, then trying to get an idea of what is happening, then work the hypotheses and then studies. It was obvious—and I have got quite a lot of research myself in the past—that there are very few adverse health effects studies undertaken, primarily because there has been no funding for adverse health effects studies. You cannot get a study if you do not pay for it, and you cannot get an impartial university-based study unless you pay a lot for it. That is my view.⁹⁴

2.85 Dr Thorne told the committee that the type of research that is needed—with 1000 participants—would cost \$1.2 million. He criticised the \$500 000 allocated to the NHMRC study noting that this sum 'would barely scratch the surface'.⁹⁵

93 Associate Professor Simon Carlisle, *Proof Committee Hansard*, 29 June 2015, Sydney, p. 69.

94 Dr Robert Thorne, *Proof Committee Hansard*, Cairns, 18 May 2015, p. 42.

95 Dr Robert Thorne, *Proof Committee Hansard*, Cairns, 18 May 2015, p. 47.

2.86 Dr Renzo Tonin, principal of AAAC member firm Renzo Tonin & Associates, noted a forthcoming NHMRC research project that will measure the effects of infrasound on a group of 100 participants in both their normal environments and in a laboratory environment. He added:

In other words, we are going to have control groups and we are going to have exposed groups, and they will not know which they are. They will be exposed to infrasound in their home and also in the laboratory. We will measure using electroencephalographs and all your fancy medical equipment to find out exactly what is going on.⁹⁶

2.87 Dr Tonin strongly supported this study and its methodology. He suggested that Senators lend their support to fund the NHMRC project.⁹⁷ Other members of the AAAC also supported the research. Mr Chris Turnbull told the committee:

I understand that that is what the NHMRC is looking to do. I agree that 'multidisciplinary' is important, because effectively we know what the noise from wind turbines is. We know what the infrasound is. That has been measured a number of times. We agree that the impact of that infrasound should be played back to others, a larger group in different situations, so that is understood, and then the potential health effects of that should be studied as well. That is, as you suggest, a multidisciplinary group, so I think we would support that.⁹⁸

2.88 However, other submitters argued that the NHMRC is not the right body to conduct future research. Mr Peter Mitchell, for example, told the committee that the Council's lack of technical capacity 'is absolutely shattering'.⁹⁹ Dr Thorne observed:

We know quite a few of our colleagues and any one of them would die to do a proper research study. Research is, by and large, researchers: they just love going for whatever the topic happens to be. So the umbrella organisation that it sits under is not so important as the actual quality of the people you get; and their expertise and their ability to talk with each other. You have to have people on that committee who have different points of view, but held in check by a strong chairperson who moderates and brings the best of the study. That, in my view, that did not happen with the NHMRC.¹⁰⁰

96 Dr Renzo Tonin, representative of the Wind Farm Subcommittee of the ACCC, *Proof Committee Hansard*, Adelaide, 10 June 2015, pp 5–6.

97 Dr Renzo Tonin, representative of the Wind Farm Subcommittee of the ACCC, *Proof Committee Hansard*, Adelaide 10 June 2015, p. 11.

98 Mr Chris Turnbull, Director, Sonus, and Chair, Wind Farm Subcommittee of the ACCC, *Proof Committee Hansard*, Adelaide, 10 June 2015, p. 20.

99 Mr Peter Mitchell, *Proof Committee Hansard*, Melbourne, 9 June 2015, pp 16–17.

100 Dr Robert Thorne, *Proof Committee Hansard*, Cairns, 18 May 2015, p. 46.

Laboratory or field testing

2.89 The committee has heard that replicating infrasound from a turbine in a laboratory setting may not be possible. In criticising the methodology for the 2015 NHMRC review, Dr Michael Crawford wrote in his submission:

The problem starts with the requirement to include wind farm emissions, rather than say comparable emissions in a laboratory setting. Consider noise emissions. For multiple reasons actually discussed in the NHMRC review, predictions of average noise levels and characteristics at individual dwellings are poor. In addition, because wind turbines operate intermittently and essentially randomly, and noise propagation varies with factors such as wind direction and other atmospheric conditions, available proxies for noise emissions are even poorer as an estimate of the noise impact at the time other data is collected for a study. The available proxies are either distance or computer models, both of which are seriously deficient. This is a problem recognised in the Information Paper in the section dealing with further research.

The only way to get good quality noise emission data for research is through actual full spectrum noise monitoring where each participant is located. However, for reasonably large sample sizes that has been prohibitively expensive for most researchers due to the capital and labour intensity of noise monitoring, in home and outside it.¹⁰¹

Synchronicity, hot spots and the middle ear

2.90 The committee has sought evidence during this inquiry on matters of possible acoustical concern in terms of the impact of wind turbines on human health. Notably, the committee heard from Dr Andrew Bell, a Visiting Fellow at the John Curtin School of Medical Research at the Australian National University. His research and theories in relation to how turbine operations may affect the human ear are of genuine interest to the committee.

2.91 Dr Bell's research draws attention to what he calls a 'possible synchronisation phenomenon that happens between each of the wind turbines'. When this occurs, he claims the sound pressure levels 'will be higher than usually expected and they will fluctuate' and 'there will be large low-pressure variations which could affect the ear'.¹⁰²

2.92 Dr Bell published a technical note last year in which he explains:

...wind turbine infrasound can be narrow band, have multiple sources, and occur intermittently as the sources drift in (and out of) phase...[T]he proposal here is that the intermittency of the in-phase and out-of-phase conditions might underlie wind turbine annoyance. Whenever the blades become synchronised (perhaps for many tens of seconds) the intensity of

101 Dr Michael Crawford, *Submission 316d*, p. 7. *Defects in 2015 NHMRC Review into Wind Farms and Human Health*, 23 March 2015

102 Dr Andrew Bell, *Proof Committee Hansard*, Canberra, 19 May 2015, p. 17.

the fundamental and some of its harmonics could, at nodes, be at least 6 dB larger, but the levels will revert to baseline when the sources fall out of synchrony.

A lingering puzzle is why some people complain of effects from wind farms which persist for hours, not effects which come and go. Such long-lasting symptoms such as headaches and pressure in the ears might be the outcome of pressure effects within the middle ear, a possibility only more research can decide.

...the evaluations made here provide indications that intermittent coherence could be the physical basis for the annoyance of wind farm noise. One key factor is the precise frequency setting of the wind turbine control circuit, and the other is the universal tendency for coupled oscillators to synchronise.¹⁰³

2.93 The committee also received evidence from Emeritus Professor Colin Hansen of the University of Adelaide relating to the intermittency of in-phase and out-of-phase conditions. He noted that when synchronised, turbines can create 'hot spots' which are intermittent, depending on the direction of the wind. They fade where there is very low frequency, in-phase noise.¹⁰⁴ Professor Hansen told the committee that these hot spots are able to be recorded and replayed.

2.94 The committee asked Dr Bell for his comment on the NHMRC's February 2015 discussion paper. He responded by criticising the monitoring equipment that has been used to measure sound and emphasised the importance of understanding the human ear:

I think it [the NHMRC paper] was too simplistic. It failed to recognise that the human ear is the final arbiter of whether something annoys a person or not, and that the human ear is more sensitive than any of the monitoring equipment that is presently used. Given that there is the choice between saying the person did not or did hear it, I would say you need to believe that a person was troubled by that sound. That was the thing that immediately struck me. I was not planning to get into wind turbine work. I was applying for a grant to the NHMRC, and I saw on their website that they had this preliminary review and wanted public statements. When I read what was there, it did seem to be excessively simplistic and favouring the standard monitoring over the position of residents living nearby.¹⁰⁵

...

My perception is that, if you look at the history of the field, there has been a whole revolution in our understanding of frequency range, of decibels, about what effects there are on the ear. Only in 1979 did we realise that the

103 Dr Andrew Bell, 'Constructive interference of tonal infrasound from synchronised wind farm turbines: Evidence and implications', *Acoustics Australia*, Vol. 42, No. 3, December 2014, p. 217.

104 Professor Andrew Hansen, *Proof Committee Hansard*, 10 June 2015

105 Dr Andrew Bell, *Proof Committee Hansard*, 19 May 2015, p. 20.

cochlea is actually an active detector: it emits sound. If you put a microphone in the ear, you can detect faint pure tones coming out of most people's ears. This is very similar to a tinnitus phenomenon. It does actually trouble some people. But normally the cochlea is an active detector and we still do not understand what that mechanism is...

I am saying, on top of a basic pressure level measurement, there is a whole sophisticated, dynamic system involved which we do not understand. So I think we need to be open to the idea that our monitoring system is not as sophisticated as the human ear, and we need to do measurements to try and match even more closely between the ear and what the measurements are telling us.¹⁰⁶

2.95 Dr Bell has formulated a theory of how middle ear muscles function to regulate sound input to the cochlea. He explained that these muscles:

...act as "gain control" devices to control the amount of sound input to the impressively sensitive cochlea, like a sound engineer controls the setting of sliders to optimise sound recording in a studio. The cochlea can sense 20 micropascals of pressure (0 dB), but still needs to be able to sense sounds a million million times louder (120 dB). According to my understanding of how middle ear muscles work, the muscles automatically control the sensitivity of the cochlea by acting on its fluid contents so as to increase or decrease the hydraulic pressure. Such a control circuit could well be affected by large infrasonic pressure pulses (5 pascals from a wind turbine, which is 250,000 times greater than the 20 micropascals which can be heard in the audible band), and this could produce disturbing sensations.¹⁰⁷

The vestibular mechanism

2.96 Apart from the muscles in the middle ear, ill-effects from turbines may be explained by the way that turbines affect the inner ear and in particular, the vestibular mechanism. This mechanism is the sensory system that provides a sense of balance and spatial orientation. Professor McMurtry told the committee:

...annoyance in the context of wind turbines translates to 'stress, psychological distress, difficulty initiating sleep and sleep disruption'—I believe those words, although from memory, are a direct quote—so it is a very serious business. The most common problems without question we find are sleep disturbance and stress. Those two are always there. Vestibular disturbance we are also finding. There is no question though when the vestibular gets perturbed, it can make you uneasy, make you feel unwell or nauseated, for example. It may be the mechanism. I am in no way discounting it and it is considered in my diagnostic criteria.¹⁰⁸

106 Dr Andrew Bell, *Proof Committee Hansard*, Canberra, 19 May 2015, p. 22. See also: Dr Andrew Bell, *Answer to question on notice no. 5*, p. 2, (received 14 June 2015)

107 Dr Andrew Bell, *Answer to question on notice, no. 13*, p. 6, (received 14 June 2015)

108 Dr Robert McMurtry, *Proof Committee Hansard*, Sydney, 29 June 2015, p. 8.

2.97 The committee also received evidence relating to the vestibular mechanism from Dr Swinbanks. He wrote in his submission:

The conventional method of assessing whether low-frequency and infrasound is perceptible has usually involved visually comparing power spectral levels or 3rd octave levels with the threshold of hearing. This approximate process, however, is unlikely to be accurate in the low-frequency wind-turbine context, because it assesses only the mean level of sound, and fails to take account either the character of the sound or the relationship between adjacent frequency bands...

[R]esearchers have now proposed two further processes which may account for increased sensitivity to very low frequency infrasound. Conventional hearing perception is considered to take place via response of the inner hair cells of the cochlea (the sensing structure of the inner ear), but it has been shown that the cochlea outer hair cells respond with greater sensitivity at very low frequency, and induce additional neurological signals. Hitherto, these outer hair cells have been considered to perform only the task of controlling the overall sensitivity of the hearing process, but it is possible that they can also contribute directly to very low frequency perception.

A further mechanism has been proposed, whereby sound pressures acting through the lymphatic fluid directly on the otolith components of the vestibular (balance) organs have been calculated to exert comparable forces to those induced by motion and acceleration. Any non-uniformity in the compliance of the structures supporting these otolith sensors may then result in a response which simulates that of physical motion. Indeed, it has been argued that the correlation between persons who suffer from motion sickness, and those who report adverse effects from wind turbines is sufficient to be more than a result of mere chance.¹⁰⁹

The committee's view on further research and the body to conduct it

2.98 The committee is concerned that for many key stakeholders, including public health associations and wind farm companies, the 2010 and 2014 NHMRC papers are the definitive findings on the issue of wind turbines and public health. This inquiry has gathered evidence from various sources that call into question the extent to which these reviews can be relied upon. The committee draws attention to:

- the NHMRC's commitment to conduct research in 2015, for some an admission of the inadequacy of its literature reviews; and
- the view of AAAC acousticians that there is a need for well-funded multi-disciplinary research, using control and exposed groups.

2.99 The committee believes there is an urgent need to put in place a central point of expert scientific advice on the risks of wind turbines to human health. As noted at the start of this chapter, the principal recommendation of the committee's interim report was to establish an independent scientific body to conduct multi-disciplinary, primary research into the possible impact of audible noise and infrasound from wind

109 Dr Malcolm Swinbanks, *Submission 189*, pp 20–21.

farms on human health. The committee confirms the federal government's commitment to establish an *Independent Expert Scientific Committee on Industrial Sound* (IESC) by 1 September 2015.

2.100 Chapter 6 of this report presents several further recommendations that will give substance to the operation of the IESC on Industrial Sound. It is crucial that the IESC's research and advice is sought by, and communicated to, federal and state health Ministers and policy-makers, as well as State Environmental Protection Authorities. It is also very important that wind farm development proposals and wind farm operations are subject to the IESC's scrutiny.

2.101 The committee considers that the level of funding provided by the NHMRC for long overdue research is manifestly inadequate to properly study this complex and poorly understood issue. While the NHMRC should still have a role in commissioning research into the impact of wind turbines on human health, the IESC must take the lead in these research efforts. Chapter 6 explains these proposed roles in more detail.

Chapter 3

Planning issues

Introduction

3.1 This chapter deals with issues relating to the planning of wind farms in Australia. These issues cover the lifespan of wind farm developments: the site selection; the feasibility of the project; the planning and approvals process; construction; commissioning and operations; and decommissioning. The committee has received considerable evidence on these matters, the bulk of which has drawn attention to poor planning processes and the lack of effective community consultation.

3.2 Currently, there is no national planning framework for wind farms in Australia: the relevant regulations and laws are within the relevant State environment and planning statutes. These statutes are regulated in an often confusing manner with jurisdictional overlap between state governments and local councils.

3.3 In its interim report, the committee argued that national wind farm planning guidelines are needed, and planning decisions relevant to technical issues must be elevated from local councils to the state government body with the relevant technical expertise. Logically, responsibility for monitoring compliance issues relevant to these technical decisions should also lie with the decision-making body that has the technical expertise. See the following chapter on Monitoring and Compliance for further discussion and recommendations.

Interim report recommendations relating to planning

Recommendation 3

The committee recommends that the Commonwealth Government introduce *National Wind Farm Guidelines* which each Australian State and Territory Government should reflect in their relevant planning and environmental statutes. The committee proposes these guidelines be finalized within 12 months and that the Commonwealth Government periodically assess the Guidelines with a view to codifying at least some of them.

Implementation of planning processes

3.4 The implementation of planning processes for wind farms has three key elements:

- land use planning frameworks—the planning regime that applies to all large-scale development in the relevant jurisdiction;

- environmental planning frameworks—the regulatory regime to assess technical and environmental issues relevant to wind farms, including the permits required to operate a wind energy facility; and
- the capacity of the relevant authority/authorities to implement these planning and permit frameworks.

3.5 Many submitters have expressed their concern at the lack of consultation by wind farm proponents both before a development application is lodged, and during the development application process.

Planning frameworks

3.6 Land use planning and construction approvals are conducted through local, state and territory planning processes. Planning and approval frameworks for all large-scale or 'significant' developments are different across all jurisdictions in Australia. In some states, individual councils approve and regulate development at a local level, while in other jurisdictions, decisions for larger developments are made at a state level, often by using 'call-in powers' exercised by state ministers with responsibility for planning issues.

3.7 To add to this confusion, planning approvals specific to wind farm development are even more variable. There is a myriad of approval processes relevant to technical issues and environmental impact, both across jurisdictions and even within different levels of government within a state or territory.

3.8 Some jurisdictions have moved to ensure that wind farm approvals are both regulated and approved at a state or territory level, while others allow local councils to make all planning decisions for wind farms. Some states, such as Victoria, have moved the decision making from local councils to state government agencies and then back again, adding to the confusion. Other jurisdictions elevate technical decision-making based on these guidelines to state agencies, while relying on local councils to monitor and enforce wind farms' compliance with operational approvals.

3.9 Proponents of a new wind farm must navigate this confusing array of separate approvals processes. Not only does this adversely impact on the wind farm industry, this process also makes it very difficult for affected communities to engage in the consultation and approvals process for new wind farm proposals. Many of the current legislative frameworks effectively take away the right of communities to appeal.

3.10 Most state governments have either drafted (New South Wales, Queensland) or finalised (Western Australia, South Australia, Victoria) guidelines for wind farm developments.¹ The guidelines cover issues such as setback from existing homes,

¹ NSW Department of Planning and Infrastructure, *NSW Planning Guidelines: Wind Farms*, December 2011, http://www.planning.nsw.gov.au/Portals/0/PolicyAndLegislation/NSW_Wind_Farm_Guidelines_Web_Dec2011.pdf (accessed 20 July 2015).

environmental and visual impacts such as noise, blade flicker and electromagnetic interference, aircraft safety, and impacts on birds and bats.

3.11 The committee has received a considerable volume of evidence, by written submission and during hearings, that state-based planning frameworks have significant flaws in a number of areas. Following is a discussion of the planning approvals processes across a few sample states, to give a picture of the complexities and problems faced due to the planning regimes that apply to wind farms around Australia.

Planning frameworks: Victoria

3.12 The Victorian Government first published the 'Policy and planning guidelines for development of wind energy facilities in Victoria' in 2003. This document has been refined and updated in 2009, 2011, 2012, and April and June 2015² to reflect policy changes and to update information.

3.13 In its submission, the Department of Economic Development, Jobs, Transport and Resources summarises the guidelines as follows:

Once lodged, a planning application is advertised to neighbouring properties and referred to relevant authorities. The decision maker then considers the proposal against the relevant planning scheme policies and controls including the particular provision at Clause 52.32 – Wind Energy Facilities. Considerations include noise, visual and landscape impact, vegetation clearance, shadow flicker, aviation safety, and fauna impacts. Following consideration of the planning provisions, referral responses and public submissions the responsible authority will determine the application.

Queensland Department of State Development, Infrastructure and Planning, *Wind farm state code: Planning guideline – draft for consultation*, April 2014, <http://www.dilgp.qld.gov.au/resources/guideline/draft-wind-farm-state-code-planning-guideline-april-2014.pdf> (accessed 29 January 2015).

Western Australian Planning Commission, *Planning Bulletin – Guidelines for Wind Farm Development*, April 2004, http://www.planning.wa.gov.au/dop_pub_pdf/pb67May04.pdf (accessed 29 January 2015).

Renewables SA, *Wind Farm Planning Policy*, <http://www.renewablessa.sa.gov.au/proponents-guide/wind-farms> (accessed 29 January 2015).

Victorian Department of Transport, Planning and Local Infrastructure, *Wind Energy Facilities, website*, <http://www.dtpli.vic.gov.au/planning/planning-applications/more-information-on-permits/wind-energy-facilities> (accessed 30 January 2015).

- 2 Victorian Department of Transport, Planning and Local Infrastructure website, *Policy and Planning Guidelines for Development of Wind Energy Facilities in Victoria*, June 2015, http://www.dtpli.vic.gov.au/data/assets/pdf_file/0011/231779/Policy-and-Planning-Guidelines-for-Development-of-Wind-Energy-Facilities-in-Victoria_June-2015.pdf (accessed 15 July 2015). The most recent version of this policy paper is available here.

Permit applicants and objectors can apply for a review of the decision to grant or refuse a permit application. Applications for review are held before the Victorian Civil and Administrative Tribunal.³

3.14 In April 2015, an amendment to planning laws made the Minister for Planning the responsible authority for all new planning permit applications for the use and development of land for the purpose of a Wind energy facility. In addition, the two kilometre buffer zone between wind farms and residential dwellings, introduced by the Coalition State Government in 2011, was reduced to one kilometre.⁴

3.15 These changes were largely in response to a Victorian parliamentary inquiry into renewable energy projects tabled on 25 February 2010.⁵ Of particular relevance to this inquiry, the Victorian inquiry recommended:

- the Victorian Planning Minister be the responsible authority for all commercial wind energy facilities;
- a departmental Project Manager be appointed to each renewable energy facility project;
- a Technical Reference Group be established and integrated into the assessment process for all renewable energy facilities;
- standard development approval conditions should be developed by the Department of Planning and Community Development for permit applications for renewable energy facilities;
- Planning Panels Victoria form a small team of members with substantial expertise in considering wind farm applications;
- The Minister for Planning be responsible for the monitoring and enforcement of conditions set out in all wind farm permits and post development plans;
- Strategic regional plans should be developed by the Department of Planning and Community Development to assist local councils and communities manage the cumulative impacts of multiple, concurrent major developments, including wind energy facilities; and

3 Victorian Department of Economic Development, Jobs, Transport and Resources, *Submission 112*, p. 6.

4 Victorian Department of Environment, Land, Water and Planning, *Planning Advisory Note 61*, April 2015, http://www.dtpli.vic.gov.au/_data/assets/pdf_file/0006/273291/AN61-Amendment-VC124-Changes-to-wind-energy-facility-provisions-and-vegetation-provisions.pdf (accessed 15 July 2015).

5 Victorian Parliamentary Environment and Natural Resources Committee, *Inquiry into the Approvals Process for Renewable Energy Projects in Victoria*, <http://www.parliament.vic.gov.au/57th-parliament/enrc/inquiries/inquiry/44> (accessed 20 July 2015).

- Regional Development Victoria fund local councils impacted by wind farm and renewable energy projects, to establish community engagement frameworks.⁶

3.16 Some of these recommendations were accepted and legislated by the government through amendments to Victorian planning law in April 2015. However, many of the problems that have been continuously raised by local councils, communities and affected residents, do not appear to have been addressed. The Victorian parliamentary inquiry found:

Local councils advised that they do not currently have the capacity, expertise and resources to act as the responsible authority for wind farm projects of less than 30 megawatts. Councils identified the cumulative impacts of wind farms and monitoring and enforcement arrangements as significant issues.⁷

3.17 Despite this finding, the new planning regime in Victoria makes the state Minister for Planning the responsible authority to issue permits for new wind farms, but local councils are the responsible authority for enforcement and compliance with the permit.⁸ The cost to local councils and ratepayers under this arrangement was raised as an issue of particular concern in the submission by Moyne Council:

Council is concerned that it will not be adequately financed by the State Government for planning permit compliance and that the general Moyne community should not have to subsidise the compliance of a major energy project.⁹

3.18 Submitters expressed frustration in the difficulties created in a complaints system with overlap between state and local governments:

Nobody is responsible, because, when I first made a complaint, I went to the state office in Ballarat. They said, 'We've got no-one here to know how to force compliance', and we got the same statement from the council that it is the department of planning's problem.¹⁰

6 Victorian Parliamentary Environment and Natural Resources Committee, *Inquiry into the Approvals Process for Renewable Energy Projects in Victoria*, pp. XXIII – XXV, http://www.parliament.vic.gov.au/images/stories/committees/enrc/renewable_energy/report/Recommendations.pdf (accessed 20 July 2015).

7 Victorian Parliament Environment and Natural Resources Committee, *Inquiry into the Approvals Process for Renewable Energy Projects in Victoria*, p. XV, http://www.parliament.vic.gov.au/images/stories/committees/enrc/renewable_energy/report/Executive_summary.pdf (accessed 20 July 2015) (accessed 20 July 2015).

8 Victorian Department of Environment, Land, Water and Planning, *Committee Hansard*, Melbourne, 9 June 2015, p. 8.

9 Moyne Shire Council, *Submission 460*, p. 5.

10 Mr Noel Dean, *Committee Hansard*, Melbourne, 9 June 2015 p. 20.

3.19 As outlined in the *Capacity of authorities* section below, even in the event local councils are willing to accept an enforcement and compliance role, they lack the expertise and funding required by this important role. A more detailed discussion of monitoring and compliance issues is undertaken in Chapter 4 of this report.

3.20 Furthermore, the Moorabool Council states that the back and forth movement between state and local government as to who is the responsible authority has added to confusion about who is responsible for the issue of permits and ongoing monitoring of compliance. The Council is also concerned where the State Planning Minister has extended permits without consultation with Council.¹¹

3.21 Former Cape Bridgewater resident Ms Joanne Kermond noted in her submission:

Some seven years after the commissioning of the Cape Bridgewater Wind Farm, neither the council (which incorporated the Portland Wind Energy Project into its planning scheme in 2004) nor the Minister (who issued the permit against the recommendations of the VCAT panel and a government appointed panel) are prepared to formally accept the responsibility for the enforcement of noise conditions attached to Portland Wind Energy Project's planning consent.

The Victorian Minister for Planning has never formally determined that he is satisfied that the Cape Bridgewater Wind Farm has met compliance with condition 13 and so Pacific Hydro still has the unmet obligation to demonstrate that the power station is compliant with the noise conditions set out in its conditionally issued planning consent.

It is my understanding that no authority has determined Cape Bridgewater Wind Farm's compliance, no authority is prepared to take responsibility for the enforcement of noise conditions attached to the Portland Project's planning permission, and no authority has made itself available to seriously address our concerns. We are simply told to direct our complaints to the wind farm company.¹²

3.22 Glenelg Shire Council told the committee that the Council does not have the technical capacity to enforce conditions of consent and nor does it have the authority to do so to the extent that the Minister is satisfied. The Minister reasons that Council is now the responsible authority for Portland Wind Energy Project because the PWEP was incorporated into the Glenelg Planning Scheme. Although the Minister for Planning is unwilling to accept responsibility for noise conditions of the Portland Wind Energy Project, he was quite prepared to use his powers to intervene, amend the

11 Moorabool Shire Council, *Submission 375*, p. 1.

12 Ms Joanne Kermond, *Submission 211*, p. 5.

permit and extend the same permit's expiry date to assist the developer to obtain finance which would allow Stage 4 of the project to be completed.¹³

Planning frameworks: South Australia

3.23 South Australia is the largest producer of wind energy in Australia. The South Australian government website notes that 'as of June 2014, South Australia hosts the bulk of the nation's installed capacity'.¹⁴ As the South Australian Government noted in its submission:

South Australia has established itself as the nation's leader in wind energy investment having attracted 41% of the nation's installed capacity. Indeed, South Australia has an international reputation, and if it were a nation state would be second only to Denmark in its amount of wind energy penetration.¹⁵

3.24 On 18 October 2012, the Minister for Planning approved the Statewide Wind Farm Development Plan Amendment (DPA).¹⁶ Under the DPA, planning and development assessment is encouraged to remain under existing local Council processes, although the SA Government notes that 'all wind farm development applications in South Australia are referred to agencies for comment to assist with the development assessment'. It adds:

Once a wind farm development application is lodged with the assessment authority there are statutory public consultation time periods and the ability for community members to make submission to the assessment authority on the development.¹⁷

3.25 However, some councils have expressed dissatisfaction with this process. The District Council of Yankalilla submitted that:

The State agencies (Environment Protection Authority (EPA) and Dept. Health) seem to be poorly set up to help Local Government get another perspective on sometime complex technical information about windfarm proposals. In the past it has not been possible to get their expert staff to

13 The committee has in its records an email dated November 2013 from the Victorian Department of Planning and Community Development Pacific Hydro to Ms Sonia Trist. The email notes that the second extension of the expiry date was done to allow stage 4 of the Portland Wind Energy Project to be completed.

14 South Australian Government, *Wind energy in SA*, <https://www.sa.gov.au/topics/water-energy-and-environment/energy/energy-supply-and-sources/renewable-energy-sources/wind-energy/wind-energy-in-sa> (accessed 5 June 2015)

15 South Australian Government, *Submission 59*, p. 1. Presumably, 'penetration' refers to a per capita basis.

16 See: https://www.sa.gov.au/_data/assets/pdf_file/0020/17660/DPA_Minister_Approved_Statewide_Wind_Farms_DPA_Gazetted_18_October_2012.PDF

17 South Australian Government, *Submission 59*, p. 7.

brief Councils /Development Assessment Panels during the rather constrained timeframe for processing Development Applications.¹⁸

3.26 The DPA identifies 'rural type zones' in the state which are classed as Category 2 developments and not subject to third party appeal rights. The exception to this is where a turbine falls within two kilometres of a non-associated dwelling or township type zone. If a turbine falls within two kilometres, then the wind farm will be classed as Category 3 and subject to third party appeal rights.¹⁹

3.27 Furthermore, the DPA limits public consultation requirements to:

...public consultation with neighbours but reserves widespread public consultation for those proposals that include one or more turbines located less than 2000 metres from: an existing or approved dwelling; tourist accommodation; or potentially incompatible zone such as an airfield, residential or township zone.²⁰

3.28 In addition, the DPA established that wind turbines:

- need to be setback at least 1km from non-associated dwellings and tourist accommodation; and
- need to be setback at least 2km from defined urban and township zones.

3.29 Responses from local councils in South Australia to this planning regime have not been positive. The Southern and Hills Local Government Association, which comprises seven South Australian local Councils submitted that:

Although the vast majority of our member Councils have not been party to or processed any Wind Farm Development applications it is generally felt the policies contained in the Development Plan following the State Amendment referred to earlier provide little guidance for Councils and Landowners.²¹

3.30 Enforcement of conditions such as noise levels is a confusing joint responsibility of local councils and the South Australian Environment Protection Authority. Submitters have stated that the agency is poorly funded and unable to properly conduct its compliance function.²²

18 Southern and Hills Local Government Association, *Submission 85*, p. 8.

19 Government of South Australia, Renewables SA, *Wind farm Planning Policy*, <http://www.renewablessa.sa.gov.au/proponents-guide/wind-farms> (accessed 5 June 2015).

20 South Australian Government, *Submission 59*, p. 7.

21 Southern and Hills Local Government Association, *Submission 85*, p. 7.

22 Regional Council of Goyder, *Committee Hansard*, Adelaide, 10 June 2015, p. 34.

3.31 The committee received considerable evidence from residents in regional areas of South Australia expressing concerns with planning processes in South Australia.²³

3.32 Ms Nicki Morgan wrote in her submission:

The State's "fair and expeditious planning system" comes at the cost of a total loss of rights for those who must live near wind power stations. There are no provisions for fair and reasonable objections to be made or acted upon when they are made. Only the Councils of the Adelaide metropolitan area, the Barossa and McLaren Vale have wind power stations banned – the entire rest of the state (including one proposed within 50 metres of the Barossa Council area) is open with no reasonable objection acceptable by the authorities. Indeed, even Councils are powerless when they oppose them themselves. I am uncertain what the government means by "fair".²⁴

3.33 Ms Jackie Rovensky, who also made a submission to the South Australian Parliamentary inquiry, wrote in her submission:

...the SA Government changed its Planning Regulations to give virtually unrestricted access to the vast majority of the State, and to assist this process removing the Right of Appeal to approvals for these projects from its citizens. As a consequence of involvement of the industry in decision making there is no evidence of State Governments making any adequate Planning Regulations to manage community concerns, rather they have created planning regulations which favour the industry and ignore community concerns.²⁵

3.34 Mrs Karen Wilson referred in her submission to the Trustpower Palmer Wind Farm development:

My husband and I own a property adjacent to the proposed Palmer Wind Farm. We will be surrounded by up to 50 x 165 [meter] tall wind turbines ranging from 2.5 km to 10km...

We now live in fear that this will go ahead. We fear for our health, we fear for our safety in regards to bush fires as we live in the Adelaide Hills which is a high bushfire zone. We also fear that our property will be devalued. Trustpower have held public consultations and right from the beginning they have given us the impression its [sic] a done deal so we may as well get used to it. The Mid Murray Council have been intimidating to say the least. The SA state government have changed legislation to make sure these wind farms are approved. We have no third party right of appeal.²⁶

23 See *Submissions* 24, 56, 60, 89, 92, 108, 118, 122, 127, 159, 165, 231, 243, 246, 247, 332, 390, 392, 397, 418, 438, 441 and 464. See also *Proof Committee Hansard*, Adelaide, 10 June 2015, pp. 32–64

24 Ms Nicki Morgan, *Submission* 247, p. [1].

25 Ms Jackie Rovensky, *Submission* 89, p. 5.

26 Ms Karen Wilson, *Submission* 122, p. [1].

Planning frameworks: Queensland

3.35 Currently, local governments are the responsible authority for wind farm development approvals, assessing these proposed developments against their local planning schemes. However, there are no Queensland guidelines specific to the assessment of new wind farm developments or the expansion of existing wind farms.²⁷

3.36 Local councils have expressed frustration with the existing process for assessing wind farm proposals. In its submission, the Tablelands Regional Council identifies the problem with these arrangements:

Small regional councils are generally under-resourced, and lack the financial and technical capabilities and expertise required to deal with complex wind farm developments, or the associated monitoring and compliance. These difficulties are compounded by the state government's failure to develop and implement enforceable state-wide policies and standards for the wind farm industry, and to address the complexity and contradictions embedded in the existing state noise regulatory environment (as they apply to wind farms).²⁸

3.37 The Queensland Government submitted that it will change the responsible authority to a state-based agency, but did not indicate when that change would occur:

Future applications for wind farm development are to be assessed by the State Assessment and Referral Agency (SARA). SARA is the single lodgement and assessment point for all development applications where the state has jurisdiction, under the Sustainable Planning Act 2009 (SPA) — Queensland's principle (sic) planning legislation.²⁹

3.38 To support the new assessment process, the Queensland Government says in its submission that:

The department is preparing a draft Wind Farm State Code (the Code) which will be incorporated into the State Development Assessment Provisions (SDAP). The SDAP is a prescribed document that sets out matters of interest SARA may have regard to when assessing development applications. A Draft Wind Farm State Code Planning Guidelines (the Guideline) is also being developed to support the Code. The purpose of the Guideline is to assist proponents in preparing a thorough development application for a new or expanded wind farm.³⁰

3.39 In subsequent evidence presented to the committee's Cairns hearing, the Department of Infrastructure, Local Government and Planning stressed that the proposal to make SARA the responsible entity to assess wind farm developments has

27 Queensland Government, *Submission 413*, p. 2.

28 Tablelands Regional Council, *Submission 158*, p. 1.

29 Queensland Government, *Submission 413*, p. 2.

30 Queensland Government, *Submission 413*, p. 2.

not yet been considered or endorsed by the new Queensland Government. If the proposal for centralised planning approval is not implemented, the Department suggests the draft wind farm code could be used by local councils as a suggested code or guideline in assessing wind farm development proposals.³¹

3.40 However, there is no clarity as to whether this proposed regime will be similar to the new regime put in place in Victoria, where planning approvals are elevated to a state level, but responsibility for monitoring compliance with the approvals is left up to local councils. In its submission, the Tablelands Regional Council finds it unclear whether it or the state will be responsible for associated compliance and enforcement, and raised concerns that ratepayers could be responsible for significant enforcement and compliance costs.³² The council noted that in terms of the costs of compliance for the Windy Hill wind farm:

It is estimated to have directly cost taxpayers over \$200,000 in acoustic expert costs and legal fees, and a further \$50,000 in indirect costs such as officers' time.³³

3.41 Several submitters have criticised the role of the Queensland Government in relation to the Mount Emerald Wind Farm development. The Tablelands Wind Turbine Action Group told the committee:

Acknowledging the inadequacy of the planning scheme, the Council made several amendments (Temporary Local Planning Instruments) [TLPI] to assist in the wind farm assessment. However, the Queensland Government diluted the TLPIs in order to expedite the wind farm planning approval. The Queensland Government has also relaxed many of the standard regulatory arrangements for the Mount Emerald developers. For instance, the developers will not be required to have a permit to clear native vegetation under Queensland's Nature Conservation (Wildlife) Regulation 2006 because the works will be considered "for the purposes of electrical works". (When these Regulations were developed, electrical works of this scale were carried out by government agencies in response to public need for power. In this case, additional energy is not required, the developer is building turbines purely to take advantage of Federal Government regulations which assist renewable energy suppliers.) The Queensland Government has also withdrawn the requirement for the turbines to comply with remnant vegetation habitat regulations under the Vegetation Management Act 2009, and has refunded the developers' assessment fee.³⁴

3.42 The Tablelands Regional Council also highlighted the higher cost to councils of development decisions under the current planning regime:

31 Queensland Department of Infrastructure, Local Government and Planning, *Committee Hansard*, Cairns, 18 May 2015, p. 16.

32 Tablelands Regional Council, *Submission 158*, p. 2.

33 Tablelands Regional Council, *Submission 158*, p. 4.

34 Tablelands Wind Turbine Action Group, *Submission 230*, p. 6.

If council decides something then the developer, if it does not agree with that approval, can appeal that decision to the Planning and Environment Court, which can be a very costly process for the council. In a ministerial call-in situation, there is no right of appeal. That is the difference—council remains exposed to the consequences of their decision; the minister does not.³⁵

Planning frameworks New South Wales

3.43 The committee received evidence from Mr Robert Griffin and Mr Alwyn Roweth, both landholders near the proposed Flyers Creek wind farm in NSW. They related their experience of dealing with the proponent, Infigen Energy, and the NSW Department of Planning.³⁶

3.44 The committee has serious concerns about the manner in which the landholder contracts were signed and the quality of information that was made available to the landholders at the time of signing the contracts. The committee notes that the contracts with the three landholders have expired and that the host landholders do not wish to be part of the project. The committee also notes that the proponent has attempted to force an extension of the contracts on Mr Griffin, Mr Roweth and Mr Neville Obourne using a *force majeure* clause. Further, the NSW Department of Planning has:

- (a) confirmed to them in writing that the Department has not caused any of the delays that the proponent purports; and
- (b) granted a further extension on the already deferred commencement conditions, thereby placing Mr Griffin, Mr Roweth and Mr Obourne under significant pressure from the proponent.

3.45 The committee expressed its concern that the aforementioned gentlemen are not adequately resourced with legal representation. The committee also notes the intricacies of changes over recent years to the planning statutes in NSW. These changes have in effect taken away the community's right of appeal and have been the subject of recent investigations by Independent Commission Against Corruption (ICAC).

Capacity of local councils

3.46 Many submissions from different local government areas have questioned the capacity of local councils to implement a robust planning approval process for developments of significance, such as windfarms. Many of these submissions have come from local councils themselves:

Small regional councils are generally under-resourced, and lack the financial and technical capabilities and expertise required to deal with

35 Tablelands Regional Council, *Committee Hansard*, 18 May 2015, p. 30.

36 See: Mr Robert Griffin, *Submission 81*; Mr Alwyn Roweth, *Submission 182*.

complex wind farm development, or the associated monitoring and compliance.³⁷

3.47 Issues raised around the capacity of local councils to manage development applications of wind farms include:

- their lack of staff to properly run a development application process for large scale developments;
- their lack of technical expertise to assess developments, or to monitor compliance with planning or permit conditions;
- the lack of funds to litigate non-compliance;
- the absence of planning laws that adequately regulate large-scale industrial development; and
- the timeframes for consultation and feedback in local planning laws are not suitable for developments of such significance as they have been developed to address residential or smaller scale non-residential development.

Technical expertise

3.48 Moyne Shire Council submits that the burden on local councils to engage in the technical assessment of development applications is too high:

There is considered to be an imbalance in the process as the applications are supported by technical and expert reports covering a wide range of topics many beyond the expertise provided by the functions of local government. To adequately consider, address and respond to either a planning permit application, a referral from the Minister for Planning or to an EES [Environmental Effects Statement] process, creates a large and expensive resource burden on both Council and the local community.³⁸

3.49 Moyne Shire Council proposes a solution, citing the approach taken in assessing the development proposals of other kinds of major industrial and infrastructure projects. The council submits that those processes have a layered approach to approvals, with planning permit approval assessed first by local councils, then works authority or aspects relating to technical issues undertaken by State Government or its agencies, which are more technically resourced.³⁹

3.50 The Pyrenees Shire Council cites similar concerns:

...resourcing issues will arise due to the significant amount of officer time and specialist technical skills required to assess complex matters such as blade flicker, cumulative impacts and noise assessments.

37 Tablelands Regional Council, *Submission 158*, p. 1. This position is echoed in submissions from other local councils. See *Submissions 47, 85, 375, and 460*.

38 Moyne Shire Council, *Submission 460*, p. 4.

39 Moyne Shire Council, *Submission 460*, p. 4 and pp 6–7.

There will also be a need to engage specialist consultants to assist with the assessment of noise reports.⁴⁰

3.51 The Pyrenees Shire Council recommends the State Government resource regional offices of the Environmental Protection Agency with wind farm coordinators with access to technical experts. The council further recommends these regional offices should be responsible for ensuring compliance with wind permit conditions.⁴¹

Financial burden

3.52 Local councils have submitted that the financial burden of both assessing development applications and ongoing monitoring of compliance is very high. Moyne Council points out state-regulated planning fees are set to a maximum planning permit fee of \$16 130, yet the council estimates their costs in assessing a wind farm proposal to be in the vicinity of \$250 000.⁴²

3.53 Moorabool Council puts forward a similar position to Moyne Council on the cost to council, stating that rates income generated per tower is not adequate compensation for councils' costs.⁴³

3.54 Individual submitters have pointed out that this financial burden is actually borne by local residents, who pay for local councils costs through rates:

The ongoing issues at Windy Hill place a considerable burden on staff resources, as well as significant legal costs that must be borne by the Council (and therefore ratepayers).⁴⁴

3.55 Another key cost raised by councils is the damage to roads caused by heavy vehicles accessing small country roads during construction of wind farms:

There has been no offer to the TRC [Tablelands Regional Council] by the developers to make good damaged roads, nor any commitment of any kind in respect of future costs to the TRC. The TRC is aware of the complaints of the Moyne Shire Council to effect that millions of dollars in road damage has occurred. It is also aware that the TRC road system is not sufficient to withstand the expected number and weight of movements from the Palmerston Highway to the site.⁴⁵

40 Pyrenees Shire Council, *Submission 47*, p. 2.

41 Pyrenees Shire Council, *Submission 47*, p. 3.

42 Moyne Shire Council, *Submission 460*, p. 5. This view is echoed by the Regional Council of Goyder, *Committee Hansard*, Adelaide, 10 June 2015, p. 33 and p. 35.

43 Moorabool Shire Council, *Submission 375*, p. 3.

44 Tableland Wind Turbine Action, *Submission 230*, p. 14.

45 Ms Marjorie Pagani, *Submission 340*, p. 4. This concern is echoed by Moorabool Shire Council. See *Submission 375*, p. 2 and Regional Council of Goyder, *Committee Hansard*, Adelaide, 10 June 2015, p. 33.

3.56 Local residents have also raised the impact to local roads as a concern. The McMillan family proposed a solution whereby wind farm developers would be required to place funds in trust to repair damage to roads, so that this financial burden did not fall to ratepayers.⁴⁶

Lack of resources

3.57 Submitters pointed to a lack of resources that local councils were able to put towards assessing development applications as well as compliance monitoring.

3.58 The Tarwin Valley Coastal Guardians (TVCG) noted in its submission that the South Gippsland Shire Council was under-resourced to fulfil its compliance responsibilities in relation to the Bald Hills Wind Farm:

In December, 2013 TVCG formally petitioned SGSC asking it to be diligent and proactive in its role as lead regulatory agency for the BHWEF planning permit. We were not confident that Council had dedicated any additional resources to support this role.⁴⁷

3.59 Later in the submission, TVCG states:

We believe the project's size and the complexity of its development plans required SGSC to assign a full time compliance officer to monitor the project, document observed breaches, liaise with local residents and initiate necessary enforcement action. This never happened. Over the full twelve-fourteen months of construction, we are aware of SGSC senior officers visiting the site four times.

TVCG members started asking that they do so in January, 2014. By September 2014 TVCG members, local residents and their lawyers had lodged approximately ten formal written complaints to SGSC and attended four or more meetings, including two with the entire elected Council, to report alleged breaches and voice concern about SGSC inaction.⁴⁸

Inappropriate local planning laws

3.60 Submitters discussed the problems faced in using local development planning laws to assess and approve large scale industrial developments such as wind farms. One issue raised was that local planning laws do not allow for assessment of developments that impact more than one council region:

Wind farms are large developments, and while they are a land use covered by the planning system, we see them as being a quite different land use to our normal planning permit applications, on the basis that they are usually a

46 McMillan Family, *Submission 29*, p. 5.

47 Tarwin Valley Coastal Guardians, *Submission 45*, p. 28.

48 Tarwin Valley Coastal Guardians, *Submission 45*, p. 29.

development over multiple titles of land, over hundreds of hectares of land stretching for kilometres.⁴⁹

3.61 This problem was highlighted by the case of the Mount Emerald Wind farm, where 90 per cent of people within 5 kilometres of the proposed were excluded from the development decision-making process because they lived in a different local government area to the wind farm site.⁵⁰

3.62 Another problem raised by submitters, is that there is no capacity in local planning laws to assess cumulative impacts—each development application must be assessed as a stand-alone application.

The issue of assessing the cumulative effect from large projects is an important issue, given the potential for greater landscape, visual and noise impacts.

Appropriate triggers need to be introduced (based on combined project size and their proximity to each other) that should be used as a mechanism for the Planning Minister to call in such proposals to ensure a co-ordinated process is followed in assessing such proposals. Without amendments to current state guidelines there is no capacity for a joint consideration of combined impacts from large projects.⁵¹

Consultation

3.63 Submitters have discussed problems faced by residents and local communities during the process of consultation undertaken by wind farm proponents, both during the initial scoping phase as well as the consultations during the formal planning approval phase. Serious concerns have been raised with the manner in which various wind farm companies have engaged with local communities when seeking prospective wind farm hosts, as well as a lack of quality and accurate information provided during formal community consultations.⁵²

Pre-application consultation

3.64 Local resident submitters raised concerns with how wind farm companies enter into what they describe as secret negotiations and discussions with hosts:

Host farmers were required to sign confidentiality agreements that emphasised lack of disclosure with neighbours, the beginning of the

49 Moyne Shire Council, *Committee Hansard*, Melbourne, 9 June 2015, p.44.

50 Tablelands Regional Council, *Committee Hansard*, Cairns, 18 May 2015, p. 34.

51 Pyrenees Shire Council, *Submission 47*, p. 3. This concern was also raised in *Submissions 119m, 227e, 232a, and 326*.

52 Concern with consultation was raised in a number of submissions. In particular see *Submissions 32, 108ss, 109, 180, 195, 198, 206, 208, 225, 230a, 232, 252, 281a, 285, 314, 316b, 336, 339, 340, 394 and 415*. This issue was raised at all public hearings with community participants.

dreadful wedge that has riven our community, overwhelmingly against this initiative.⁵³

3.65 The quality and detail of information provided to communities at the pre-proposal stage was raised. Submitters have also discussed the level of information provided to prospective wind farm hosts as being difficult to gauge, due to non-disclosure rules in agreements. Other submissions discussed the lack of quality information provided to non-host residents at the pre-approval stage had negative impacts on the later community consultation phase:

In Yankalilla's experience in assessing a Development Application (DA), we received substantial public comment and our Development Assessment Panel (DAP) went on to hold 2 or 3 meetings just to give sufficient item for presenters to make their verbal (and Audio Visual) presentations in relation to their objections. It would have been good if a series of pre-application public information sessions could have been given by the proponent of the windfarm application in the lead up to the actual formal DA process.⁵⁴

3.66 Some submissions raised concerns over the manner in which wind farm companies interacted with individuals. The McMillan family describe being pressured to sign a contract:

After this interview with them in December 2013 we were receiving 18-20 phone calls per day pushing us to sign their contract. This went on for 5 months, we got caller ID on our phone line so that we could just let the calls go through to the answering service, as well as an alarm on our driveway due to them continually calling in to get the contract.⁵⁵

3.67 Mr David Mortimer noted a similar negative experience of dealing with wind farm developers in his submission:

As a recent turbine host, we have first hand experience of the way in which wind farm developers work in securing willing turbine hosts and creating compliant governments at all levels.

Once a wind farm developer has chosen a suitable area of land, he begins to infiltrate the community and win the hearts and minds of the locals with promises of community funding, and endearing themselves with the prospective hosts with one on one sessions around the kitchen table with strong requests not to discuss matters with neighbours or any others. These days, it is common in the up front "option to lease" document to include a confidentiality or gag clause preventing any such communication.⁵⁶

53 Heartland Famers, *Submission 183*, p. 67. This was echoed in *Submission 214*.

54 Southern and Hills Local Government Association, *Submission 85*, p. 7.

55 McMillan Family, *Submission 29*, p. 1.

56 Mr David and Mrs Alida Mortimer, *Submission 24*, p. [2].

3.68 Mr Richard Paltridge also submitted that gag clauses negatively impact on community consultation:

There had been no public/community discussions in public between residents in the district about the project, even though it is now evident Acciona had been speaking with landholders since around 2005 as they were seeking those willing to accept payment to have turbines on their land. I was not one of those approached. They had also held Community Group meetings, but it is unknown which groups and how many are supported by other than a few of the local community.

That not many realised what was happening and how advanced the work on the project proposal is directly a result of all those contacted by Acciona were required not to speak publically about the project or their meetings with Acciona.⁵⁷

3.69 The South Australian Government submitted that the positive practices of Trustpower enables non turbine hosts to benefit financially from wind farm developments:

An example of good practice in South Australia is the Trust Power Palmer Wind Farm development. The company sends regular newsletters to stakeholders, has undertaken community meetings and employed a community liaison person who lives in the local area to assist with information dissemination. They have developed the concept of neighbourhood agreements whereby non-host residents who live nearby a wind farm, but who are not hosts, can benefit financially from the development.⁵⁸

3.70 The committee heard further evidence from Trustpower Ltd that they had not had any operational concerns raised on any of their projects in New Zealand or South Australia. They attributed this to the combination of strong community consultation processes, particularly in the pre-lodgement phase, combined with financial benefits for neighbouring landowners.⁵⁹

Post application consultation

3.71 There was a wide range of evidence presented on problems encountered by individuals, community groups and local councils during the consultation phase mandated by planning laws. Concerns included the paucity of accurate information provided by proponents, the lack of real community engagement, too-short consultation phases compounded by communities finding out about developments well into the planning state instead of near the beginning. Some submitters also identified a tendency for some councils to have already decided in favour of a development prior to the public consultation phase.

57 Mr Richard Paltridge, *Submission 367*, pp. 1–2.

58 South Australian Government, *Submission 59*, p. 8.

59 Trustpower Ltd, *Committee Hansard*, Adelaide, 10 June 2015, pp. 25–27.

3.72 Submitters have presented evidence that wind farm proponents use various strategies to reduce the capacity of people to organise themselves into groups that improve community advocacy during the consultation phase. The Bodangora Wind Turbine Awareness Group wrote that the wind farm company preferred to meet with individuals rather than groups:

Infigen (the proponent in this instance) have refused to meet with the BWTAG or any groups of neighbouring property owners, despite numerous requests. They (the proponent) prefer 'one on one meetings'.⁶⁰

3.73 Heartland Farmers had a similar experience and submitted:

Suzlon representatives were asked to meet with the Heartland Farmers in January this year. This meeting was refused as Suzlon failed to recognise the Heartland Farmers as a legitimate group and demanded the names and details of the individual members.

Suzlon have failed to attend open meetings that are not controlled by them, failed to respond to telephone messages, faxes and messages on their blogs.⁶¹

3.74 Heartland Farmers also provided an experience of one member in their submission:

The first we knew of how many would be on my boundary was when the maps were released by Suzlon on the Information Day in January 2013. At these meetings, Suzlon's representatives controlled the interaction with our farmers by allowing only 25 to listen to a presentation. Their tactic was to not allow questions from the floor and asked everyone to move to the back of the room and ask questions one---on---one rather than use an open style forum which would have then shared information amongst the wider group. These meetings were held in Curramulka, Port Vincent and Port Julia, the smallest towns, venues with limited space. Why did they choose small venues? Why didn't they use town halls in Maitland and Minlaton? Because that way they could limit the numbers to 25 people at a time. They knew that a farmer---filled Minlaton Town Hall with an open forum would be a PR disaster.⁶²

3.75 The McMillan family found that the public consultation events were tightly controlled by the wind farm proponents:

Their public consultation has been non existent to the extent that the only meeting they organised was only open to pro-wind people by email invitation, where your email had to be shown at the door to be able to get in. If you were not pro wind you could not get in.⁶³

60 Bodangora Wind Turbine Awareness Group, *Submission 227*, p. 3.

61 Heartland Farmers, *Submission 183*, p. 68.

62 Heartland Farmers, *Submission 183*, p. 67.

63 McMillan Family, *Submission 29*, p. 1.

3.76 Evidence from a number of submitters questioned the community survey results that are published by wind farm proponents which claim community support for the project:

Melbourne based Suzlon describe the support in the community as overwhelmingly good. One could only say this from Collins Street, having spent no time consulting a community that we know has overwhelmingly voted to stop this project. The Council of this community, along with the coastal progress associations of Black Point, Port Julia and Sheoak Flat have unanimously rejected this proposal at recent meetings.⁶⁴

3.77 Ratch-Australia (RATCH) presented evidence that the pre-development community survey of the Mount Emerald wind farm found that 70 per cent of people were supportive of the project.⁶⁵

3.78 However, the Tablelands Regional Council contends that the survey was framed to provide a positive response to the proposed wind farm, as it included many respondents living a long distance from the wind farm.⁶⁶ The survey demographics shows that 400 people in total were surveyed: 59 per cent of respondents lived over 15 kilometres from the proposed site and only 19 people surveyed (5 per cent) lived less than 5 kilometres from the proposed site.⁶⁷ Conversely, the Tablelands Regional Council states that around 2 500 people live within 5 kilometres of the proposed site, with a total of around 3 500 people within 10 kilometres.⁶⁸

3.79 In comparison, the Tablelands Regional Council quoted results from a community-citizen funded survey:

When the community citizens got together and did a very professional survey, which was open and transparent and available to RATCH for comment and criticism, 700 residential addresses within five kilometres were posted to, and the reflection there was: 91.7 [per cent] did not support, 3.5 [per cent] did support and neither way was 4.8 [per cent].⁶⁹

3.80 Other submissions have highlighted a problem with the quality and accuracy of information provided during the consultation phase:

The Community Engagement Process has been less than satisfactory. We had received information from the initial developers, we never received information from Acciona. Indeed our residence, as many other local homes

64 Heartland Farmers, *Submission 183*, p. 69. See also *Submissions 89, 230, 316, and 459*

65 Ratch-Australia, *Committee Hansard*, Cairns, 18 May 2015, p. 6.

66 Tablelands Regional Council, *Committee Hansard*, Cairns, 18 May 2015, p. 29.

67 The survey can be found on the Ratch-Australia website at: http://ratchaustralia.com/mt_emerald/mewf_eis_docs.html. For demographics see [Vol 3 – App. 9 – Stakeholder Consultation Program Appendix C](#), p. 40, (accessed 20 July 2015).

68 Tablelands Regional Council, *Committee Hansard*, Cairns, 18 May 2015, p. 27.

69 Tablelands Regional Council, *Committee Hansard*, Cairns, 18 May 2015, p. 29.

were not on their maps, even though most of them have been there for a minimum of thirty years.⁷⁰

...

The level of community consultation undertaken by developers has been abysmal and any that was undertaken generally ignored community concerns. There has been a less than honest approach by developers in relation to noise, shadow, blade flicker affects and visual amenity on residents.⁷¹

...

The developers have attempted to minimise any opposition by withholding information, incorrectly presenting data and rejecting community concerns about the project. Throughout the planning process, they have tried to keep details as vague as possible and have avoided any meaningful stakeholder engagement.⁷²

...

In their proposal RATCH says that they have contacted the volunteer fire brigade and have permission from us to access all our water supplies and get help from us if they should have a fire. My father is the secretary, and no-one has ever been contacted by RATCH with regard to firefighting on the mountain. It shows that they write what they think people want to hear, and they are not actually talking to the people on the ground.⁷³

3.81 Some submitters provided evidence that communities had only 10 days in which to respond to development proposals, and stated that this was not enough time for people to research a complex issue and write comprehensively of their concerns.⁷⁴ This was compounded by the situation where projects were well into the late planning stages before communities became aware a wind farm was being proposed in their area.⁷⁵ It reaffirms the point made in evidence by the Queensland Department of Infrastructure, Local Government and Planning official: 'the department formed the view that we cannot say no to any wind farms'.⁷⁶

70 Ms Bernadette Janssen, *Submission 195*, p. 2.

71 Upper Hunter Landscape Guardians Inc, *Submission 58*, p. 2.

72 Tablelands Wind Turbine Action, *Submission 230*, p. 9.

73 Ms Hewitt-Stubbs, *Committee Hansard*, Cairns, 18 May 2015, pp. 58–59.

74 Mr Richard Paltridge, *Submission 367*, pp. 2–3. This was also raised by The District Council of Yankalilla within *Submission 85* from the Southern and Hills Local Government Association.

75 Mr and Mrs David and Maureen Coleman, *Submission 262*, p. 1. Late notification of communities to a proposed wind farms was also discussed by Mr Tony Edney, *Submission 214*, p. 2.

76 Mr Greg Chemello, *Proof Committee Hansard*, 18 May 2015, p. 24. See paragraph 2.43.

Consultation Case Study: Mount Emerald Wind Farm

3.82 The Mount Emerald Wind Farm development was proposed by the partnership of RATCH Australia and Port Bajool. The site is private land on the plateau adjacent to the Mt Emerald / Springmount area, approximately halfway between Mareeba and Atherton, five kilometres west of Walkamin.⁷⁷ RATCH is proposing to build 63 wind turbines generating up to 189MW of power from this site. The towers will be approximately 80 to 90 metres high with approximately 50 metre blades, utilising 3 MW machines.⁷⁸

3.83 On 24 April 2015, the Queensland Government approved the development application for the Mount Emerald Wind Farm. The Deputy Premier and the Minister for Infrastructure, Local Government and Planning, the Hon. Jackie Trad MP, said:

I have listened first-hand to the community's concerns regarding the proposed development, particularly in relation to potential noise, traffic and environmental issues. As part of the approval, the State requires the proponent, Mount Emerald Wind Farm Pty Ltd, to comply with a number of strict conditions, including daytime and night time noise limits which are equal to, or better than, standards in other states like Victoria and South Australia.⁷⁹

3.84 In explaining the decision to approve the project, the Queensland Government stated:

- the approval also includes a condition requiring all turbines to be located at least 1.5km from any existing dwelling;
- the applicant is also required to submit detailed traffic and environment management plans for approval prior to construction commencing; and
- the approval also includes conditions requiring the applicant to undertake community consultation prior, during and post construction to ensure any community concerns are addressed, as well as the establishment of a hotline and complaints register to ensure any community concerns are appropriately managed.⁸⁰

77 Mount Emerald Wind Farm, <http://mtemeraldwindfarm.com.au/> (accessed 10 May 2015).

78 Mount Emerald Wind Farm, <http://mtemeraldwindfarm.com.au/> (accessed 10 May 2015).

79 The Hon. Jackie Trad MP, Deputy Premier of Queensland and Minister for Infrastructure, Local Government and Planning, 'Wind Farm to contribute to FNQ energy security', Media Release, <http://statements.qld.gov.au/Statement/2015/4/24/wind-farm-to-contribute-to-fnq-energy-security> (accessed 24 April 2015).

80 The Hon. Jackie Trad MP, Deputy Premier of Queensland and Minister for Infrastructure, Local Government and Planning, 'Wind Farm to contribute to FNQ energy security', *Media Release*

3.85 The inquiry has received evidence from numerous submissions concerned with the community consultation processes for this development. In his submission, Mr Ian Parker states:

Ratch has presented its case at all legislative levels and to the media as a benign and much needed investment in Far North Queensland, making out that it has met all requirements demanded in law for such a development. Yet in doing so it has lied over many issues. Among them claiming to have canvassed and received favourable local opinion on its proposal. It never did so in the areas contiguous to the wind turbine site.⁸¹

3.86 Ms Jennifer Disley and Mr Jack Krikorian submitted they were approached in 2007 by the Port Bajool developers who sought to sell them 100 acres of land. They describe RATCH and Port Bajool's behaviour as 'unethical and condescending'.⁸² They note that 'the assessment on Community Impact has never been done. This is a part of normal application process and has been bypassed'.

3.87 Ms Disley and Mr Krikorian also offered the following criticisms of their experience with the consultation process:

I personally invited RPS Consultant, David Finney to my property on 5 separate occasions, so that I could show him our community and the number of enterprises which employ large numbers of employees. His response, "I know your road, I drove down it once". As locals we found this contemptuous.

On following community development guidelines for windfarms, Port Bajool stated that they had done letter drops of their newsletters. We do not have a rural delivery service here, and we do not have letter boxes. The local Postmistress has never been given any information from the wind farm developers....

Politicians and media have always been told that there is only a handful, or 5-6 people who object to the wind farm. The action group has an emailing list hundreds of people long for those objectors in the area who want to keep up with the information.

Ratch conducted via a Melbourne Firm, a phone survey regarding the wind farm. Their survey did not include local people to the wind farm. One third of the people questioned resided over 20 kms away. No one on Channel Road was interviewed, i.e. some of the most impacted people. With over 100 residents on Channel Road it is surprising they could not find one person to contact. 80% of people surveyed said they knew nothing of Mt Emerald...

John Morris and Jim Noli visited a few of the neighbouring farmers. They stated they would get back with the information sought. To date there has never been a second visit or information offered.

81 Mr Ian Parker, *Submission 236*, p. 1.

82 Ms Jennifer Disley, *Submission 290a*, p. 6.

During some council meetings, despite Ratch stating they were open and transparent, council sessions were closed and the public had to leave. I have been shut out of one of their meetings during the public session as were all other members of the public.

3.88 Ms Krista Watkins, a resident of Walkamin, wrote in her submission:

We had in fact been completely lied to, given false information by the proponent and in no way shape or form had the community been advised, consulted or provided information. We had been privy to the lies and deceit due to the venue of the "meetings". We only researched the project ourselves because a good Samaritan informed us that we might want to research it ourselves.⁸³

3.89 The committee has received evidence from a number of submitters relating to RATCH and the Mt Emerald wind farm development. John and Grace Cargan, in their submission, stated that 'RATCH Australia, in an attempt to be transparent, put the original development application on their website but when we started asking questions they removed it'.⁸⁴

3.90 Expectations that the development would not impact local agriculture have not been followed through with by RATCH or its representatives. This specifically relates to the aerial spraying industry:

At that time we expected to be presented with a draft written assurance that our ability to service our customers would not be affected by the wind farm development, however this did not eventuate.⁸⁵

3.91 In its submission, the Tablelands Wind Turbine Action (TWTA) Group suggests that the developers have not engaged in good faith with the community stating that 'ongoing betrayal and disrespectful behaviour [has] destroyed our community's trust in the Mount Emerald developers'.⁸⁶ TWTA further submits:

- there has been no consultation about fundamental changes to the project, (e.g. number of turbines and sizes of turbines);

83 Ms Krista Watkins, *Submission 244*, p. 1.

84 Mr and Mrs Jon and Grace Gargan, *Submission 236*, p. 1.

85 Mr Mark McDonald, *Submission 223*, p. 2. The submitter raises the issue of turbulence and the unknown impacts this will have on spraying operations. See also: Ms Marjorie Pagani, *Submission 340*, p. 6. This submitter contends that the wind farm will lead to 'curtailments of plant disease control, and of overspray' in addition to 'light aircraft dangers, and possible restrictions on further airport development'.

86 This approach has been noted by other submitters. Ms Krista Watkins, *Submission 244*, p. [1]. Ms Watkins noted that the proponents were telling people in 2012 that they 'were planning to put "a couple of wind turbines, way back over the mountain range, you won't hear them or see them"... We had in fact been completely lied to, given false information by the proponent, and in no way shape or form had the community been advised, consulted or provided information.'

- the EPBC Act referral documents were released for community consultation over the Christmas period;
- there has been a misrepresentation of the number of receptors to government;
- there has been a misrepresentation of 'surveys' to demonstrate support for the project that is not apparent;
- there has been a lack of engagement on community concerns and 'denigration and rejection' whenever valid issues have been raised; and
- there have been extraordinary claims made by the proponents including that:
Some prospective buyers were told by Port Bajool they would not see or hear the wind farm because "sound travels upwards" and they signed away both their rights to object, and their rights to compensation from the developer.⁸⁷

3.92 TWTA notes that 'attempts to buy the community should be banned', citing the following examples:

- The developers sponsorship of the Mareeba Chamber of Commerce; the Chamber supports the wind farm.
- Port Bajool are Executive Members of Advance Cairns at a cost of \$20 000 per annum; Advance Cairns supports the Mt Emerald wind farm as a regional priority.
- The developers have proposed sponsoring a community benefit fund for \$200 000 per annum. There is a concern this will bias the decision making process for the project approval.
- The developers offered Tolga State School \$10 000 in the early stages of project scoping. This donation was refused on the basis that 'schools are places for teaching and learning'.⁸⁸

Consultation frameworks

3.93 Generally, community consultations for development approval are requirements under the relevant planning provisions in each state or territory. Some jurisdictions, such as Victoria, have additional consultation requirements specific to wind farm developments. The committee notes the reported widespread inaccuracy of community consultation in all States.

3.94 The Victorian Government first published the 'Policy and planning guidelines for development of wind energy facilities in Victoria' in 2003 and was last updated in 2015 to reflect policy changes and to update information. In its submission, the

87 Tablelands Wind Farm Action, *Submission 230*, pp 9–11.

88 Tablelands Wind Farm Action, *Submission 230*, pp 9–11.

Department of Economic Development, Jobs, Transport and Resources summarises the guidelines as follows:

The guidelines encourage proponents to undertake pre-application engagement with decision makers and the community. They provide clear information for prospective wind farm hosts about the planning process under the *Planning and Environment Act 1987*. The information is targeted for use by proponents, decision makers and the community on the planning approval process, matters considered by decision makers, and to provide links to other information sources. It also includes model permit conditions to provide consistency.⁸⁹

3.95 The Clean Energy Council has also prepared guidelines for wind farm development proposals. They have developed a guide to best practice community engagement for the wind industry, and a guide for communities on the steps to expect in a wind farm development project.⁹⁰ However, both the Victorian Government and the Clean Energy Council guidelines are not enforceable.

3.96 However, the ACT Government has developed a mechanism to ensure quality consultation is financially rewarded. Such a mechanism could be replicated in other jurisdictions. In its submission, the ACT Government outlined a method it used to incorporate community engagement criterion into the assessment of proposals submitted to its 2014/2015 wind auction.

The community engagement criterion accounted for twenty per cent of the assessment score of each wind auction proposal. Proposals that were able to demonstrate good community engagement practices throughout all stages of their development were assessed favourably against this criterion.⁹¹

3.97 The committee's view is that improvements to community consultation processes are urgently required across all jurisdictions, and a mechanism to ensure compliance must be incorporated into the National Wind Farm Guidelines, as outlined later in this chapter.

Improvements to planning processes

3.98 A large volume of evidence has been provided to this inquiry, outlining significant problems encountered by local councils, residents and wind farm proponents in the development approval process for wind farms.

89 Victorian Department of Economic Development, Jobs, Transport and Resources, *Submission 112*, p. 6.

90 Clean Energy Council, *Committee Hansard*, Melbourne, 9 June 2015, p. 2. These two guides are available on the Clean Energy Council website, <http://www.cleanenergycouncil.org.au/technologies/wind-energy.html> (accessed 20 July 2015).

91 ACT Government, *Submission 12*, p. 2.

3.99 Different jurisdictions are taking different approaches: in some places local councils are responsible for all aspects of development approval including sources technical consultants. In other states, councils are provided technical support from state governments. While some jurisdictions have moved to elevate development decision-making to a state agency level, monitoring and compliance enforcement of state agency-made development decisions are left to local councils. Where state agencies are making development decisions, often there is no input sought from councils regarding their knowledge of local region development constraints or needs.

3.100 Moyne Council recommends a two tiered approach, where local council grants planning approval, but there is also an approval to operate. This second approval process would be the mechanism to assess technical aspects, and would also be the appropriate mechanism to conduct monitoring and compliance. The council also recommended:

...there is a role for the Commonwealth to set the standards but I think the actual enforcement and meeting of those standards could best be dealt with maybe through a state agency.⁹²

3.101 The Clean Energy Council argued that planning for wind farm development should remain with the state governments:

Certainly in our view the states have worked hard over the years to evolve their planning schemes as they relate to our sector.⁹³

I think consistency in approaches across jurisdictions is something that we generally welcome as a principle. I think it can make things more straightforward from an industry perspective and from a community perspective. But, as I said, I think fundamentally that is a question for the regulators in each of those jurisdictions to pass judgement.⁹⁴

3.102 The committee's view is that it is clear from the range of evidence presented that no single jurisdiction in Australia has yet developed an appropriate system of decision-making for planning approvals of wind farms. Such a system would ensure that aspects relevant to local knowledge, such as traffic impacts and facilitating community consultation would be the responsibility of local councils, while technical aspects of evaluating development proposals would be the responsibility of the state-level agency with the appropriate technical expertise.

92 Moyne Shire Council, *Committee Hansard*, Melbourne, 9 June 2015, p.45. The proposal for a two-tiered planning and operational permit system has been made by Mrs Michelle Grainger, Manager Planning, Moyne Shire Council, *Committee Hansard*, Melbourne, 9 June 2015, p. 44.

93 Clean Energy Council, *Committee Hansard*, Melbourne, 9 June 2015, p. 3.

94 Clean Energy Council, *Committee Hansard*, Melbourne, 9 June 2015, p. 4.

National wind farm guidelines

3.103 There are no official national regulations or guidelines relating to the planning and development approval of wind turbines in Australia. National Wind Farm Guidelines (National Guidelines) were first proposed nearly a decade ago and were developed by the former Environment Protection and Heritage Council of Australia and New Zealand (EPHC), now replaced by the Council of Australian Governments National Environment Protection Council.

3.104 The draft National Guidelines were released for public consultation in 2010.⁹⁵ These guidelines were not mandatory, but were intended to encourage improvements in state and territory processes for assessing wind farm proposals by clearly outlining the key principals and issues for consideration both by proponents and decision makers during the development approval process. The draft National Guidelines provided advice ranging from detailed best-practice methods for impact assessment, to short guidance notes:

Detailed best-practice methods	Short guidance notes	Issues not covered
Wind turbine noise	Aircraft safety and lighting	Vegetation clearance
Visual and landscape impacts	Blade glint	Soil disturbance/erosion
Birds & bats	Risk of fire	Terrestrial fauna impacts other than birds and bats
Shadow flicker	Heritage	Other ecological impacts
Electromagnetic interference (EMI)	Indigenous heritage	Traffic management
Community and stakeholder consultation		Construction and engineering standards
		Social and economic impact on local community

3.105 In its 2012 inquiry, *The Social and Economic Impact of Rural Wind Farms*, the Senate Community Affairs References Committee made recommendations regarding the National Guidelines. The committee considered the National Guidelines could 'provide for greater transparency and consistency for planning for wind energy facilities.'⁹⁶

95 Council of Australian Governments former Standing Council on Environment and Water, *Future of the national Wind Farm Guidelines*, , <http://www.scew.gov.au/resource/future-national-wind-farm-development-guidelines> (accessed 29 January 2015).

96 Senate Community Affairs References Committee, *The Social and Economic Impact of Rural Wind Farms*, p. 49, http://www.aph.gov.au/Parliamentary_Business/Committees/Senate/Community_Affairs/Completed_inquiries/2010-13/impacruralwindfarms/report/index (accessed 20 July 2015).

3.106 In its response to the inquiry report, the former Australian Government did not accept the recommendation to redraft the National Guidelines. The former Australian Government went further, and announced the EPHC would cease further development of the National Guidelines, on the grounds that:

Jurisdictions have developed, or are currently developing, planning application, assessment and approvals processes within their own planning frameworks to manage community concerns about wind farm developments such as turbine noise, shadow flicker, electromagnetic interference and impacts on landscapes and wildlife.⁹⁷

3.107 It is not a coincidence that progress at the state and territory level to develop robust wind farm development frameworks has also faltered. The nature of evidence presented to this inquiry shows that where progress has been made, it has not resulted in assessment, monitoring and compliance frameworks that are robust enough to alleviate negative impacts on the communities surrounding wind farm developments.

Committee view

3.108 By the sheer weight of submissions to this inquiry alone, some from the regulatory decision-makers themselves, it is clear that current planning frameworks have failed to address community concerns, or to create nationally consistent wind farm development standards to give certainty to residents that the precautionary principle is being applied.

3.109 It is clear that there is an ongoing role for the Australian Government to play in the development of a consistent, transparent and sustainable regulatory framework for the development, monitoring and compliance of wind farms. Such a framework would have the benefit of:

- providing certainty to the wind farm industry of standards that must be met in development proposals;
- providing nationally consistent industry standards that does not favour or hinder industry investment in any one state or territory;
- assisting regulators to apply nationally consistent decision making on the planning, construction and operation of wind farms'
- assisting in more consistent and transparent monitoring and compliance of operating wind farms; and
- providing greater transparency to communities on the potential impact of new wind farm proposals, as well as a more easily understood framework for community generated compliance complaints.

97 Council of Australian Governments former Standing Council on Environment and Water, *Future of the national Wind Farm Guidelines*, <http://www.scew.gov.au/resource/future-national-wind-farm-development-guidelines> (accessed 29 January 2015).

3.110 In its interim report, the committee recommended the Commonwealth Government finalise the National Guidelines within 12 months, which each state and territory should reflect in their relevant planning and environmental statutes. The interim report recommended the Commonwealth periodically assess the National Guidelines with a view to codifying some of them.⁹⁸

3.111 The committee has since deliberated further on the significant volume of evidence presented to this inquiry—that previous attempts to develop national consistent guidelines and planning frameworks has failed and the current proposals for state level wind farm development assessment is neither robust nor sustainable.

3.112 The committee is therefore of the view that the National Guidelines for a two-tiered wind farm approvals process to ensure local councils have authority for local development issues, and the relevant state agency is the decision-making authority for environmental impact issues.

98 Senate Select Committee on Wind Turbines, *Interim Report*, June 2015, http://www.aph.gov.au/Parliamentary_Business/Committees/Senate/Wind_Turbines/Wind_Turbines/Interim_Report (accessed 20 July 2015).

Chapter 4

The monitoring and compliance of windfarms

4.1 This chapter addresses issues relating to the current standards and processes for monitoring and ensuring the ongoing compliance of wind farms in Australia. The committee has received evidence from several stakeholders that:

- the current standards to monitor noise and environmental impacts are too lax;
- even these insufficient standards are not adequately monitored or properly enforced by the relevant authority in each jurisdiction;
- the Clean Energy Regulator (CER) is potentially in breach of its legislative requirements by awarding certificates to operators that are operating contrary to their planning approval;
- current monitoring and compliance frameworks in some state jurisdictions place considerable pressure on the resources of local councils and fail to utilise the expertise of State Environment Protection Authorities (EPAs); and
- there needs to be a better complaint handling mechanism.

Structure of the chapter

4.2 This chapter addresses the following issues:

- the current standards for monitoring noise and environmental impacts wind farms in Australia;
- the current role of State Governments and local councils in monitoring noise and environmental impacts from wind farms;
- the view of local Councils on their monitoring responsibilities;
- the view of State Governments and State EPAs on their monitoring responsibilities;
- wind farm operators' views on the adequacy of current monitoring and compliance arrangements;
- the role of—and the limitations on—the CER;
- the need to ensure independent and competent monitoring of wind farms;
- the case for State EPAs to take prime responsibility for the monitoring of wind farms;
- a fee-for-service licencing system;
- the case for greater transparency in the monitoring of wind farms; and
- the need for a complaints Ombudsman.

The committee's interim report recommends that there needs to be substantive reform in the way that wind farms are monitored in all Australian jurisdictions. These recommendations are in Box 4.1.

Box 4.1: Interim report recommendations relating to monitoring and compliance of wind farms

Recommendation 4

The committee recommends that eligibility to receive Renewable Energy Certificates should be made subject to general compliance with the *National Wind Farm Guidelines* and specific compliance with the NEPM. This should apply immediately to new developments, while existing and approved wind farms should be given a period of no more than five years in which to comply.

Recommendation 5

The committee recommends that the Commonwealth Government establish a *National Wind Farm Ombudsman* to handle complaints from concerned community residents about the operations of wind turbine facilities accredited to receive renewable energy certificates. The Ombudsman will be a one-stop-shop to refer complaints to relevant state authorities and help ensure that complaints are satisfactorily addressed.

Recommendation 6

The committee recommends that the Commonwealth Government impose a levy on wind turbine operators accredited to receive renewable energy certificates to fund the costs of the *Independent Expert Scientific Committee on Industrial Sound*—including the funding of additional research—and the costs of a National Wind Farm Ombudsman.

Recommendation 7

The committee recommends that the data collected by wind turbine operators relating to wind speed, basic operation statistics including operating hours and noise monitoring should be made freely and publicly available on a regular basis. The proposed Independent Expert Scientific Committee should consult with scientific researchers and the wind industry to establish what data can be reasonably made freely and publicly available from all wind turbine operations accredited to receive renewable energy certificates.

Current noise monitoring standards and the need to monitor infrasound

4.3 Currently, State Government planning regulations require a noise monitoring regime as part of wind farm development approvals.¹ State Guidelines also set out these requirements at both approval and operation stages.

4.4 The Victorian Government uses 'the New Zealand Standard' as the basis for its noise monitoring of wind farm. The Victorian Government's 2015 *Policy and Planning Guidelines for Development of Wind Energy Facilities in Victoria* state:

1 See Australian Wind Alliance, *Answers to questions on notice*, available on the committee's website.

A wind energy facility should comply with the noise limits recommended for dwellings and other noise sensitive locations in the New Zealand Standard NZS 6808:2010 Acoustics – Wind Farm Noise (the Standard). The Standard specifies a general 40 decibel limit for wind farm sound levels, or the sound should not exceed the background sound level by more than five decibels, whichever is the greater. Under section 5.3 of the Standard, a ‘high amenity noise limit’ of 35 decibels applies in special circumstances. All wind farm applications must be assessed using section 5.3 of the Standard to determine whether a high amenity noise limit is justified for specific locations, following procedures outlined in clause C5.3.1 of the Standard. Compliance with the higher standard can typically be achieved by a change in the location, number of operating mode of the turbines. Planning permit conditions should require post installation noise compliance to be monitored and demonstrated to the satisfaction of the responsible authority...

Certification of whether a wind energy facility complies with the Standard and other applicable noise requirements must be undertaken by an acoustic engineer. The wind energy facility operator must provide the responsible authority with appropriate documentation signed by an independent, appropriately qualified and experienced person. The certifier must be able to demonstrate to the responsible authority appropriate independence, qualifications and experience to carry out the task. Measurement and compliance assessment methods are set out in the Standard.²

4.5 South Australia and New South Wales use a noise standard developed by the South Australian Environment Protection Authority.³ The Queensland Government's draft wind farm code proposes a noise standard similar to the South Australian EPA's standard.⁴ The 2009 South Australian EPA's *Wind farms environmental noise guidelines* state:

The predicted equivalent noise level (LAeq,10), adjusted for tonality in accordance with these guidelines, should not exceed:

- 35dB(A) at relevant receivers in localities which are primarily intended for rural living, or
- 40dB(A) at relevant receivers in localities in other zones, or
- the background noise (LA90,10) by more than 5dB(A),

whichever is the greater, at all relevant receivers for wind speed from cut-in to rated power of the WTG and each integer wind speed in between.

The background noise should be as determined by the data collection and regression analysis procedure recommended under these guidelines

2 Government of Victoria, Department of Environment, Land, Water and Planning, *Policy and planning guidelines for development of wind energy facilities in Victoria*, 2015, p. 29.

3 Mr Steven Cooper, *Proof Committee Hansard*, Portland, 30 March 2015, p. 5.

4 Government of Queensland, Department of State Development, *Infrastructure and Planning, Wind farm state code, Planning guideline—draft for consultation*, Appendix 5.

(Section 3). It should be read from the resultant graph at the relevant integer wind speed. Compliance with the noise criteria should also be demonstrated for the approved developments in the zone adjacent to the wind farm.⁵

4.6 The Queensland Government recently released a draft state wind farm code (see chapter 3) which based noise limits on the South Australian EPA Guidelines.⁶ The New South Wales Government has developed draft noise guidelines for wind farms based on the South Australia guidelines and the New Zealand Standard:

In developing this guideline, consideration has been given to guidelines developed for overseas jurisdictions as well as those used regularly in Australia including the New Zealand and South Australian guidelines. In particular this document closely follows methodologies and practices presented in the 2009 South Australian document *Wind farms - environmental noise guidelines* and Australian Standard AS4959 – 2010 *Acoustics – Measurement, prediction and assessment of noise from wind turbine generators*.⁷

4.7 Dr Kim Forde argued in her submission that:

Monitoring on wind farms should be to the recognised international standards. The New Zealand and South Australian standards, that are commonly used, are recognised internationally as being of the highest levels, and therefore should continue to be implemented. Any changes should be justified based on valid research or evidence; or at least compared to one of those two standards, to ensure that it is valid.⁸

4.8 However, the committee expresses its fundamental concern that the current standards for monitoring wind farm noise in Australia are inadequate and incomplete. There are two limbs to the argument. The first is that there are concerns with the New Zealand Standard which many believe need to be reviewed in light of Australian conditions and current wind turbine technology. The second is that infrasound standards must be set and monitored.

Concerns with the New Zealand Standard

4.9 The committee notes that there are mixed views as to the adequacy of the New Zealand Standard. Acoustician Dr Bruce Rapley prepared a submission for the committee titled 'Systemic Failure of a Noise Standard: A Case Study of NZS6808:2010'. In the submission, he argued:

5 Government of South Australia, Environment Protection Authority, *Wind farms environmental noise guidelines*, 2009, p. 3.

6 Government of Queensland, Department of State Development, *Infrastructure and Planning, Wind farm state code, Planning guideline—draft for consultation*, Appendix 5.

7 Government of New South Wales, Department of Planning and Infrastructure, *NSW Planning Guidelines Wind Farms*, December 2011, p. 27.

8 Dr Kim Forde, *Submission 65*, pp 3–4.

In its current form, NZS6808:2010 can in no way protect those who live in standard New Zealand (or Australian) homes in close proximity to industrial wind turbines (less than 10 km). Given also that many homes are within less than 5 km of industrial wind turbines, it is easy to understand why so many complaints of adverse health effects have been lodged. The same situation is mirrored throughout the world, wherever industrial wind turbines have been built in close proximity to dwellings.⁹

[T]he majority of the power in the acoustic spectrum is concentrated towards the low end. The egregious error that NZS6808:2010 makes is the assumption that this portion of low-frequency and infrasound has no effect on human receivers. Nothing could be further from the truth, yet many standards for wind turbine noise continue to perpetuate this myth.¹⁰

In comparison to environmental noise at similar sound pressure levels, wind turbine emissions are more annoying and disturbing than aircraft noise, road or rail traffic.¹¹

4.10 Another eminent acoustician, Mr Les Huson cautioned against using the standard of another country:

In Victoria reference is made to a New Zealand standard. The problem with referring to a standard from a different country is that within that standard it refers to legislation from another country. In my view, that is fundamentally wrong because you cannot implement the requirement completely because it is a different set of legislation. More fundamentally, the process is based upon the ETSU-R-97 methodology from the UK. There are any number of references that have shed significant doubt on its ability to protect people from noise nuisance.¹²

4.11 Victorian witnesses pointed to the need to revise the New Zealand standard given the new breed of larger turbines. Mr Tim Brew, for example, told the committee: 'It is obvious that the New Zealand standards of the 1990s for turbines a quarter of the size of the current ones are not working'.¹³ Mr Andrew Gabb argued that the New Zealand Standard was not protecting rural residents and is now 'obsolete'.¹⁴ The Pyrenees Shire Council observed:

Most of the permits issued were prior to the 2011 period, which included standards in the conditions and requirements to comply with the New Zealand standard 6808, 1988, which does have a fairly limited scope and direction on how to assess issues such as special aural characteristics. This has created difficulties and issues for those responsible for enforcing the

9 Atkinson and Rapley Consulting Pty Ltd, *Submission 409*, p. 34.

10 Atkinson and Rapley Consulting Pty Ltd, *Submission 409*, p. 35.

11 Atkinson and Rapley Consulting Pty Ltd, *Submission 409*, p. 3.

12 Mr Les Huson, *Proof Committee Hansard*, Melbourne, 9 June 2015, p. 61.

13 Mr Tim Brew, *Proof Committee Hansard*, Melbourne, 9 June 2015, p. 83.

14 Mr Andrew Gabb, *Proof Committee Hansard*, Portland, 30 March 2015, p. 74.

permits and, in a lot of cases, in determining compliance in that marginal range around the low 30s to 40 dBA noise contour.¹⁵

Infrasound

4.12 Chapter 2 discussed in some detail the issue of infrasound (measured below 20 hertz) and the need for independent research into the effects of infrasound from wind turbines on human health. It highlighted the significant findings of acoustician Mr Steven Cooper at Cape Bridgewater.

4.13 This chapter highlights the absence of a standard on infrasound and the need for this standard to be introduced if monitoring and compliance activities are to be taken seriously.

4.14 The New Zealand Standard relates only to audible noise. As Mr Steven Cooper told the committee:

...there is a wind turbine signature that is generated and that the dBA level which appears in permits, conditions and guidelines-so the New Zealand standard-do not cover infrasound and low-frequency noise.¹⁶

4.15 The South Australian EPA's Guidelines essentially dismiss the presence of wind farm infrasound:

The EPA has consulted the working group and completed an extensive literature search but is not aware of infrasound being present at any modern wind farm site.¹⁷

4.16 However, the committee highlights a study published last year by researchers from the University of Adelaide which showed that, in contrast to the South Australian EPA's findings at the Waterloo wind farm¹⁸:

...there is a low frequency noise problem associated with the Waterloo wind farm. Therefore, it is extremely important that further investigation is carried out at this wind farm in order to determine the source of the low frequency noise and to develop mitigation technologies. In addition, further research is necessary to establish the long-term effects of low frequency noise and infrasound on the residents at Waterloo. This research should

15 Mr Christopher Hall, Pyrenees Shire Council, *Proof Committee Hansard*, 30 March 2015, p. 34.

16 Mr Steven Cooper, *Proof Committee Hansard*, Portland, 30 March 2015, p. 4.

17 Government of South Australia, Environment Protection Authority, *Wind farms environmental noise guidelines*, 2009, p. 3.

18 Government of South Australia, Environment Protection Authority, *Waterloo Wind Farm: Environmental Noise Study*, November 2013.

include health monitoring and sleep studies with simultaneous noise and vibration measurements.¹⁹

4.17 The inadequacy of a wind farm standard based on the New Zealand Standard is well recognised. The Tarwin Valley Coastal Guardians, for example, wrote in its submission:

The noise standard for BHWEF [Bald Hills Wind Energy Facility] is still NZS 6808: 1998. The slightly updated but still deficient 2010 version does not apply to the BHWEF permit. However, neither reiteration of NZS 6808 measures low frequency and infrasound. Both are constrained to the measurement of audible sound – noise, and wholly inadequate to regulate the full spectrum of WEF acoustic emissions. Their testing methodology for audible sound is flawed and neither version addresses the pressing need to specify acoustic monitoring instrumentation.²⁰

4.18 Similarly, Mrs Theresa Grima of Lidsdale in New South Wales wrote:

Not only is there an issue with noise that the NSW EPA regulates but there is an issue with high levels of infrasound and low frequency noise that the various regulatory authorities fail to measure, regulate, and act upon to prevent serious harm to human and animal health. This needs to be addressed to adequately protect the health of the communities.²¹

4.19 South Australian resident Ms Mary Morris also argued the need to monitor infrasound:

Currently, low frequency noise is not measured, noise monitoring results are not provided to affected residents, noise monitoring is not a transparent, open and honest process.

A thorough review of audible and inaudible noise measurements and monitoring relating to wind farms is long overdue and should be undertaken immediately by experts independent of the industry to protect residents where wind farms are planned.²²

4.20 The committee has sought evidence on whether emissions in the range of zero to 20 hertz can be monitored. Dr Geraldine McGuire drew the committee's attention to the complexities of measuring the sound of wind farms:

In terms of monitoring, wind farms are complex. I have worked in the mining and oil and gas industry for over 20 years and the monitoring there is complex, but from what I am learning about wind farms it is even more

19 Hansen K, Zajamsek B, Hansen, C. Noise Monitoring in the Vicinity of the Waterloo Wind Farm. Adelaide, Australia: University of Adelaide; 2014. See Professor Robert McMurtry, *submission 146*, Attachment i

20 Tarwin Valley Coastal Guardians, *Submission 45*, p. 16.

21 Mrs Theresa Grima, *Submission 374*, p. 1.

22 Mrs Mary Morris, *Submission 464*, p. 3.

complex. It is not just about decibels; it is to do with how we measure the infrasound. It is not just about distances away—because of mountains being the shape they are and wind being the way it behaves, it is much more complicated than just how far away you are from the wind farms. It is really a lot to do with the shape of the mountains and your proximity to that particular aspect.²³

4.21 Acoustician Mr Geoff McPherson told the committee that there are techniques available to conduct this monitoring. The committee asked whether the equipment required would be expensive, to which he responded:

I think you pay for what you get. That equipment is available. The expertise is available, particularly in southern Australia. I do not think you should be looking too closely within Queensland for that...²⁴

4.22 The committee draws attention to the following comment and recommendation of New Zealand psychoacoustician Dr Daniel Shepherd:

A handicap of current noise standards, including the New Zealand standard (NZS6808R, 2010) which is used in some Australian states, is the use of the dBA metric. Zwicker (1999), a recognised global authority on noise measurement and noise abatement, questions the “enthronement” (p. 66) of the dBA scale in noise measurement practice. He demonstrates that, frequently, dBA measures are of no intrinsic use, and can produce misleading measurements. He also warns against the exclusive use of physical sound measures such as dBA in noise control situations.

Current noise standards relying upon dBA measures, such as NZS6808R, are not fit for purpose and should not be utilised. Instead, Australia should embrace the opportunity to produce a gold standard set of guidelines that are in line with modern research.²⁵

4.23 Chapter 6 of this report makes a recommendation along these lines.

The role of State Governments and local councils in monitoring wind farms

4.24 As with planning arrangements, there are various State-based arrangements for monitoring and ensuring the compliance of wind farms.

- In Victoria, the State Environment Protection Authority is not permitted to monitor wind turbine noise. This responsibility rests with local councils although the State Government is the decision-maker where there is evidence of a breach of compliance conditions. The State Government is responsible for front-end planning matters including issuing permits for new wind farms (see chapter 3).

23 Dr Geraldine McGuire, *Proof Committee Hansard*, Cairns, 18 May 2015, p. 62.

24 Mr Geoff McPherson, *Proof Committee Hansard*, Cairns, 18 May 2015, p. 40.

25 E. Zwicker and H. Fastl, *Psychoacoustics: Facts and Models*, Springer, 1999.

- In South Australia, the State EPA regulates wind farms under the general protection duty in section 25 of the South Australian *Environment Protection Act 1993*. There is no licencing system in South Australia although every wind farm in the State has had a noise impact assessment undertaken at pre- and post-construction phases by independent acoustic consultants. In 2013, the State EPA conducted an extensive study at the Waterloo wind farm in response to complaints from concerned residents.
- In Queensland, the councils are currently responsible for monitoring and compliance although it is not clear whether this situation will remain under the State's new wind farm regime.²⁶ In certain cases, the monitoring role has been left to an agreement between the council and the company with the company conducting the monitoring (see below).
- The New South Wales Government decided in 2013 to transfer responsibility for regulating large-scale wind farms from local councils to the State EPA. The State's wind farms have been brought within the EPA's established environmental protection licencing regime. The main environmental issue that the NSW EPA regulates via a wind farm licence is operational noise. However, the licence may also address other environmental issues during the construction phase, such as construction noise, dust and sedimentation.²⁷ Chapter 6 of this report discusses these arrangements in more detail and recommends that all State Governments consider implementing a licencing system to regulate wind farms.

The view of local Councils on current monitoring arrangements

4.25 The committee has received evidence from various local councils commenting on their monitoring and compliance responsibilities. The Municipal Association of Victoria (MAV) emphasised the impost that these responsibilities currently have on its members' precious resources:

Councils have reported that they are receiving noise complaints under the Planning and Environment Act and noise-related nuisance complaints under the Public Health and Wellbeing Act. Compliance with the planning permit is determined by assessing applications against the planning permit conditions and the relevant noise standards.

...Over the past few years it has become clear that community confidence in the assessment of noise compliance is a principal concern for councils. Currently councils are largely responsible for undertaking this task despite its being well beyond the expertise provided by the functions of local government. A council is required to engage an acoustic engineer to peer

26 See chapter 3; also, Mr Greg Chemello, Deputy Director-General, Queensland Department of Infrastructure, Planning and Local Government, *Proof Committee Hansard*, Cairns, 18 May 2015, pp 16–17.

27 New South Wales Environment Protection Authority, <http://www.epa.nsw.gov.au/licensing/windfarmfaq.htm#Q13> (accessed 17 July 2015).

review noise reports at a financial cost ranging from \$8,000 to \$10,000 per assessment.²⁸

4.26 One of the MAV's members, the Moorabool Shire Council, emphasised that council revenue from rates is inadequate for councils to monitor wind farm operations. The Council stated:

The wind energy operators claim that the rate income (or income in lieu of rates) generated for each tower is adequate compensation for Councils that will incur additional costs. The costs for MSC in attracting and retaining staff who are qualified and skilled in town planning interpretation, noise monitoring of noise data and scientific analysis is estimated to cost \$200,000 in year one alone. With the addition of assets repairs mentioned above, the rate income is estimated to be a small proportion of the costs incurred by Council.²⁹

4.27 The Glenelg Shire Council highlighted the difficulties inherent in current arrangements whereby the local councils have responsibility for compliance and monitoring, but the State Government—inexperienced in compliance—is the decision-maker. In response to a question on notice, the Shire stated:

Undertaking the ongoing enforcement of wind farm permits is problematic for Council where the decision is made by State Government. The decision makers are unlikely to have had any significant experience in ongoing operational compliance of wind farms. In this scenario there is low confidence in compliance of the wind farm being achievable. Further if the rules changed, this would need to consider how existing wind farm permits would be impacted. For example if new rules found the \$1 billion Macarthur Wind Farm (in Moyne Shire Council) non-compliant, would there seriously be an expectation that a small rural Council be taking legal action to shut down such a major private investment? In Council's submission it was stated that having national guidelines would assist Councils in both monitoring and addressing complaints against state legislation. This will provide consistency for industry, residents and responsible authorities in developing and operating wind energy facilities.³⁰

4.28 The Regional Council of Goyder explained that while the South Australian EPA has the lead role in monitoring and compliance, the council has requested the EPA's involvement where specific complaints have been made:

As far as the enforcement goes, that is basically left to the EPA in South Australia, which—perhaps I should not say it here—seems to me to be fairly poorly funded. I would like to see a lot more monitoring of noise

28 Mr Gareth Hatley, Municipal Association of Victoria, *Proof Committee Hansard*, Melbourne, 9 June 2015, pp 53–54.

29 Moorabool Shire Council, *Submission 375*, p. [3].

30 Glenelg Shire Council, *Answer to question on notice from public hearing*, 30 March 2015, p. 3, (received 5 June 2015).

levels at specific points. We have strips of wind farms that run along three adjoining ranges. It would certainly be very interesting to have a lot more monitoring of the noise levels between those wind farms. It is left to the EPA. If we have a problem then we ask them to put a monitoring device in there to try to get some sort of idea as to whether or not the noise levels are being exceeded.³¹

4.29 The Council of Goyder added:

What I would like to see...is that where there are persistent complaints about noise there should be a full-time monitoring arrangement, probably financed by the owners themselves, and where noise exceeds a certain level in certain conditions, then those turbines should be shutdown for a period of time. They do not like that idea, but it is a cheaper way than actually removing or shifting the turbines altogether.³²

4.30 The Tablelands Regional Council (TRC) in far north Queensland expressed its frustration at the current situation with compliance and monitoring arrangements in the State:

...one of the real concerns we have is about the monitoring and compliance conditions. We know, from our Windy Hill experience, which cost far more than any little council can pay, that the flow-on effect from that is that, if we cannot take them on, how can the residents?

We have complainant residents, which is why Tablelands Regional Council set about its task of trying to make them comply. All of the business you heard about 'We've done so much testing,' is a nonsense. The first testing which we required after the complaints in 2011, when RATCH bought the property—they did six hours of testing. They were supposed to test over a three-month period. Our council said, 'That's not good enough. Do it properly.' In the end, we had to go to the Planning and Environment Court, hundreds of thousands of dollars later.³³

4.31 The TRC argued that local councils could and should do monitoring and compliance work but that they need to be properly resourced to do so:

...you heard Mr Chemello [the Queensland Government] say he has no acousticians and no experts—just a planning department doing all this important noise stuff. Councils can do that but they have to be funded to do it, and what needs to happen is there needs to be security for costs in the approvals process, so that councils can properly monitor. We hear yet again that this monitoring is probably going to be in the hands of the developer.

31 Councillor Peter Matthey, Mayor, Regional Council of Goyder, *Proof Committee Hansard*, Adelaide, 10 June 2015, p. 34.

32 Councillor Peter Matthey, Mayor, Regional Council of Goyder, *Proof Committee Hansard*, Adelaide, 10 June 2015, p. 38.

33 Councillor Majorie Pagani, Tablelands Regional Council, *Proof Committee Hansard*, Cairns, 18 May 2015, p. 28.

We saw what happened there with Windy Hill: it does not work. We need proper funding to enable us to do it.³⁴

4.32 The MAV told the committee that its discussions with the State Government has been through a Working Group:

The working group is made up of two layers. There is the CEOs and mayors group, which is focused primarily around advocacy—the arrangement that we have brokered with the Environmental Protection Authority came from that group—and there is a wind farm officers group, which is really focusing on providing a networking opportunity for officers who are dealing with assessing applications under the previous regime but also dealing with monitoring and compliance issues.³⁵

4.33 The committee's interim report flagged the committee's interest in these discussions and in particular, MAV's proposal of a fee for service licencing system. This issue is covered later in this chapter and again in chapter 6.

State Governments' views on current monitoring arrangements

4.34 The Queensland Government noted that it was yet to develop a system to monitor compliance for infrasound. Mr Greg Chemello of the State Department of Local Government and Planning told the committee:

If we get the state-wide system and the state-wide code, one of the advantages of that is when research gets to the point where we have the evidence, which I think we talked about earlier on—that is, where we have got a much better way of measuring and dealing with it—we can then change that code relatively quickly and then all development approvals need to comply with that code.³⁶

4.35 The Queensland Government told the committee that in terms of the process for monitoring the soon-to-be-developed Mount Emerald wind farm:

We still have to work that through. That is a process where they (RATCH Australia) have to do a report and we need to agree with them on the process of monitoring. I think it gets back a little bit to the issue that you were talking about earlier on—the frequency of monitoring. That has not been specified in the development decision. That is a matter that we will need to agree, 'we' as in the chief executive of my department, who is the planning entity for SARA. The report needs to be done to the satisfaction of our chief executive and those sorts of arrangements should be worked out through that. It may well be a monitoring process of, every year or two or

34 Councillor Majorie Pagani, Tablelands Regional Council, *Proof Committee Hansard*, Cairns, 18 May 2015, p. 30.

35 Mr Gareth Hatley, Municipal Association of Victoria, *Proof Committee Hansard*, 9 June 2015, p. 56.

36 *Proof Committee Hansard*, 18 May 2015, p. 19.

three, looking at what we have done. In some instances, not wind farms, we have used a scale-back monitoring process: you start monitoring more intensively and then, as the years go by, if there are no issues you scale back on the frequency of the monitoring.³⁷

4.36 The Victorian Government noted in its submission that it has improved its monitoring and compliance framework as part of the recent updating of wind farm guidelines.³⁸ It explained that:

Some older permits for wind farms do not have the ability to compel operators to undertake further testing. In these instances further acoustic testing could be undertaken by the council if warranted to address specific issues or concerns.³⁹

4.37 The South Australian EPA told the committee:

...we regulate wind farms under the South Australian Environment Protection Act, under the general duty provisions in section 25. We use this provision because wind farms are not licensed in South Australia. So our involvement is limited to the technical aspects, particularly around noise.⁴⁰

4.38 While acknowledging that infrasound is emitted from wind turbines, the South Australian EPA argued that based on NHMRC advice, it is not emitted at levels that can harm human health and that should be regulated. It added:

One of the challenges—and I would be interested to see research in this area—is whether there might be some sort of impact from infrasound below perception levels. With infrasound, the lower the frequency, the harder it is to perceive, and it is generally accepted that you cannot perceive infrasound until 85 dBG, which is the range we tend to use. The levels we are finding near wind farms are much, much lower than that; they are in the order of 30 dBG. So it would be of interest if people did research in that area.⁴¹

37 Mr Greg Chemello, Deputy Director General, Queensland Department of Infrastructure, Planning and Local Government, *Proof Committee Hansard*, Cairns, 18 May 2015, p. 19.

38 *Policy and planning guidelines for development of wind energy facilities in Victoria*, 2015

39 Government of Victoria, Department of Economic Development, Jobs, Transport and Resources, *Submission 112*, p. 5.

40 Mr Peter Dolan, Operations Director, Science Assessment and Planning, Environment Protection Authority, *Proof Committee Hansard*, Sydney, 29 June 2015, p. 12.

41 Mr Peter Dolan, Operations Director, Science Assessment and Planning, Environment Protection Authority, *Proof Committee Hansard*, Sydney, 29 June 2015, p. 12. See also: Victorian Government Department of Health, *Wind Farms, sound and health: Technical information*, 2013, p. 8, <http://www.infigenenergy.com/Media/docs/Wind-farms-sound-and-health-2c38d957-bb49-4d8a-847a-fb84c2d2b3ba-0.pdf> (accessed 20 July 2015). This report states that 'like the human ear, the A-weighted network [dBA] is less sensitive to low frequencies. Therefore, the C-weighting [dBC] has been developed to measure sounds with a significant low frequency component, and the G-weighting [dBG] has been developed to measure sounds in the infrasound range.'

Residents' view of monitoring and compliance

4.39 The committee stated in its interim report that 'it is dissatisfied with the current monitoring and compliance processes which it considers to be a patchwork and which have caused considerable community angst and frustration'.⁴² The committee has received many submissions from the residents of nearby wind turbines complaining of the lack of adequate monitoring and compliance and the incapacity of local councils to perform the role. It suggests that there is an overwhelming lack of confidence within communities in how wind farms are required to comply and, therefore, in the findings and transparency of compliance reports.

4.40 The following extract, from Ms Anne Gardner, an adjoining landholder at the Macarthur wind farm, gives a sense of the agitation and distress that poor compliance processes have caused:

Monitoring and Compliance governance of wind farms in Victoria has been, and still is AN ABSOLUTE SHAMBLES. No doubt the previous Minister for Planning Matthew Guy wanted to rid himself of this onerous responsibility, so he hand balled it over to local Shire Councils, which DO NOT HAVE THE KNOWLEDGE, EXPERTISE nor the FINANCIAL CAPACITY to handle such complex responsibilities, particularly as they involve people's health and wellbeing, apart from other issues. We all thought our own Moyne Shire would have responsibly represented our best interests. However, not to be.....⁴³

4.41 Mr Donald Thomas, an adjoining landholder at the Waubra wind farm, also complained of the complete inadequacy of efforts to monitor the wind farm operator's compliance:

The noise monitoring was not done in accordance with the New Zealand Standard NZS 6808:1998. The installation of the equipment was not done by a qualified person. No specification of the equipment was provided. The equipment was not placed within the specified NZ Standard area. The timeframe was inadequate. It should have been there for a week, but was taken away after a few days. Testing should be done under similar conditions to the period of which complaints were made. No background noise data was collected. The Waubra Wind Farm staff members insisted noise compliance obligations had been met. At this meeting I requested that these 2 staff members showed where the test results showed compliance. They could not and conceded that the test results did not show compliance but in their view did not show non-compliance.⁴⁴

42 Senate Select Committee on Wind Turbines, *Interim Report*, June 2015, p. 10, http://www.aph.gov.au/Parliamentary_Business/Committees/Senate/Wind_Turbines/Wind_Turbines/Interim_Report (accessed 20 July 2015).

43 Ms Anne Gardner, *Submission 208*, p. 12. Emphasis in original.

44 Mr Donald Thomas, *Submission 197*, p. 1.

Box 4.2: The Victorian State Government's failure to enforce compliance of the Waubra wind farm

The Victorian State Planning Minister was informed by his department that the Waubra wind farm was non-compliant with noise limits as early as 2010. However, the former minister failed to officially determine non-compliance. Additionally, the Minister avoided the compliance pathway specified in the planning permit and instead negotiated with the operator for several years about the development of a new Special Audible Characteristic (SAC) testing methodology. This methodology was neither compatible with, nor executed in accordance with, the applicable New Zealand standard—6808:1998.

These matters were described in detail by Mrs Samantha Stepnell (submission 470):

We were deeply concerned that Minister Guy justified his acceptance of Acciona's controversial, 'subjective' testing methodology by relying on advice from an unauthorised, unpublished draft document which he improperly refers to as "the EPA guidelines".

We are aware that the incomplete draft was being prepared in close collaboration with DPCD (Department of Planning and Community Development). We told Mr [Paul] Jarman that in its flawed draft form, the draft document was not approved for publication by the EPA and that the SAC methodology Minister Guy had agreed to was never endorsed by the EPA. It is incorrect for the department to have suggested otherwise.

At any rate, Section 10 of the draft wind farm policy for the assessment of SACs refers exclusively to developments bound by NZS 6808:2010. The Waubra Wind Farm permits provide that compliance must be assessed in accordance with NZ6808:1998. Even if the DPCD/EPA's unpublished draft wind farm guideline was a credible resource, the methodology proposed for the assessment of SACs (that EPA was not prepared to publish), could not retrospectively apply to the assessment of noise at Waubra Wind Farm.

Further, acoustic experts, the EPA and officers of the Victorian Planning department had already made a number of site inspections of the Waubra Wind Farm. DPCD had raised concern about the 'likely presence of SACs at some properties,' (including ours), recognising a number of possible causes including mechanical noise, tonal noise and Amplitude Modulation. I told Mr Jarman that his department's many observations indicated that subjective assessment had already occurred – and on multiple occasions. Moreover, the draft guidelines that the Minister relied upon to approve Acciona's SAC methodology reaffirmed that where SACs have been identified the noise standard requires a 5 dBA penalty and 35 dBA limit.

I noted that in BMIN011632 the Minister received expert advice that acknowledged presence of SACs: 'the department considers that operating the wind farm in noise management mode will not enable the facility to meet the applicable 35dBA limit.'

Non-compliance at Waubra Wind Farm was found in 2010, confirmed again in 2011 and at the advice of DPCD commissioned acoustic experts, even in the unlikely event that Acciona was to operate the facility in a noise optimised mode, the department didn't expect that would enable the wind farm to meet compliance with the appropriate standard.

Condition 16 of the permits specifies that on-off shut down testing and decommissioning should have been the next logical, necessary steps along the compliance pathway. We remain perplexed as to why the Minister and his department spent the last several years avoiding the enforcement of the permit and failing to officially determine the known non-compliance. Without intervention, the Minister allowed Acciona to continue to operate the power station in excess of the prescribed noise standard, outside compliance to the detriment of the community it continues to harm. Minister Guy approved Acciona's SAC testing methodology which was totally at odds with all the advice he had ever received about SACs at Waubra Wind Farm.

The committee has learned that the current Victorian Planning Minister recently declared that the Waubra wind farm is compliant with noise limits. His determination relied upon the SAC testing methodology as described.

4.42 Similar concerns were expressed by Mr Crispin Trist, a local resident in close proximity to the Cape Bridgewater wind farm. In his submission, Mr Trist referred to an acoustic assessment report which identified non-compliance at his property. These memos identified non-compliance at several Cape Bridgewater properties on multiple occasions throughout the noise monitoring period.⁴⁵

Box 4.3: When is a 'compliant' wind operator not compliant?

In his submission, Mr Crispin Trist provided a copy of Marshall Day's noise monitoring memo (dated 31 July 2009) showing non-compliance of Pacific Hydro's Cape Bridgewater wind farm. In relation to House 63 (Antil) of the Cape Bridgewater wind farm as measured between 29 May 2009 and 12 June 2009, the memo stated:

The NZ6808 limits are significantly exceeded for the wind speed range 5–11m/s.
(Submission 251, p. 3)

However, Pacific Hydro has provided the committee with a copy of Marshall Day Acoustics' 'Cape Bridgewater Wind Farm Post-construction Noise Compliance Assessment' report dated 23 July 2010. This report concluded:

It was found that noise emissions from the Cape Bridgewater Wind Farm comply with the NZS6808:1998 noise limits at Houses 1, 2, 46, 54, 63 and 70 at all assessed wind speeds. (p. 22)

This is an example that shows how the compliance process can be easily manipulated by operators and the acousticians they pay to get the report they want. It is directly contrary to the evidence of Mr Oliver Yates of the Clean Energy Finance Corporation at a Senate Estimates hearing on 25 February 2015 (pp 60–61):

Senator MADIGAN: Recent acoustic investigation undertaken at stage 2 of Pacific Hydro's Portland project revealed a correlation or a trend between the occurrence of specific infrasound frequency that occurred at various phases of operation at the Cape Bridgewater power generation facility and the residents' reports of adverse sensation and health effects. This could have ramifications under the Public Health and Wellbeing Act 2008. If so, would the facility be in breach of conditions relating to its financial arrangements and contractual obligations with the CEFC?

Mr Yates: All projects are required to comply with the law. Currently it is dependent upon whatever planning permits or requirements are there at that site. If the project fails to meet its compliance obligations, there is typically a right of termination of the funding requirements under the facilities. We do expect people who are borrowing from any financial institution—it is common, whether you are public or private—to use the money in a way which is used for lawful purposes and, if it is not used for lawful purposes, it is unlikely that the money would be available for very long; it would typically be an event of default.

Senator MADIGAN: Did the CEFC make sure that it had appropriate evidence to satisfy that Portland Wind Energy Project's earlier wind farms had met all conditions of planning permit and approval requirements before providing the \$70 million in debt financing to Pacific Hydro for the refinancing of these stages and stage 4? Whose money is at risk here if these projects have not met their planning permit conditions?

Mr Yates: In relation to the first question, there is an extensive due diligence process that we go through. Obviously, every lender does that, because you do not want to lend to a project which is in default. That relies upon detailed legal due diligence and specialist due diligence in relation to any project that we lend to....

Mr Yates: We require external law opinions as well, from external law counsel, who will actually go through and check to make sure that any of those items or representations that the company has made are actually legitimate. Obviously, you do expect companies to make valid representations, but it is not for us to take those representations without due inquiry, to check the validity of whether those representations are actually true.

45 Mr Crispin Trist, *Submission 251*, p. 2.

Later in his testimony, Mr Yates admits that there is a problem:

Senator MADIGAN: This is my final question, Chair: the other day I asked a question of the Clean Energy Regulator. I asked whether they have an unambiguous statement from the Victorian Minister for Planning as to whether the facility was compliant or non-compliant, and they said they have neither.

Mr Yates: Yes.

Senator MADIGAN: They have neither; so, in fact, it is in the demilitarised zone—no-man's land. It is neither compliant nor non-compliant. But you lend money on a thing that they have told me is neither compliant nor non-compliant. There is not a definitive statement as to compliance.

Mr Yates: I think the question goes to legality. The project is legally entitled to operate. I agree with you: it is a ridiculous world where people cannot get clarity in relation to this. This is a planning failure, in my view, and a minister, a government or a responsible entity need to actually draw a line and say whether it is compliant or non-compliant. (*Senate Economics Legislation Committee, 25 February 2015, pp61–62*)

4.43 Mr Colin Walken, an adjoining landholder at the Windy Hill wind farm in far north Queensland, sought for years to have the operator—Stanwell—meet compliance. As he wrote in his submission:

I have been seeking the assistance of council to enforce compliance of the various operators since 2000. Some 12 years later I continue to suffer; my mental health continues to deteriorate; my living circumstances become less and less bearable as time passes. It is wholly unreasonable to expect a constituent to suffer as I have for 12 years without any or any adequate steps being taken by the council or its predecessor. Council will be aware that the former operator, Stanwell, admitted in 2001 they were non compliant. Stanwell did noise monitoring in 2003. Again in 2007 they acknowledged that the turbines were non-compliant (according to the noise monitoring done in 2003). However, they did not supply me with the data. Consequential upon their admitted non-compliance, Stanwell paid me \$4000 in 2007 to insulate the roof, which had little to no effect. That was prior to the sale of the wind turbine facility to Transfield Services, and then to the current operators. No remedial steps have been taken by the latter.⁴⁶

4.44 Mr Roger Kruse noted in his submission that he and his wife had requested that Energy Australia, the Waterloo wind farm operator, conduct noise monitoring at their property. While the company obliged, Mr Kruse questioned whether the acoustic report's findings showed compliance:

Data was apparently not collected for the first 2 months due to equipment failure. This was unfortunate as the windfarm was very noisy on the days that we were home. I have attached the report from Marshall Day Acoustics entitled Waterloo Wind Farm – Kruse Monitoring. I find it interesting that the noise levels can be above 40dB, but the line of best fit is below 40dB (pg11, Marshall Day Acoustics Rp 006 2010277ML). To me this means that the windfarm can be noisy at times, but it is still within the EPA guidelines. It makes me wonder about the EPA guidelines. Are the EPA

46 Mrs Lee Schwerdtfeger, *Submission 458j*, p. 1.

guidelines reasonable, especially given that there was no distinction between night and day noise in this report?⁴⁷

4.45 Mr and Mrs John and Sue Dean, adjacent landholders to the Moorabool wind farm, identified a range of concerns with the planning and compliance process, including the equipment used to conduct the noise assessments and the absence of field surveys in the flora and fauna assessments:

Compliance of the proposed Moorabool windfarm is in serious doubt. Reports submitted to the Hearing were inaccurate and faulty, had been conducted under very brief or inappropriate periods and tailored to meet the developers requirements.

The equipment used to measure sound was not supposed to be used below 30dB (manufacturers specifications), the monitoring equipment was not calibrated as required by the New Zealand Standard referred to by the Victoria Planning Guideline and no confirmation was provided to confirm the loggers were not outside the calibration/verification use by date.

...

Shadow flicker reports were questionable. This report was peer reviewed resulting in contradictions to the number of shadow hours for neighbouring properties. In some cases the shadow hours were identified as exceeding the allowable.

The fact that these studies were not sufficient will place a huge reliance on the council to ensure compliance in all areas is met. We very much doubt they will have the resources or capabilities to do so. It also brings into question the application of and integrity of the national wind farm guidelines. Our experience has been that the windfarm developers select the parts of the guidelines they wish to adhere to and discard the rest.⁴⁸

4.46 Some residents have taken matters into their own hands, conducting their own monitoring. In New South Wales, *Residents against Jupiter Wind Turbines* was established in the Tarago area to oppose the Jupiter wind farm. Mr Mark Tomlinson described the group's efforts to monitor background noise:

A subcommittee was formed, now known as the noise committee, and members of this committee are tasked with investigating various aspects of wind turbine noise. Some of these areas are noise propagation and the effects of topography and geographical spread, the relationship between multiple turbines and wind shear relating to international standards—just to mention a few.

My role as a member of the noise committee is to investigate the background noise monitoring process as outlined in the various wind farm guidelines used in New South Wales. This role involves monitoring equipment set-up, data collection, data analysis and preliminary findings

47 Mr Roger Kruse, *Submission 231*, p. 2.

48 Mr and Mrs John and Sue Dean, *Submission 63*, p. 1.

reports. This has also led into the investigation into wind turbine infrasound. The committee purchased industry standard class 1 noise monitoring equipment and use the current New South Wales draft wind farm guidelines and the 2003 South Australia wind farm guidelines as guiding documents, as used by the Department of Planning and Infrastructure.

In January 2015, we commenced a monitoring program to ascertain the ambient environmental background noise at six properties around the proposed wind farm. We have currently completed five and, as a result, have discovered numerous deficiencies within the guidelines used for wind farm approvals. The major deficiencies include removal of extraneous noise; wind over microphone; position of monitoring equipment; checks and balances as to the accuracy of noise monitoring reports submitted by developer-paid acousticians; ongoing compliance monitoring; and others listed in our submission...

We believe the current wind farm guidelines are in no way adequate and must be amended as a matter of urgency.⁴⁹

The view of wind companies on monitoring and compliance

4.47 Unsurprisingly, wind farm companies themselves have no quarrel with current monitoring and compliance arrangements of their operations. Trustpower told the committee:

...we believe that wind farms in Australia are governed by well-established robust compliance requirements—and some states are amongst the most stringent in the world—and that the monitoring and governance arrangements currently in place are adequate.⁵⁰

4.48 Trustpower explained to the committee that it conducts its own monitoring:

Part of the conditions of approval at our Snowtown Wind Farm—again, I can talk from our South Australian or Australian experience—is that we have ongoing monitoring, some of it actually voluntarily and not necessarily strictly according to planning approval conditions. We do annual surveys of, for example, wedge-tailed eagle breeding sites and mortality. There is an obligation to report on any mortality findings.⁵¹

4.49 AGL recognised that where turbines had not been compliant, they were stopped until a solution was found. Generally, however, it emphasised that the results showed its compliance with noise monitoring standards:

49 Mr Mark Tomlinson, *Proof Committee Hansard*, Sydney, 29 June 2015, pp 46–47.

50 Mr Clayton Delmarter, Engineering Manager, Trustpower Limited, *Proof Committee Hansard*, 10 June 2015, p. 24.

51 Mr Rontheo van Zyl, Trustpower Ltd, *Proof Committee Hansard*, Adelaide, 10 June 2015, p. 27.

...over 40,000 hours of noise monitoring was conducted at AGL's Macarthur Wind Farm with the results demonstrating the compliance of the project with the acoustic requirements of the Planning Permit. In the event of exceedance of limits, the developer is obliged to make good and retest. AGL has in the past restricted turbine usage at another project with underperforming turbines until a solution was sourced and retesting conducted. In addition to regulatory noise monitoring, AGL also undertook a voluntary investigation into the infrasound levels at the Macarthur Wind Farm (with results released in 2013) to further alleviate community concerns around noise. The research measured infrasound and low frequency noise at residences located 2.7 and 1.8 kilometres from the nearest turbine before any turbines were operating, when approximately 105 of 140 turbines were operating and when all 140 turbines were operating. This research demonstrates that there was no measurable change in the infrasound levels measured before and after construction of the Macarthur Wind Farm.⁵²

4.50 Infigen drew the committee's attention to monitoring in New South Wales:

In NSW, the Government decided to conduct an additional follow up noise audit of their wind farms in 2012 despite all of their wind farms successfully passing noise compliance audits undertaken just after each wind farm was commissioned. The NSW Government chose an independent acoustic engineer who had appeared on behalf of wind farm opponents in two environment court cases to conduct the audits. After the additional noise audit was completed and the data analysed, all three wind farms, including two operated by Infigen Energy, were found to be compliant with their noise criteria.⁵³

4.51 The committee finds the evidence of wind farm operators on their fulfilment of monitoring requirements entirely unconvincing and notes that wind farm operators do not have the authority to comment on noise compliance audits which are not their own.

The Clean Energy Regulator and its legislative requirements

4.52 The terms of reference of this inquiry ask how effective the Clean Energy Regulator (CER) is in performing its legislative responsibilities. Submitters and witnesses to this inquiry have expressed strong concerns about the need for the federal government to give the CER increased powers to suspend a wind operator's accreditation and penalise the company for breaching its approval conditions. The committee share these concerns.

4.53 The CER oversees the operation of the Renewable Energy Target. Part 2 of the *Renewable Energy (Electricity) Act 2000* (REE Act) sets out the CER's functions

52 AGL Energy Ltd, *Submission 83*, p. 5.

53 Infigen, *Submission 425*, p. 12.

and powers. The CER has responsibility for accrediting power stations as part of the RET scheme, which enables power stations to receive certificates. The CER does have powers (Part 2, Division 8, section 30) to suspend accreditation if a power station is not operating in accordance with a planning approval.

4.54 In its submission to this inquiry, the CER explained how it administers the law:

...the Regulator accredits power stations that meet the eligibility requirements set out in the REE Act and the REE Regulations. It monitors and facilitates compliance with that legislation, primarily by conducting its own investigations and working with relevant Commonwealth, State and Territory authorities where appropriate (including the police). The Regulator has always exercised, and will continue to exercise, its monitoring and enforcement powers in accordance with the relevant legislation and Australian Government Investigations Standards. The agency has assembled a team of appropriately qualified and experienced investigators to whom all allegations of breaches of administered legislation are referred.⁵⁴

... Where the Regulator has any potential concerns over the creation of certificates [Renewable Energy Certificates (REC)], it may undertake on site monitoring visits. As stated earlier, any such visits are not for the purpose of assessing other jurisdictions' approval conditions.⁵⁵

A reactive regulator dependent on state authorities' monitoring systems

4.55 The CER is not a proactive investigator. It is not responsible for conducting compliance and it does not independently assess specific compliance with the conditions in planning approvals.⁵⁶ Rather the CER is reliant on approval from the relevant state authorities that a wind farm operator is compliant. In the case of Queensland, for example, the wind farm company would reach an agreement with the State Department of Infrastructure and Planning in terms of the frequency of monitoring.⁵⁷ It is the obligation of the company to conduct the monitor and produce reports to the State Government. There are penalties if the company breaches the conditions of the development approval.⁵⁸

4.56 The Regulator's own submission gave the example of the appeal against the Gullen Range wind farm in New South Wales. The Planning Assessment Commission

54 Clean Energy Regulator, *Submission 93*, p. 12.

55 Clean Energy Regulator, *Submission 93*, p. 7.

56 Clean Energy Regulator, *submission 93*, p. 5.

57 Mr Greg Chemello, Deputy Director General, Queensland Department of Infrastructure, Planning and Local Government, *Proof Committee Hansard*, Cairns, 18 May 2015, p. 22.

58 Mr Greg Chemello, Deputy Director General, Queensland Department of Infrastructure, Planning and Local Government, *Proof Committee Hansard*, Cairns, 18 May 2015, p. 23.

(PAC) in NSW issued a draft order to the operator (New Gullen Range Wind Farm Pty Ltd) requiring that it show cause why nine turbines should not be relocated to the originally-approved location or removed. The operators then commenced ‘Class 4 Proceedings’ in the Land and Environment Court (NSW) challenging the PAC determination. Despite the finding of the PAC, the CER states that:

...it cannot be reasonably satisfied that a contravention of the law is occurring. The Clean Energy Regulator has had regard to a number of matters in coming to its preliminary conclusion, including:

- (a) there is a genuine dispute as to whether the turbines are in unapproved locations and what constitutes ‘minor’ movement;
- (b) the NSW Department has not progressed to issuing a final order;
- (c) the PAC determination was only in relation to a modification of planning approval, rather than a finding of non-compliance with the original planning approval;
- (d) there has been no admission of any contravention of the law by the operators of the power station; and
- (e) the matter is currently before the Land and Environment Court in what appears to be a genuine, rather than frivolous dispute.

The Regulator continues to monitor the matter and will, if new evidence or information comes to light, further consider exercising the power to suspend accreditation.⁵⁹

4.57 This ‘wait and see’ approach seems entirely inadequate. The committee is aware that the regulator believes it is constrained in its capacity and possibly its willingness to suspend the accreditation of a wind farm operator. It can only impose a penalty once non-compliance is established. At that point, the operator adjusts its behaviour, become compliant and a penalty can no longer be applied. The CER needs to have the ability to retrospectively say, ‘You have done something wrong and you are going to pay a penalty’.

4.58 Some submitters expressed their disappointment at the lack of assistance provided to the CER in cases where an operator had breached approval conditions. Put simply, how can the CER perform its role effectively when there is inadequate monitoring and compliance of approval conditions? Dr Robert Thorne wrote in his submission: ‘[T]o the best of my knowledge, no wind farm in Victoria or South Australia employs continuous monitoring to ensure compliance with planning approval conditions’. He gave the example of the Cape Bridgewater wind farm operated by Pacific Hydro:

The Cape Bridgewater approval conditions issued by the Council (Glenelg Planning Scheme 2004) has...conditions [that] are subject to the “satisfaction of the Minister for Planning” and apply to four wind farms.

I am advised by residents who have sourced all the approval documents from Glenelg Shire Council that there is no “satisfaction” document from

⁵⁹ Clean Energy Regulator, *Submission 93*, pp 14–15.

the Minister and there is no formal complaint process as required by the conditions. I have reviewed the approval documents and cannot see any document that establishes acceptable noise limits for the wind farms.

In my view, therefore, the following outcomes follow:

- The wind farm operator cannot say the wind farm is in compliance with its approval conditions relating to noise as no approval conditions exist in fact.
- Therefore a compliance certificate cannot be given to the Clean Energy Regulator.
- Therefore the power station cannot be accredited.

Consequently the failure of the authorities responsible for checking compliance with planning approvals have failed in this statutory duty and have failed the duty of care that they owe to the affected residents. Further the planning authorities including the Minister have failed in their duty of care to the Clean Energy Regulator.⁶⁰

4.59 The committee received evidence on the need for the federal government to act to correct the passivity of the CER. Mr Bryan Lyons of Wind Energy Queensland told the committee:

Given the problems created by the federal legislation, on any 'fair go' argument the federal government must bear the responsibility to fix it. The system that must be set up for the protection of the Australian citizens and interests must cover at least the following: accreditation approvals with adequate conditions to protect ordinary Australian citizens such as the Walkdens and the Newmans; adequate, competent, independent, regular monitoring and testing of compliance at the cost of the operator; effective enforcement of compliance at the cost of the operator, including removal of the subsidy by removing accreditation for serious or repeated breaches of conditions; adequate and effective conditions for removal of the wind turbines at the end of their economic life; and reinstatement of the land at the cost of the operator.⁶¹

4.60 Even the CER indicated that improvements could be made to the compliance process:

...the Select Committee might consider whether the Regulator's current legislative tools could be enhanced to ensure that only compliant activity is rewarded, and that economic disincentives are commensurate with any contravention.⁶²

4.61 One suggestion, for a national wind farm noise regulator, was flagged by Wind Industry Reform Victoria (WIRV). As it told the committee:

60 Dr Bob Thorne, *Submission 155*, p. 7.

61 Mr Bryan Lyons, Wind Energy Queensland, *Proof Committee Hansard*, Cairns, 18 May 2015, p. 57.

62 Clean Energy Regulator, *Submission 93*, p. 16.

There is a school of thought that they become the national turbine noise police and be clearly instructed to issue RECs only to those wind facilities which are on a very regular basis shown by their testing and auditing to be compliant. That would be a noise policeman with real teeth and a big improvement. It should also be a reference point for the Clean Energy Finance Corporation's lending activities. If not the CER then let there be a stand-alone national noise policeman, which must be referred to before RECs or loans are issued.⁶³

4.62 WIRV described as 'highly significant' that the Australian Wind Alliance is now advocating improved monitoring and compliance regimes. It stated:

It is critical that monitoring and compliance of wind farms is robust and responsive to community concerns.

Compliance of wind farms with applicable regulations is in many cases devolved to the local council level, who are often under resourced and lack the appropriate skill base to execute this work properly.

Postconstruction noise monitoring is generally done by acoustic consultants retained by the developer. Submission 111 to this Inquiry from Glenelg Shire Council has suggested that postconstruction and ongoing monitoring work be done at arms' length from developers.

AWA sees merit in this idea and would welcome it as a way to increase the community's trust in the process.⁶⁴

The need to ensure independent and competent monitoring of wind farms

4.63 In addition to setting appropriate compliance standards, an important theme of this inquiry has been the need for wind farms to be monitored competently and independently. Currently, the evidence strongly indicates that this is not the case. The nature of the problem was put well by Dr Michael Crawford in his submission:

One of the fundamental problems with existing arrangements for approval and regulation of wind farms is the extensive discretion, in matters large and small, given to officials who frequently have no relevant expertise about those matters. This is in the context of pressure at the political level often to wave proposals [sic] through.⁶⁵

...there is very little effective monitoring of wind farm noise – even in relation to the ineffective noise conditions imposed on wind farms. No doubt other submissions will deal with the fundamental deficiencies in typical regulatory wind farm noise conditions. But there is no systematic monitoring to ensure adherence to those conditions.

If permanent, full spectrum, noise monitoring equipment was appropriately installed near at risk homes, ensuring compliance with the (inadequate)

63 Wind Industry Reform Victoria, *Committee Hansard*, Melbourne, 9 June 2015, p. 66.

64 Mr John McMahon, *Proof Committee Hansard*, Melbourne, 9 June 2015, p. 66

65 Dr Michael Crawford, *Submission 316b*, p. 8.

conditions would have some chance. Without those, effective operational noise monitoring is essentially “too hard”.⁶⁶

4.64 Mr Hamish Cumming also argued that a lack of political will and the undue influence of wind farm companies have compromised an effective monitoring system. He wrote in his submission:

The monitoring and compliance of wind farms is an area that lacks any real support or desire for the truth from Government departments. The wind farm companies seem to have geared the monitoring approach to suit themselves, and are generally unopposed by regulatory authorities.

For instance bird and bat mortality monitoring is structured to find minimal dead birds. AGL Macarthur employed a consultant to assess the mortality records, and they highlighted the fact that by the time the people looking for the dead birds once a month, most had been carried away by predators and scavengers. Also they highlighted that only a small percentage of turbines are searched around anyway. The consultant recommended that searches be done weekly and over more turbines. AGL did not adopt the consultants [sic] recommendations and has not changed their collection method. The consultant showed the actual mortality rates were likely to be 10 times higher than what AGL originally claimed in their permit application. The Moyne Shire is supposed to put conditions in place as part of their responsibility as Responsible Authority to limit the bird deaths, and the AGL wind farm should be shut down at peak bird times. However the Mayor and CEO are so supportive of wind farms that they will not even respond to letters making this request.

The Victorian Ombudsman has followed them up, and now the Council appears to be making false claims to the Ombudsman. This is now being looked into.⁶⁷

The folly of self-monitoring and the need for independent monitoring

4.65 It is clear to the committee the inadequacy of arrangements whereby companies self-monitor their operations in response to complaints and councils' resources are employed to adjudge whether the company's actions are adequate. Take the following example of how RATCH Australia self-monitored:

We did have a noise complaint in relation to the Windy Hill wind farm...As soon as that complaint was brought to attention...we contacted that person to find out what the problem was and to find out what we could do to try to address it. The complaint was also brought to our attention by the Tablelands Regional Council in I believe September 2011. Once those complaints were brought to our attention, what ensued was a process where we sought to conduct noise monitoring on the relevant property to find out if we were operating in a way which was interfering with the property

66 Dr Michael Crawford, *Submission 316b*, p. 8.

67 Mr Hamish Cumming, *Submission 31*, p. 5.

owner's enjoyment of the property or if we were in breach of our development consent.

That process became quite a prolonged process for a range of reasons. During the process of us conducting that noise monitoring, Tablelands Regional Council did seek to bring legal action against us. We challenged the basis of that legal action. In short, the basis upon which we challenged it was that the notice under which the council claimed that we had breached our development consent did not actually say what the breaches were, so it was quite difficult for us to work out how to address the problem. The council did seek orders in relation to the wind farm, but those orders were not granted by a court.

What ensued after that was that we continued our discussions with the council and with the relevant landowner. We were then able to complete the noise monitoring on the landowner's property. At the end of that, the results of the noise monitoring were presented to Tablelands Regional Council and they then found that the operation of the wind farm had not been in breach of its development consent.⁶⁸

4.66 Ms Lee Schwerdtfeger, a prominent community organiser against the Mount Emerald wind farm development, argued that RATCH had devised its own complaints management plan. She questioned whether this favourable framework was a creation of political convenience:

The approval conditions have no mandatory process for dealing with noise complaints. RATCH writes their own complaints management plan, and this does not have to be approved by the state government. So why do other approval conditions all require that management plans be submitted and approved, not merely submitted? Is this a deliberate oversight by the state government to favour the developer? We can be sure that noise complaints will never be properly dealt with if this project is ever built. This will just be more of the same from RATCH.⁶⁹

4.67 Mr Walkden told the committee that RATCH was ordered by the Council to conduct the monitoring, which was done by MWA environmental consultants. However, MWA received its instructions from the company and:

...only did audible noise. They were not required, as far as I am aware, to do infrasound. One of the first times that Stanwell monitored, they did not do it to the standard required. It was supposed to be a certain distance from the house and things like that in their conditions, and they did not do that. One lot of measuring was taken at the back fence and that was not according to the New Zealand standard either. They did all these little monitorings, yes it all sounded good, but it was not what they were

68 Mr Simon Greenacre, RATCH Australia, *Proof Committee Hansard*, Cairns, 18 May 2015, pp 4–5.

69 Mrs Lee Schwerdtfeger, *Proof Committee Hansard*, Cairns, 18 May 2015, p. 61.

supposed to do. And I was not confident that they would continue to do that.⁷⁰

4.68 The need for an independent monitor is recognised by a broad cross-section of stakeholders. WIRV told the committee:

The most urgent thing is to ensure that whatever noise regulations are in place are actually policed truly, independently and competently. So many of the problems we have heard about are the result of wind companies absurdly being allowed to effectively self-police. Suffering neighbours must be able to complain to somebody who wants to listen and who they know will act promptly, fairly and properly.⁷¹

4.69 Significantly, the Australian Wind Alliance agrees on the need to improve regulatory arrangements. It highlighted the Glenelg Shire Council's proposal for an independent body to monitor and enforce compliance:

It is critical that monitoring and compliance of wind farms is robust and responsive to community concerns. Compliance of wind farms with applicable regulations is in many cases devolved to the local council level, who are often under resourced and lack the appropriate skill base to execute this work properly. Postconstruction noise monitoring is generally done by acoustic consultants retained by the developer. Submission 111 to this Inquiry from Glenelg Shire Council has suggested that postconstruction and ongoing monitoring work be done at arms' length from developers. AWA sees merit in this idea and would welcome it as a way to increase the community's trust in the process.⁷²

4.70 Mr Richard Sharp proposed a reform to create a national wind farm monitoring framework based on current arrangements in NSW:

I note that in NSW, the Department of Planning and Environment achieves this by requiring wind farm developers to engage a qualified and experienced person to independently monitor environmental compliance during construction and operations.

I consider that this approach taken by the NSW Government should be applied nationally to all wind farms and should take the form of the following 'standard condition' as part of an approval:

Prior to the construction of the wind farm, or as otherwise agreed by the approving authority, the wind farm developer shall engage a Registered Environmental Professional¹ or a Certified Environmental Practitioner² who shall:

- *be independent of the planning, design, construction and operation personnel;*

70 Mr Colin Walkden, *Proof Committee Hansard*, Cairns, 18 May 2015, p. 55.

71 Mr John McMahon, *Proof Committee Hansard*, Melbourne, 9 June 2015, p. 67.

72 Mr John McMahon, *Proof Committee Hansard*, Melbourne, 9 June 2015, p. 67.

- *oversee the implementation of all environmental management plans and monitoring programs required under this approval and advise the wind farm developer upon the achievement of all project environmental outcomes;*
- *consider and advise the wind farm developer on its compliance obligations against all matters specified in the conditions of this approval and any other approval, permits and/or licences; and have the authority and independence to recommend to the wind farm developer reasonable steps to be taken to avoid or minimise unintended or adverse environmental impacts; or*
- *recommend to the wind farm developer that relevant activities are to be ceased as soon as reasonably practicable if there is likely to be a significant risk of an adverse impact on the environment, until reasonable steps are implemented to avoid such impact.*

*The wind farm developer shall act on all recommendations made by the Registered Environmental Professional or the Certified Environmental Practitioner as soon as practicable, unless otherwise agreed by the approving authority. If the wind farm proponent chooses not to implement recommendations, it shall provide written justification of the alternate course of action to the satisfaction of the approving authority within 7 days of receiving the recommendation.*⁷³

The need for adequate resources to conduct monitoring effectively

4.71 The committee understands that establishing a system that monitors wind farms systematically and scientifically will require both expertise and resources. Dr Crawford explained the resource-intensive nature of a proper wind farm monitoring system:

...wind farms [are] spread out over a large area and so proper monitoring activity requires multiple, geographically dispersed, stations with noise monitoring occurring over an extended period, since the problem depends on weather conditions which may change between the time of complaints and any monitoring action. This has to happen in the country (where the wind farms are located) whereas the relevant staff are generally city-based, so mobilising them is a significant effort. And if the wind farm operator is aware of the monitoring they can reduce the noise output in various ways, including changing the pitch of turbine blades. Doing so diminishes their electricity output and costs them some money but is worthwhile to frustrate a noise monitoring effort.

What actually exists is a mechanism for operational regulatory agencies to go through the motions of regulating without having the ability to do the job properly, or indeed regulating against the criteria which really matter, i.e. the harm being caused to individuals.

73 Mr Richard Sharp, *Submission 100*, p. 1.

If regulatory agencies persist with regulating according to noise standards, there should be a requirement for fixed noise monitoring, paid for but not controlled by the wind farm, at all at risk locations, and that noise monitoring should take account of new developments in the understanding of wind farm noise impact, such as the recent work of Steve Cooper at the Cape Bridgewater Wind Farm.⁷⁴

4.72 Other submitters also highlighted the need for the effective deployment of resources to undertake effective monitoring:

The main enforcement problem is that the local impact of wind farm noise depends on multiple changing factors, such as wind direction and speed, atmospheric conditions, and operator [sic] action in controlling the turbines. Consequently any attempt to monitor in response to complaints may well occur when the problem has temporarily subsided, relocated (because of different wind direction), or been diminished by operator action during monitoring.

The only effective solution is permanent noise monitoring, located at multiple points around a wind farm, under the control of parties with a strong motivation to quickly prosecute any breach of noise conditions to deter such occurrences. This should be paid for by the wind farm as a safety measure, just as many industrial operators are required to pay for facilities, mechanisms and practices that increase the safety of their operation. The cost of such safety provisions would be very small, typically amounting to less than 0.1% of a wind farm's capital cost.⁷⁵

The case for State EPAs to take over wind farm monitoring

4.73 The committee notes that there have been proposals to shift responsibility for monitoring and compliance of wind farms to the State EPAs. The Victorian Parliamentary Environment and Natural Resources Committee's final report for the Inquiry into the Approvals Process for Renewable Energy Projects in Victoria was tabled on 25 February 2010. The report stated:

Local councils advised that they do not currently have the capacity, expertise and resources to act as the responsible authority for wind farm projects of less than 30 megawatts. Councils identified the cumulative impacts of wind farms and monitoring and enforcement arrangements as significant issues.⁷⁶

4.74 The report recommended that:

74 Dr Michael Crawford, *Submission 316b*, pp 9–10.

75 Ms Sharn Ogden, *Submission 275*, pp 6–7.

76 Inquiry into the Approvals process for renewable energy projects in Victoria, p. xv, http://www.parliament.vic.gov.au/images/stories/committees/enrc/renewable_energy/report/Executive_summary.pdf (accessed 13 July 2015).

The Minister for Planning be responsible for the monitoring and enforcement of conditions set out in all wind farm permits and post development plans.⁷⁷

4.75 The Tarwin Valley Coastal Landscape Guardians drew the committee's attention to the following recommendations of the 2004 Bald Hills Wind Energy Facility's Planning Panel:

‘Recommendation 19: In the medium term, consideration should be given to the establishment of a role for the EPA in monitoring and enforcing acoustic conditions.

‘Recommendation 20: In the medium term, consideration should be given to the use of a SEPP or other relevant Victorian standard to define the specific application of NZS 6808 and or the forthcoming Australian standard to wind energy facilities.’⁷⁸

The Panel's report also stated that:

The absence of an independent entity charged with acoustic condition compliance monitoring adds considerably to difficulties in assessing operational performance in the face of noise complaints.⁷⁹

4.76 Landholders, such as Ms Jane Robson of Mt. Helen in Victoria, also proposed a prominent role for the State EPA in monitoring and compliance:

Adequacy of monitoring and compliance is of a very low standard at this time and I believe there needs to be independent noise monitoring done and that the EPA should be given the role and the funds to fulfil this role so there is a better avenue for complaints by neighbours. Noise testing should occur regularly and randomly at lots of different times of the day and night and under all conditions to get an honest view of Wind Turbine noise.⁸⁰

4.77 However, it is important that any proposal to shift responsibility for compliance to State EPAs comes with a commensurate shift in resources and expertise to the EPAs. Mr Les Huson has indicated that the Victorian EPA may not currently have the capacity to fulfil the lead role in monitoring and compliance of wind farms.⁸¹

77 Inquiry into the Approvals process for renewable energy projects in Victoria, p. xvii http://www.parliament.vic.gov.au/images/stories/committees/enrc/renewable_energy/report/Executive_summary.pdf (accessed 13 July 2015).

78 Tarwin Valley Coastal Guardians, *Submission 45*, p. 17. See page 210 of the Panel report. A full list of recommendations is provided in Appendix A of submission 45.

79 Tarwin Valley Coastal Guardians, *Submission 45*, p. 17.

80 Ms Jane Robson, *Submission 144*, p. 2.

81 Mr Les Huson, *Proof Committee Hansard*, Melbourne, 9 June 2015, p. 60.

A fee for service system

4.78 The MAV discussed with the committee a proposal to establish a licencing regime. Under this scheme, wind farm operators must pay an annual licencing fee for an independent authority to undertake ongoing monitoring and compliance. An annual certificate or licence is then awarded to the operator to verify compliance with the relevant standards and conditions. In MAV's view:

Such a regime would provide a number of benefits, including community confidence that noise is appropriately regulated, regulatory certainty for the wind farm industry, equity between different types of electricity generators and removing the noise compliance and monitoring impost on councils. Recognising that the above requires time and political will to progress, the MAV, in partnership with the Victorian Environment Protection Authority, has brokered an arrangement that will provide councils with access to EPA accredited noise auditors on a fee-for-service basis. While the service comes at a cost and the monitoring compliance burden still rests with council, the auditors are certified as independent by the EPA. This arrangement should remove any doubt regarding the independence of the noise compliance assessment and should provide an authority of advice on the wind farm's compliance with the relevant standards. These services will also be made available to the wind energy industry providing additional certainty to the local government and community that the application complies with the relevant New Zealand standard as part of the planning permit process. Ideally, under this arrangement, we would also like to see any new and existing wind farms being required to submit an annual compliance certificate to verify ongoing compliance.⁸²

4.79 The committee believes that a fee for service licencing system would offer these, and other, benefits. Chapter 6 presents the committee's recommendation on how this system should be framed and developed.

The case for greater transparency in monitoring and compliance

4.80 Some submitters and witnesses to this inquiry have emphasised the need for monitoring and compliance processes to be more transparent. Ms Kay Smith, for example, argued:

The EPA's involvement in monitoring turbine noise emission would provide a more transparent avenue for dealing with complaints/claims from neighbours re experiencing adverse effects.⁸³

4.81 Mr Tony Edney from Ballarat raised questions about the power of local councils over wind farm operators:

82 Mr Gareth Hatley, Municipal Association of Victoria, *Proof Committee Hansard*, 9 June 2015, p. 54.

83 Ms Kay Smith, *Submission 72*, p. 2.

Councils probably at the moment do not have the power to compel turbine operators to turn off their machines, to enable proper base level sound recordings, without which it is very difficult to make a useful comparison with operating sound levels. Neither would they be able to force operators to provide mast head information about wind speed and direction from the turbine nacelle, data necessary to correlate with in home recordings, to obtain an accurate take on sound energy present in a dwelling.

Wind farm operators are effectively in control of the data that is necessary to properly investigate complaints against them. Government presently, at whatever level, does not have the legislative capacity to force this information out of them, to have them stop the turbines, for any purpose. Wind companies are safely at liberty to go on causing damage to people, to drive some from their homes, in the comfortable knowledge no one can do much about it.⁸⁴

4.82 The difficulty accessing critical data has also been raised by several acousticians. Mr Les Huson is one acoustician who has expressed his disappointment that wind farm operators have not made wind speed data publicly available. He told the committee:

I have been involved in the measurement of noise emissions from the Leonards Hill wind farm and the Macarthur Wind Farm. For the past three or four years I have been hampered in my attempts to complete an independent compliance assessment of the Leonards Hill wind farm. I have gathered all the acoustical data but do not have the corresponding wind speed data that is required to complete the analysis. This wind speed data has been promised by Hepburn Wind but as yet has not been made available.

4.83 Mr Huson also told the committee of significant flaws in the peer review process for compliance assessment:

Recently I was asked to provide comment on the compliance assessment and two peer reviews of an assessment done for the Macarthur Wind Farm. I prepared a report summarising my findings, but the report was refused to be accepted by the local shire council, even though it showed serious flaws in the analysis process which skewed data to the benefit of the wind farm operator. The analytical flaws were presented but ignored. The data giving rise to the flaws was not provided to either the authors of the compliance report or the peer reviewers of that report. Effectively what was happening there was that data was being withheld from the people doing assessments on noise compliance, which effectively made it easier to comply.⁸⁵

84 Mr Tony Edney, *Submission 214*, p. 4.

85 Mr Les Huson, *Proof Committee Hansard*, Melbourne, 9 June 2015, pp 59–60.

Commercial-in-confidence considerations

4.84 The committee questions the basis on which wind farm companies claim that there are commercial-in-confidence considerations relating to their operating data. The committee has not received a convincing explanation from these companies as to why its recommendation to publish wind speed and basic operation statistics would harm commercial interests.

4.85 All wind farm data should be publicly available and published where all citizens can scrutinise the operation of turbines. In its interim report, the committee recommended that the data collected by wind turbine operators relating to wind speed, basic operation statistics including operating hours and noise monitoring should be made freely and publicly available on a regular basis. The committee argued that the proposed Independent Expert Scientific Committee (see chapter 6) should consult with scientific researchers and the wind industry to establish what data can be reasonably made freely and publicly available from all wind turbine operations accredited to receive renewable energy certificates.⁸⁶

The need for a wind farm Ombudsman

4.86 This committee has gathered a volume of evidence from citizens with complaints about the operation of wind turbines, and who have relayed to the committee their annoyance and frustration that these complaints not having been heard. The following is an excerpt from a submission made by Mr Gunter Wilhelm of Evansford in Victoria. His account is, unfortunately, not uncommon:

Acciona's complaint procedure is entirely unsatisfactory. When we and our neighbours began making complaints, no Incident Report Reference Number was provided. Initially we made phone complaints but when we realised that Incident Report Numbers were not being issued, we proceeded to complain via email so as to have an official record of our complaint. On 1 June, 2010, my partner requested an official complaint form and an outline of the complaints procedure, only to be told there was no complaints procedure – just to respond within 48 hours to a complaint. Yet in the Operational (stage 2) Environmental Management Plan (OEMP) Version 1.1 February 2008 of Acciona's Permit, there is a Complaint Procedure outlined. It was not until I requested and continued to request that an Incident Report Number be provided that it was.

On 6 June, 2010, I was sent an email by Acciona's Community Liaison Officer, in response to my request for an official Incident Report Reference Number. I was issued Incident Report Number 1 (email available on request). I emailed back and asked if this was my personal complaint log and was told that this Incident Report Reference Number was not personal and applied to all complaints lodged. What had happened to all the complaints lodged by phone or email from April 2009 – June 2010, all prior

86 Senate Select Committee on Wind Turbines, *Interim Report*, June 2015, Recommendation 7.

to Incident Report Reference Number 1 being issued? We know that many of our neighbours either complained by phone, or dropped into the Acciona office. They were not issued Incident Report Reference numbers. No wonder Acciona could claim so few complaints!

At no stage has Acciona made any attempt to site visit our property to evaluate, monitor for noise or discuss health concerns.⁸⁷

4.87 Waubra resident Mr Noel Dean had similar frustrations in dealing with Acciona, the local council and the Victorian Planning Department. He noted the different complaint mechanisms at local and state level and his annoyance at the State Government's handling of his grievance:

...when I first made a complaint, I went to the state office in Ballarat. They said, 'We've got no-one here to know how to force compliance', and we got the same statement from the council that it is the department of planning's problem. So the department of planning put out a thing in 2009 to say that the council is responsible for it. They said, 'We can't do it'. All the council had to do at Waubra was to issue an enforcement notice that said to comply. The problem is that the laws by the planning department are different from those of the council. With the council, if any one person makes a complaint or a degree of a complaint, they have to investigate it. The planning department only has to satisfy probably 90 per cent of people, and the planning department has not got the force to force compliance like the department of health and wellbeing and the council do. The council has our report, and the report that is in our submission, with letters from the planning minister, went to the council. The council have been hearing that for four years. They have known that Waubra Wind Farm is noncompliant for four years and would not put enforcement notices in. What happened in the planning department is the planning cabinet was corrupt in that its condition 17 was changed to be commissioned by the proponent who is the owner of the information. Therefore they said to us, 'We don't have to give the thing to you' because they have got no obligation. They were given the permission to commission the report, so they got the report. It was the planning minister's responsibility to commission the report, and someone in the office has changed it around so that means we have got no protection. They have got a legal right and they have said to us in legal letters: 'We have no obligation to give you the report.' They commissioned a report through Marshall Day and kept it, and we cannot get it off them until we have a court case.⁸⁸

4.88 Similarly, another Waubra resident, Mr Donald Thomas told the committee:

There is desperate need for a proper complaint system, because nothing is done anyway. Most of the time the worst part of the noise issue is that it happens in out-of-office hours, so you are not going to get someone to

87 Mr Gunther Wilhelm, *Submission 198*, p. 3.

88 Mr Noel Dean, *Proof Committee Hansard*, Melbourne, 9 June 2015, p. 20.

come and listen at three o'clock in the morning. They come the next day, and that is very little use.⁸⁹

4.89 The committee's interim report recommended that the Commonwealth Government establish a National Wind Farm Ombudsman to handle complaints from concerned community residents about the operations of wind turbine facilities accredited to receive renewable energy certificates. The Ombudsman will be a one-stop-shop to refer complaints to relevant state authorities and help ensure that complaints are satisfactorily addressed.

4.90 The committee is pleased that the federal government has agreed to establish a National Wind Farm Commissioner to resolve complaints from concerned residents about the operation of wind farm facilities. The Commissioner will publish documents on:

- the location of existing and proposed wind farms in Australia;
- planning and environmental approvals in place for each wind farm;
- RECs received by each wind farm; and
- data on wind farm operators including operating times, wind speed, power output and sound monitoring.

Committee view

4.91 The evidence presented in this chapter strongly points to the need for regulatory reform in the way that wind farms are monitored and forced to meet compliance standards in Australia. Chapter 6 of this report presents a number of recommendations relating to these issues. Fundamentally, there is a need for rigorous and uniform sound standards that form the cornerstone of National Wind Farm Guidelines. There is also need for a State-based system that licences all large-scale wind farm operators and enables the State regulator to suspend and cancel an operating licence if the company breaches compliance conditions. As chapter 6 discusses, the eligibility of wind farm operators to receive renewable energy certificates should be based on their satisfying ongoing compliance checks.

89 Mr Donald Thomas, *Proof Committee Hansard*, Melbourne, 9 June 2015, p. 14.

Chapter 5

Fauna and aircraft

Introduction

5.1 In addition to the effect of wind turbines and industrial noise on human health, wind turbines have a range of other detrimental environmental impacts on the surrounding environment that require attention. Term of reference (g) of this inquiry directs the committee to examine the 'effect that wind towers have on fauna and aerial operations around wind turbines, including firefighting and crop management'.¹ This chapter will examine the following issues:

- modification of sensitive ecosystems through land clearing activities and interference in the flight zones of native birds leading to serious injury and death;
- impacts on visual amenity;
- interference with aerial firefighting activities, resulting in increased destruction of native vegetation and habitat during fire events; and
- interference with crop management activities (including aerial application of fungicides and herbicides that result in downgrading of crop quality and yields (hence decreasing farmer's profits. and local economies).

Fauna

5.2 The impact of wind farm development and operation on native fauna, in particular native birds and bats, has been raised by many witnesses and submissions to the committee. In its submission, Save the Eagles International described wind turbines as "ecological traps"—population sinks that attract and kill millions of birds and bats year after year'.²

5.3 There are a wide range of estimates as to the extent of fatalities caused by wind turbines on aerial fauna. Ms Emma Bennett noted that 'only a limited number of studies' had been conducted into the impact of wind farms on bird mortality, and that estimates indicate that '2 000 to 8 000 birds [are] annually killed across all wind farms in Australia'.³ The Australia Institute contends that the 'average death rate is 1–2 birds

1 Term of reference (g)

2 Save the Eagles International, *Submission 326*, pp [5–6].

3 Ms Emma Bennett, *Committee Hansard*, Melbourne, 9 June 2015, p. 33.

per turbine per year'.⁴ Considering that there are currently 2 077 turbines in Australia, these estimates seem to correlate.⁵

5.4 However, a report on bird and avifauna mortality commissioned by AGL Energy for its Macarthur Wind Farm found that 10.19 birds were killed by each turbine in a 12 month period. This equates to over 1 400 birds killed at the Macarthur Wind Farm alone and over 21 000 if extrapolated across the country. Despite the apparent thoroughness of this monitoring exercise—4 surveys in 12 months—the authors of the report were concerned that the 'estimates of mortality, however, are considered to be inaccurate due to the frequent removal of carcasses by scavengers'.⁶

5.5 Notwithstanding the debate over the number of mortalities, some submitters argued that the number of deaths caused by wind farms were insignificant compared to the 'higher rate of avian mortality that results from collisions with automobiles, transmission towers and power lines, as well as the damage done by domestic and feral cats which cause significantly more deaths'.⁷ The committee shares the concerns of many submitters that information on the subject of avifauna mortality at windfarms is unclear and that more research in this area is required with special consideration of those bird species which are endangered.

5.6 Many submitters noted the high prevalence of native birds in areas surrounding current and proposed wind farms. In her submission to the committee, Councillor Marjorie Pagani noted that the region adjacent to the proposed Mt Emerald Wind Farm in northern Queensland is a haven for many species of birds and bats:

Our region (and my own property) is home to abundant raptor and other bird life, and quolls, including the rare northern spotted quoll. These have all been observed on my property. The containment of mass destruction of habitats has not been sufficiently explained in the developer applications. Nardellos Lagoon, a few kilometres from the centre of the range, is a significant breeding area for Sea Eagles, Saris Cranes, Brolgas and a major habitat for black swans. The range is a major migratory bird flight path, for not only the raptors, but also the flying foxes. The developer has admitted

4 The Australia Institute, *Submission 67*, p. 3. See also: South Australian Government, *Submission 59*, p. 9; Ms Kim Forde, *Submission 65*, p. [4]; Ms Emma Bennett, *Submission 267*, pp [2–3].

5 Number of turbines, see Chapter 1.

6 Dr Matthew Wood, Australian Ecological Research Services, *Macarthur Wind Farm, Bat and Avifauna Mortality Monitoring* (Prepared for AGL Energy), June 2014, p. ii, <https://stopthesethings.files.wordpress.com/2014/09/macarthur-bat-and-avifauna-mortality-monitoring-report-full.pdf> (accessed 1 July 2015).

7 The Australia Institute, *Submission 67a*, p. 24. See also: Ms Emma Bennett, *Committee Hansard*, Melbourne, 9 June 2015, p. 33; Wallace P. Erickson, Gregory D. Johnson and David P. Young, 'A Summary and Comparison of Bird Mortality from Anthropogenic Causes with an Emphasis on Collisions', *USDA Forest Service General Technical Report*, PSW-GTR-191, 2005, p. 1039. A number of submissions disagree with this proposition. See, for example: Mr Michael Crawford, *Submission 316b*, p. 7.

the flight path of these birds is at the height of the proposed turbines. It has not acknowledged either the migratory species, nor the Nardellos breeding lagoon in its report, nor has it acknowledged the extensive cropping in the area and the bird numbers from that perspective.⁸

5.7 Mr Alan Cole, a farmer in the Yass region of southern NSW highlighted a number of the key species currently found at his farm, part of the proposed site for the Yass Valley Wind Farm:

My farm sits in a valley located between the Black Range and Mt Bowning just west of Yass. This valley is a raptor hotspot, with numerous species of raptors including Wedge Tailed Eagles, Little Eagles, Sea Eagles (from Burrinjuck Dam) and Peregrine Falcons (to name a few) frequent the area. Whilst only two of these species are considered endangered, it is my opinion that the Epuron proposed WINDPEG's for the Black Range have the potential to decimate local populations of these raptors.⁹

5.8 Several submissions and witnesses highlighted two bird species that are particularly vulnerable—the brolga (*Grus rubicunda*) and the Superb Parrot (*Polytelis swainsonii*).

5.9 The brolga is one of only two types of crane found in Australia. The NSW Office of Environment and Heritage notes that the brolga population 'is very sparse across the southern part of its range' and that the brolga is regarded as being a 'vulnerable' species in both NSW and Victoria.¹⁰ Mrs Susan Dennis, President of the Brolga Recovery Group, concurs noting:

The brolga is considered to be significantly prone to future threats which are likely to result in its extinction; it is very rare in terms of abundance. There are fewer than 500 remaining in south-west Victoria.¹¹

5.10 Mrs Dennis outlined the impact that wind farms have on brolgas.

There are three ways that wind energy facilities can impact on the brolga: direct collision, barrier effects and, the most critical of all, displacement from habitat. The brolga simply cannot afford to be displaced from an already limited habitat. It can be quite clearly seen in the maps that there are groups of wind energy facilities proposed and constructed in important

8 Ms Marjorie Pagani, *Submission 340*, p. [5].

9 Mr Alan Cole, *Submission 73*, p. [6].

10 A vulnerable listing means that the species is facing a 'high risk of extinction in the wild'. See: NSW Office of Environment and Heritage, *Threatened Species: Brolga – profile*, <http://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10382> (accessed 29 June 2015); Victorian Department of Sustainability and Environment, *Advisory List of Threatened Vertebrate Fauna—2013*, p. 11, http://www.depi.vic.gov.au/_data/assets/pdf_file/0019/210439/Advisory-List-of-Threatened-Vertebrate-Fauna_FINAL-2013.pdf (accessed 29 June 2015).

11 Mrs Susan Dennis, President, Brolga Recovery Group, *Committee Hansard*, Melbourne, 9 June 2015, p. 38.

brolga habitat. The current evidence is that the brolgas are likely to be displaced up to eight kilometres. So where do they go? Brolgas tend to use the same habitat areas over many years, so it is not just a case of creating a wetland somewhere else and hoping the brolgas will go there. Clearly, there are no offset plans that can compensate for stolen habitat. And when wind energy facilities are so close together in brolga habitat, there cannot be a zero net impact and the requirement to avoid any cumulative impact is clearly impossible.¹²

5.11 Mr Hamish Cumming, formerly a Brolga Recovery Group secretary, told the committee that the issue relating to brolgas and wind turbines is one of displacement:

Studies have been done in America and Australia that show that the turbines are displacing cranes—and brolgas are a crane—for a distance of up to 14 kilometres but regularly a distance of six kilometres. Since the Macarthur wind farm started—and I try to use all these people's own reports; they are the best thing to use—their reports have said that 45 wetlands were abandoned in the first 12 months, and 25 of them were potential breeding wetlands, and no brolgas have successfully nested within six kilometres of turbines.¹³

5.12 The Superb Parrot is another species that is under threat from wind farm development and operation. Similar to the brolga, the Superb Parrot is listed as a vulnerable species under the federal *Environment Protection and Biodiversity Conservation Act 1999* and at a state level in the ACT and NSW.¹⁴ The Victorian Government has taken one step further, listing it as an endangered species.¹⁵ In his submission, Mr Cole observes:

The Yass District happens to enjoy the natural range of one of the most beautiful and rare parrots found in NSW; the Superb Parrot.

It is understood that this threatened species is starting to recover from the population loss it has experienced from habitat destruction. Of great concern for the future of this species is the potential impact of wind turbines in central NSW. The proponents of WINDPEG's tend to trivialise these potential impacts.¹⁶

12 Mrs Susan Dennis, President, Brolga Recovery Group, *Committee Hansard*, Melbourne, 9 June 2015, p. 38.

13 Mr Hamish Cumming, *Proof Committee Hansard*, Portland, 30 March 2015, p. 52. See also: Mr Hamish Cumming, *Submission 31*, p. 6.

14 Australian Government Department of the Environment, *Polytelis swainsonii—Superb Parrot in Species Profiles and Threats Database*, 2015, http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=738 (accessed 3 July 2015).

15 An endangered listing means that the species is facing a 'very high risk of extinction in the wild'. See also: Victorian Department of Sustainability and Environment, *Advisory List of Threatened Vertebrate Fauna—2013*, p. 11.

16 Mr Alan Cole, *Submission 73*, p. [6]. See also: Mr John McGrath, *Submission 314*.

5.13 The committee notes that the Superb Parrot is subject to the same threats as the brolga—'direct collision, barrier effects and, the most critical of all, displacement from habitat' as outlined by Mrs Dennis above. Mr John McGrath states that 'the greater Boorowa area is a known breeding ground for the Superb Parrot' and that any development in this area must consider wind turbines as a key threatening process.¹⁷

5.14 The committee is also concerned about the impact of land-clearing activities related to wind farm development that result in the direct and indirect deaths of fauna—birds, bats and other invertebrates. The Waterloo and District Concerned Citizens Group noted that the Waterloo Wind Farm has resulted in the 'loss of habitat of native and endangered birds and animals, particularly eagles and other raptors'¹⁸ The Tarwin Valley Coastal Guardians described the horror of finding four dead koalas over a 4–6 week period as a result of land clearing to install a transmission line.¹⁹ One of these dead koalas can be seen in Figure 6.1 below. Mr John McGrath shared his concerns about unexpected deaths in his submission:

We remain mystified as to why perfectly healthy and heavy Wedged Tailed Eagles fall out of trees dead or are found in local paddocks in the same condition dead. A fact that we believe as a family needs further investigation.²⁰

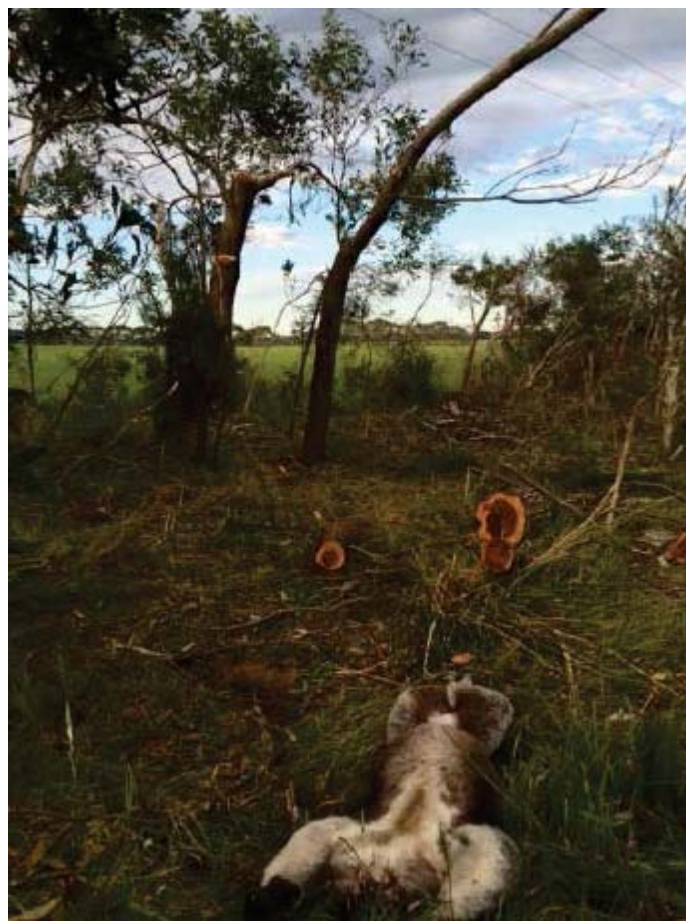
17 Mr John McGrath, *Submission 314*, p. 4. See also: BWTAG, *Submission 227a*, p. 6.

18 Waterloo and District Concerned Citizens Group, *Submission 21*, p. [2].

19 Tarwin Valley Coastal Guardians, *Submission 45*, p. 45.

20 Mr John McGrath, *Submission 314*, p. [3].

Figure 5.1: One of four dead koalas allegedly found by local residents at a construction site associated with the Bald Hills Wind Farm



Source: Tarwin Valley Coastal Guardians, *Submission 45*, p. 45.

Inadequacy of bird and bat surveys

5.15 The committee has received evidence about the poor knowledge base that exists within the environmental consultancies that prepare and submit environmental approvals and management plans on behalf of wind farm proponents, and the planning and environmental agencies that regulate and approve wind farm development.²¹ This section will discuss examples of avifauna surveys conducted in conjunction with wind farm development.

5.16 The bird survey conducted by Brett Lane and Associates as part of the environmental approvals process for the Bald Hills Wind Farm was reviewed by Dr Lucas Bluff in a report to the Tarwin Valley Coastal Guardians. This report quoted the Victorian Government's independent Planning Panel as describing the bird survey as 'a relatively low survey effort'. Not only was the total number of hours completed for the bird survey manifestly inadequate, the quality of the survey work was also

21 Tarwin Valley Coastal Guardians, *Submission 45*, p. [65].

questioned.²² Most of the survey work was undertaken between 8.00am and 5.00pm, clearly not in line with best-practice with the panel indicating that 'you really need to start predawn and finish after dusk'.²³ Finally, Dr Bluff states that an inappropriate survey spatial design was chosen and implemented. Dr Bluff is quite plain in his concluding observations on the bird survey:

It has been acknowledged that the timing of Lane's survey work was flawed, and that the result of this error is to reduce the apparent utilization of the site by birds and potentially to miss movement patterns of some species altogether. Therefore, the risk that the development would pose to birds is unambiguously higher than that claimed by Lane.²⁴

5.17 Many of the same issues were apparent in the bat survey. A review of the bat survey by the Planning Panel highlighted that a species known to the area and of high conservation concern—the Bentwing Bat—was not located during these surveys with the Panel acknowledging 'that Lane's bat survey work was insufficient to quantify the presence of Bentwing bats at the site, and recommended extended monitoring of the bat population and of bat kills'. An expert on these bats, Dr Belinda Appleton, was more direct stating that:

The proposed wind farm should not be approved until the necessary investigations into effects on bat mortality have been carried out.²⁵

5.18 This is not the only incidence where the results of a fauna survey have been called into question. The fauna surveys conducted for wind farms in the Boorowa area, in southern NSW, were appraised by Mr John McGrath:

Brett Lane and Associates basically self-admitted that they did [no] more than small walk t[h]rough's of the area of some of the proposed conglomeration of 360 wind towers stretching from the Hume Highway just North of Yass through to the Rye Park Rugby area.

From my memory they claimed that they did a "walk through" in May of small portions of this proposed conglomerations of towers and stated that there were no Superb Parrots *Polytelis swainsonii*—That's exactly correct there are no Superb Parrots in residen[ce] in the Boorowa area in May, the birds arrive from their Northern haunts in preparation for breeding in very late August mid-September whereupon they build themselves up physically for breeding by feasting on the blossom of the Yellow Box *Eucalyptus melliodora*, then after a hectic period breeding of less than 4 months viz laying, setting on their eggs[,] hen[s] only being fed mainly by the cock bird, raising their chicks to fledging, fledging their chicks they all then

22 Tarwin Valley Coastal Guardians, *Submission 45*, p. [59].

23 Tarwin Valley Coastal Guardians, *Submission 45*, p. [60].

24 Tarwin Valley Coastal Guardians, *Submission 45*, p. [62].

25 Tarwin Valley Coastal Guardians, *Submission 45*, p. [62].

depart again for their Northern haunts in mid-January the next year. The greater Boorowa area is a known breeding ground for the Superb Parrot.²⁶

5.19 Adjacent landholders to the Moorabool wind farm in Victoria, Mr and Mrs John and Sue Dean noted the inadequacy of flora and fauna assessments:

Flora and Fauna studies were faulty. No level 2 survey was undertaken for the Wedge Tailed Eagle. No specific survey was undertaken for the Growling Grass Frog. No survey undertaken for the Powerful Owl and no consideration given to the flight path of the Yellow Tailed Black Cockatoo. In fact, there were only desk top studies done for most of the rare and threatened species and no EES was requested by the Planning Minister.²⁷

5.20 In its submission to the committee, the Bodangara Wind Turbine Awareness Group (BWTAG) raised a number of concerns about the Flora and Fauna Assessment conducted for the Bodangara Wind Farm. These concerns focus on the inadequacy of the biodiversity assessment and include:

- insufficient detail provided to support the assessment of impacts on native flora and fauna;
- insufficient detail provided with regard to avoidance measures;
- inadequate details provided with regard to options for mitigating impacts on biodiversity; and
- the EA [Environmental Assessment] does not include a detailed offset proposal.

BWTAG found that there appears to be insufficient data in the Flora and fauna Assessment to 'support the conclusions of the impact assessment'. These concerns were also shared by the NSW Office of Environment and Heritage.²⁸

5.21 In its defence, the proponent asserts that a more detailed assessment is not required as the wind farm site is 'an "overcleared" agricultural landscape' of low ecological value. However, BWTAG argues that the value of the remnant scattered paddock trees is 'constantly being underplayed':

Removal of a single tree from an over-cleared landscape can have detrimental impacts to landscape connectivity for some threatened woodland birds (see Doerr et al.'s (2011) work on Brown Treecreepers and threshold distances for crossing gaps between habitat). Furthermore, wind turbines have been found to reduce bird breeding habitat up to 500m (Pearce-Higgins et al. 2009), thus appropriate buffers should be applied to habitat supporting threatened species.²⁹

26 Mr John McGrath, *Submission 314*, p. 4.

27 Mr and Mrs John and Sue Dean, *Submission 63*, p. 1.

28 Bodangara Wind Turbine Awareness Group, *Submission 227a*, pp 1–2.

29 Bodangara Wind Turbine Awareness Group, *Submission 227a*, p. 2.

5.22 The collection of data detailing the delicate interactions between landscape and fauna is integral to the developer's understanding of the impact of any changes that the wind farm development will impose on the environment—no matter how minuscule the developer may perceive these changes to be. BWTAG states:

While intensive surveys to inform potential impacts are expensive, [BWTAG] agrees that a balance must be met to obtain robust, scientifically backed assessments of impacts. However, in the absence of data, the precautionary principle should be applied.³⁰

National Wind Farm Guidelines

5.23 The previous section has highlighted the real risks posed to fauna, particularly to avifauna, by the development and operation of wind farms. The committee has received evidence detailing considerable inconsistencies in the conduct of environmental assessments leading to insufficient and incomplete data-sets.

5.24 In its interim report, the committee has recommended that the Commonwealth Government implement National Wind Farm Guidelines to provide a 'consistent, transparent and sustainable regulatory framework for the development, monitoring and compliance of wind farms'. These would establish minimum standards on a range of planning and development issues including on standards relating to avifauna.³¹

5.25 Mr Richard Sharp noted that many of these inconsistencies exist between state and national recovery plans resulting in the arbitrary inclusion or exclusion of certain species from environmental assessments:

I am of the opinion that there is scope to provide better information concerning the effect that wind towers have on fauna, especially birds or reptiles. For example, the national recovery plan for the Superb Parrot does not identify wind towers as a threat and yet wind farm developers are often required to consider this threatened bird species during their design and planning phases. Another example, concerns the White-breasted Sea Eagle. In Tasmania, the effect of wind towers on this large bird of prey is identified in the state recovery plan which highlights this particular species is at threat due to the high incidence of and potential for fatalities and injuries from collisions with wind towers. Given that the White-breasted Sea Eagle is a nationally protected migratory species that inhabits the coastline and inland Australia, it is disappointing that wind farm developments on the mainland do not, as a mandatory requirement, give due consideration to the White-breasted Sea Eagle.³²

30 Bodangara Wind Turbine Awareness Group, *Submission 227a*, p. 2.

31 Senate Select Committee on Wind Turbines, *Interim Report*, June 2015, pp 2 & 9. See Recommendation 3.

32 Mr Richard Sharp, *Submission 100*, p. [2].

5.26 In addition, when certain species are included there does not seem to be a standardised approach to the planning and conduct of fauna surveys.

Even if the department guidelines for buffering brolga habitat areas from wind turbines were the best guidelines in the world, without any requirement for proponents to use complete datasets of known brolga breeding, flocking and feeding sites they are useless. We have seen that time and time again. This systematic underestimation of both the number of brolga in a given area and the number of flights taken can only lead to the demise of the brolga. In addition, no cumulative studies have been undertaken. Each wind energy facility has its own dataset and, even if the same consultants do the research for multiple wind energy facility proposals, the data cannot be shared due to commercial-in-confidence issues.³³

5.27 The committee highlights the considerable work already undertaken in establishing the Draft National Guidelines that were released in 2010. Chapter 3 of this report has highlighted the history of this process and how these national guidelines may be developed in a more holistic sense to capture all aspects of the planning and development process.

5.28 These Draft National Guidelines represent an appropriate start from which to continue the development of a new set of National Wind Farm Guidelines. The committee notes the following key concepts from the Draft National Guidelines that should be considered as 'guiding principles' in developing the new National Wind Farm Guidelines as they relate to assessments of fauna:

- That wind farms 'not be approved in or near areas of significant wildlife habitat, breeding grounds, or transitory pathways'.³⁴
- That 'locating additional wind turbines along a migratory corridor may have a cumulative impact on birds and bats. This is particularly an issue if there are species that utilise the wider area of the combined wind farms. Migratory birds may fall into this category as, while they may only be present at a site for short periods of time, they may be exposed to more wind farms.'³⁵

33 Mrs Susan Dennis, President, Brolga Recovery Group, *Committee Hansard*, Melbourne, 9 June 2015, p. 38.

34 Environment Protection and Heritage Council, *Draft National Wind Farm Development Guidelines*, July 2010, p. 11, <http://www.scew.gov.au/system/files/resources/8e446a1a-ab93-5f84-99d0-12d3422d2a23/files/draft-national-wind-farm-development-guidelines-july-2010.pdf> (accessed 26 June 2015). See also: Ms Marjorie Pagani, *Submission 340*, p. [5].

35 Environment Protection and Heritage Council, *Draft National Wind Farm Development Guidelines*, July 2010, p. 11, (accessed 26 June 2015).

- That wind farm development and planning adopt a 'a risk-tiered approach, whereby assessment becomes more intense with increased potential for impacts.'³⁶

Visual amenity

5.29 There is an expectation in rural areas that changes to landscape character and vistas will be minimal over time, largely reflecting the relatively low development requirements of the pre-dominantly farming and grazing activities of those areas. Landscapes in these rural areas are dominated by natural vistas such as forests and grasslands with occasional farming related infrastructure such as houses, sheds, livestock handling facilities and silos—all usually the equivalent of one storey—interspersed in a sympathetic manner with the landscape. The proposed development and operation of wind farms in these settings fundamentally alters the character of these landscapes.

5.30 The committee has received considerable evidence detailing the impacts that wind farm development and operation have on the visual amenity of their host sites.³⁷ Greg and Michelle Noel summarised the views of many submitters:

Visual amenity will be hard to get used to as the turbines will disrupt the natural landscape qualities that we enjoy every day in this area. We built our house in a position where we could enjoy such views and now will be looking at it with turbines jutting out in the range beyond it.³⁸

5.31 In his submission, Mr Keith Staff noted his concerns about the primary methodology used to illustrate to the community what a wind farm will look like—photomontages:

These visual photomontages are displayed at public information days in an attempt to try to prove how little impact there will be on visual amenity for landholders and local communities or impacts on the Landscape and hide how dominant turbines will be when located close to properties and communities...

The outcomes are that communities have little idea of the size/ impacts until the massive wind towers are constructed, it is then too late for any objections.³⁹

36 Environment Protection and Heritage Council, *Draft National Wind Farm Development Guidelines*, July 2010, p. 117, (accessed 26 June 2015). Reference to the voluntary standard *Wind farms and birds: Interim standards for risk assessment*.

37 See, for example: Dr Michael Crawford, *Submission 316ss*; Ms Jacqueline A Rovensky, *Submission 89b*, pp 4–5. Tarwin Valley Coastal Guardians, *Submission 45*, p. 10. Parkesbourne Mummel Landscape Guardians, *Submission 119*.

38 Mr Greg and Mrs Michelle Noel, *Submission 390*, p. [2].

39 Mr Keith Staff, *Submission 32*, p. [4].

5.32 In this context, the committee draws attention to a submission from Mr Robert Allen in which he notes incorrect information distributed by the proponent of Sapphire wind farm in northern New South Wales. The parent company CWP Renewables has published a map of the proposed wind turbine locations in which seven turbines are pictured. The map is reproduced in Appendix 5. Mr Allen quite rightly expresses his annoyance and bemusement:

This is highly misleading as there are actually one hundred and fifty nine turbines. And note that the map reads: The wind turbines depicted on this map represent the approximate extent of the current windfarm layout. That's a highly interesting interpretation of the word approximate! Since when is 7 an approximation of 159?⁴⁰

5.33 In addition to the loss of views from a family home, there are tangible impacts for those seeking to sell their house and land. Some submitters spoke about the erosion of property values with some landholders reporting decreases of up to 40 per cent in land value due to the immediate proximity of a wind farm.⁴¹ Mr Charles Barber and others have told the committee that 'it has rendered my farm unsaleable.'⁴²

Committee view

5.34 One of the many concerns that the committee has around environmental assessments for wind farms is the poor engagement of proponents with community groups and affected landholders on the adequacy of surveys and reports. It is common for proponents to make no attempt to assuage the concerns of these groups by stonewalling any opposition and ring-fencing environmental reports. This attitude is clearly inadequate. In many cases, additional survey work and provision of more detailed data-sets may provide comfort to the broader community that these projects are proceeding on the basis of sound science and the best available information. It is the committee's view that the establishment and implementation of National Wind Farm Guidelines will assist in maintaining coherent national minimum standards for environmental assessment (including visual amenity) that landholders, communities, government and wind farm operators can have confidence in.

Aerial activities

5.35 The National Airports Safeguarding Framework note that 'wind farms can be hazardous to aviation as they are tall structures with the potential to come into conflict

40 Mr Robert Allen, *Submission 410*, p. [3].

41 Mr Charles Barber, *Committee Hansard*, Canberra, 19 June 2015, p. 45. See also: Dr Michael Crawford, *Submission 316b*, p. 12; Ms Marjorie Pagani, *Submission 340*, pp [4–5]; Waterloo and District Concerned Citizens Group, *Submission 21*, p. [2].

42 Mr Charles Barber, *Committee Hansard*, Canberra, 19 June 2015, p. 44.

with low flying aircraft'.⁴³ The Draft National Wind Farm Development Guidelines of 2010 also note that 'wind farms inherently involve the construction of tall structures (towers plus blades) that have the potential to impact on the safety of low flying commercial, private and defence aircraft'. The guidelines continue:

In this respect, wind farms are similar to tall buildings, communications towers and other tall engineered structures. They differ by virtue that they are generally located in areas remote from other tall structures, and are generally deployed along ridgelines (further exacerbating the potential impacts) and they involve components moving through shared airspace. Thus, the primary impact of a wind farm is the potential safety risk it may pose to aircraft operating at low levels (below 350 metres above ground level) in vicinity of a wind farm.⁴⁴

5.36 The Aerial Agricultural Association of Australia (AAAA), the peak body for Australia's agricultural and firefighting pilots 'believes that windfarm developments and especially wind monitoring towers are posing an unacceptable threat to aviation safety and especially aerial application'.⁴⁵ The AAAA also notes the economic threats that wind farms pose to the aerial applicator industry and the farming sector more broadly:

They also pose an economic threat to the industry where the costs of windfarm development—including those of compensation for loss of income—are externalized onto other sectors such as aerial application.⁴⁶

5.37 Clearly these structures will impact on the operations of aircraft involved in aerial firefighting and aerial crop management (application of fertilisers and pesticides) with these activities commonly being undertaken in rural localities.

5.38 The Civil Aviation Safety Authority (CASA) provided evidence to the committee about the limited role it plays in regulating airspace around wind farms:

We know our responsibilities and the power of our legislation, which is very limited. For the most part, wind turbines are built away from aerodromes and certainly away from federally leased aerodromes. So the only power that we have is to make a recommendation to the planning authority about whether the turbine is going to be an obstacle and, if we

43 Australian Government Department of Infrastructure, *National Airports Safeguarding Framework Principles and Guidelines—Guideline D: Managing the Risk of Wind Turbine Farms as Physical Obstacles to Air Navigation*, May 2015, https://infrastructure.gov.au/aviation/environmental/airport_safeguarding/nasf/nasf_principles_guidelines.aspx (accessed 8 July 2015).

44 Environment Protection and Heritage Council, *Draft National Wind Farm Development Guidelines*, July 2010, p. 11, <http://www.scew.gov.au/system/files/resources/8e446a1a-ab93-5f84-99d0-12d3422d2a23/files/draft-national-wind-farm-development-guidelines-july-2010.pdf> (accessed 26 June 2015).

45 AAAA, *Submission 20*, p. [1].

46 AAAA, *Submission 20a*, p. 1.

decide it is an obstacle, we can make a recommendation as to whether it should be lighted and marked. That is the extent of our power.⁴⁷

5.39 The Crookwell Aerodrome in southern NSW—where a proponent was seeking to develop a wind farm in proximity to the aerodrome—was discussed at the Canberra hearing. Prior to construction of the adjacent wind farm, representations from the AAAA led to CASA recommending an exclusion zone around the aerodrome of 3 600 metres. In this case, 11 wind turbines were not constructed in order to comply with the exclusion zone.⁴⁸ This appears to be the extent of CASA's involvement in regulating airspace near wind farms.

5.40 Mr Terry Farquharson of CASA told the committee that 'there are some indications of people who might be close to below the level of the turbines suffering or experiencing some degree of turbulence'. Further to this CASA officials admitted that more research need to be conducted in this area; however, CASA noted that they were currently not resourced to undertake this 'tricky and expensive' research.⁴⁹ Turbulence will be discussed in more detail in the crop management section.

5.41 The next section will examine specific issues relevant to firefighting and crop aircraft.

Firefighting

5.42 Some submitters expressed concerns about wind turbines posing an 'increased bush fire risk' and 'decreasing the capacity of fire services to fight bush fires'.⁵⁰ There is no question that aircraft play a key role in the mitigation and control of bushfire events across Australia.

The use of aircraft plays an integral role in current firefighting strategies⁵¹...

[A]erial water bombing has proved to be an integral part of rapid fire control because the aeroplane can get access to the head of the fire where no ground rig can go.⁵²

47 Mr Peter Cromarty, Executive Manager, Airspace and Aerodrome Regulation, Civil Aviation Safety Authority, *Committee Hansard*, Canberra, 19 May 2015, p. 35.

48 Mr Terry Farquharson, Deputy Director, Aviation Safety, Civil Aviation Safety Authority, *Committee Hansard*, Canberra, 19 May 2015, p. 35. See also: Ms Marjorie Pagani, *Submission 340*, p. [6]. Ms Pagani states that 'apart from the danger to crop-spraying pilots, curtailment of plant disease control, and of overspray, there are light aircraft dangers, and possible restrictions on further airport development'.

49 Mr Terry Farquharson, Deputy Director, Aviation Safety, Civil Aviation Safety Authority, *Committee Hansard*, Canberra, 19 May 2015, pp 35–36.

50 Parkesbourne/Mummel Landscape Guardians Inc., *Submission 119*, p. 6. See also: Grain Producers SA, *Submission 175*, p. 2.

51 NSW Rural Fire Service, *Submission 97*, p. [2].

52 Grain Producers SA, *Submission 175*, p. 3.

5.43 However, the committee received a range of evidence relating to the extent to which wind turbines affect firefighting. The NSW Rural Fire Service (NSW RFS) noted that:

Aerial firefighting suppression in close proximity to wind turbines may be inhibited at times, given that the aircraft operate under the [CASA] *Visual Flight Rules* for navigation by visual reference. Pilots are necessarily required to maintain standard distances from wind turbines, as is the case with any other potential hazard such as power lines, transmission towers, mountains and valleys...

This [NSW RFS] position paper concluded that wind turbines are not expected to pose increased risks due to wind turbulence or the moving blades.⁵³

5.44 Mr Craig Brownlie, an Operations Officer with the Victorian Country Fire Authority gave similar evidence to the committee during the Portland hearing. Mr Brownlie acknowledged that wind turbines pose a threat as obstacles to aircraft in the same way that other anthropogenic structures do:

Operations Officer Wayne Rigg is the CFA manager for the aerial work that we do. Basically, the air fleet that we use operates under visual flight rules. That means that they will not operate in low light or after light, or through cloud or smoke. Wayne has indicated that there are a lot of other, higher-risk areas, like power lines and the like, over wind towers. They are quite visible and they do not cause the aircraft any concern in aviation operations for CFA.⁵⁴

5.45 The South Australian Government also agreed:

Where vertical obstructions exist in the airspace around a fire such as power lines, weather masts, radio and television transmission towers, tall trees and wind turbines, a dynamic risk assessment is undertaken prior to the aircraft being committed to fire-bombing operations.⁵⁵

5.46 Although indirectly related to aerial firefighting, Infigen Energy states that 'the construction of wind farms also result in all-weather tracks being built to previously difficult to access areas, thereby improving the ability of fire trucks to fight fires'. These tracks can act as 'fire breaks and facilitate fire truck deployment'.⁵⁶

53 NSW Rural Fire Service, *Submission 97*, p. [2].

54 Mr Craig Brownlie, Operations Officer, Specialist Response, Country Fire Authority *Committee Hansard*, Portland, 30 March 2015, p. 41. See also: pp 43–44. Mr Brownlie also noted that aerial firefighting units are not required to maintain an exclusion distance from wind turbines.

55 South Australian Government, *Submission 59*, pp 9–10. See also: Ms Kim Forde, *Submission 65*, p. [4].

56 Infigen Energy, *Submission 425*, p. 16.

5.47 Despite this, the committee has received evidence suggesting that rural fire services across the country have not properly considered these issues. Mr Alan Cole noted that the catastrophic Cobbler Road bushfire in 2013 would not have been able to be controlled if wind turbines had been installed at the top of the range at the time of the fire:

The predominant Catastrophic Bush Fire Weather in the Yass district is dominated by severe NW [north-west] winds. The Cobbler Road bushfire of January 2013 burnt approximately 12,000 ha of farmland and travelled from the eastern edge of Jugiong over the southern end of the Black Range and into Burrinjuck Dam in an afternoon. Aerial water bombing of this fire was critical in controlling its spread and eventually containing the fire. Had the entire length of the Black Range been covered with wind turbines as per Epuron's desire and proposals these critical firefighting resources would not have been able to be deployed to the head of this fire.⁵⁷

5.48 This view was concurred by the Noel family, landholders from South Australia:

A huge concern is accessibility for aerial fire fighting in and around the turbines, a fire would travel a long way before the planes could get near the fire creating great risk to adjoining landholders properties.⁵⁸

5.49 Further, Mr Cole noted that although legislation currently prevents dwellings being built in Bushfire Prone Land, that 'no such legislation regulates where [wind turbines] can be proposed on the same Bushfire Prone Land'.⁵⁹ The committee notes this legislative inconsistency.

5.50 The committee also notes that wind turbine manufacturers may have misled the rural fire services by claiming that non-combustible oil is used in turbines.⁶⁰ On notice, the Victorian CFA confirmed that combustible oil is used in wind turbines (AS1940 Combustible Class C2).⁶¹ The Victorian CFA told the committee that it

57 Mr Alan Cole, *Submission 73*, p. [5].

58 Mr Greg and Mrs Michelle Noel, *Submission 390*, p. [2].

59 Mr Alan Cole, *Submission 73*, p. [5]. This refers to NSW legislation drafted in response to the catastrophic bushfires in the Greater Blue Mountains Area, west of Sydney in late 2013. These legislative changes included the Environmental Planning and Assessment Amendment (Bush Fire Prone Land) Regulation 2014 under the *Environmental Planning and Assessment Act 1979* and the *Rural Fires Amendment (Vegetation Clearing) Act 2014* which amended the *Rural Fires Act 1997*.

60 See the comments of Mr Andrew Andreou, Executive Manager, Country Fire Authority, *Proof Committee Hansard*, 30 March 2015, p. 44.

61 *Answer to question on notice*, received 1 April 2015. Available on committee's website (Question No. 2)

'relies upon the manufacturers to provide information and advice as to the nature of hydraulic fluids used and their flammability'.⁶²

5.51 In its submission, BWTAG expressed its concerns that the '[NSW] RFS still have no protocols in relation to fighting fires from the air in and around wind turbines'.⁶³

5.52 The committee heard evidence about the inadvertent consequences that result from the placement of wind farms near operating aerodromes. Mr Jim Hutson notes that 'the Crookwell Aerodrome will no longer be considered for aerial firefighting by the NSW Rural Fire Service'. This is because the presence of the wind turbines will limit the circling area of the main aircraft used in aerial firefighting activities.⁶⁴

Crop management

5.53 The committee received evidence suggesting that time-critical crop management activities such as the aerial application of pesticides and fertiliser are impacted by the presence of wind farms. Most wind farms are hosted along ridgelines in areas of steep terrain with aerial application sometimes being the only option to treat these crops and pastures.⁶⁵ Mr Mark McDonald, an experienced Aerial Agricultural Pilot quantified the importance of aerial application to the agricultural and horticultural industries immediately adjacent to the proposed Mt Emerald Wind Farm in far north Queensland:

Our records show that in past years nearly all of the 13,000 ha of arable land within 5km of the wind farm site has been treated either occasionally or regularly by aircraft, including firefighting over the Lotus Glen Correctional Centre.⁶⁶

5.54 Epuron, a wind farm owner and operator suggested that the impacts of wind farms on crop management aircraft are minimal:

Aerial crop spraying has been reported to be ongoing within 1 km of the Cullerin Range Wind Farm with few impacts to aerial agricultural operations.⁶⁷

62 *Answer to question on notice*, received 30 March 2015. Available on committee's website (Question No. 1)

63 Bodangora Wind Turbine Action Group, *Submission 227*, pp 4–5.

64 Mr Jim Hutson, *Submission 30*, p. 6. See also: Ms Ann Gardner, *Submission 208*, p.[20].

65 Farmers may choose to use aerial application over ground options for a range of other reasons—even on relatively flat terrain. These reasons can include protection of the crop canopy from wheel damage, lack of ground access under very wet conditions, and to avoid soil compaction in wet conditions.

66 Mr Mark McDonald, *Submission 223*, p. [3].

67 Epuron, *Response to Adverse Comment in Submission 285*, p. [1].

5.55 Dr Kim Forde, an environmental consultant from far north Queensland agreed noting that:

[A]erial spraying can only occur at wind speeds lower than the minimal operating regime for the turbines.

Wind turbines do not operate below approx[imately] 10–15km/hr and aerial spraying should not occur above these wind speeds due to the inability to control where the chemical is targeted at higher speeds. Again, the risk of interaction has been significantly over-blown.⁶⁸

5.56 Notwithstanding this, the committee received evidence suggesting that a more complex relationship between wind farms and aircraft exists. As acknowledged by CASA earlier in this section, wind turbines produce a wake of 'unpredicted and unpredictable turbulence'.⁶⁹ This turbulence presents two main risks to aerial operations:

The major concerns are, firstly, the risk to safety of flying operations and, secondly, the risk of dispersal of chemicals as a result of turbulence. And of course the negative economic impacts of these on the agricultural spraying operators and on the viability of local agribusinesses which need to use these services. Whilst the Aeronautical Impact Assessment identifies that “wind shear, turbulence and downdrafts in the wake of the turbine rotors” present “a critical hazard to aircraft such as agricultural aircraft operating at low level and high weights during application of chemicals and seeding”, and that wake effects may exist up to 5km from turbines, it also states there will be minimal impact on aerial operations.⁷⁰

5.57 Mr Mark McDonald highlighted the risk that turbulence from wind turbines may have on non-target crops and the surrounding environment:

The impact of turbulence on pilot safety is not the only risk. Turbulence also has the potential to cause off-target spray drift. Aerial agricultural operators have a legal responsibility to prevent spray drift onto neighbouring crops, which are sometimes only metres away from the crops being treated.⁷¹

5.58 It is clear that if the flying conditions are not safe, then these aerial operations should not be undertaken until such time as the conditions are conducive to safe flying and that only then should aerial application occur. However, the turbulence created by these wind turbines is not an intermittent weather phenomenon, instead it occurs

68 Ms Kim Forde, *Submission 65*, p. [5].

69 Ms Marjorie Pagani, *Submission 340*, p. [6]. See also: Grain Producers SA, *Submission 175*, p. 2.

70 Mr Mark McDonald, *Submission 223*, p. [2].

71 Mr Mark McDonald, *Submission 223*, p. [3]. See also: Grain Producers SA, *Submission 175*, p. 2. The question is raised of who bears the responsibility of non-target spray drift caused by wind turbines.

whenever the wind turbines operate and is in addition to the vagaries of the weather that farmers and pilots must manage when undertaking their aerial activities. Ultimately, in areas with wind farms the optimum window for aerial application is shortened and the net result will be that farmers are not able to spray their fields and manage their crops, incurring a financial loss as a result:

Wind turbines amongst land used for intensive grains production will irrevocably impinge upon crop management practises. Timeliness of crop nutrition, and the application of crop protection products, is critical in maximising productivity and profitability in agriculture. To this end, aerial applications of fertilisers for nutrition, and herbicides, fungicides and insecticides for crop protection and quality, are the key to efficient and rapid management decisions as weather patterns and rainfall events unfold. Imported pests, such as Italian snails, are contained by aerial baiting of large areas of land when small windows of opportunity are presented for this practice to be effective. To restrict and deny aerial access to the cropping lands of those grain producers on whose properties wind turbines are placed, or are adjacent to such structures, is an impost on grain production that ground based machinery cannot compensate for.⁷²

Committee view

5.59 The committee accepts that there are a range of risks inherent in the work of pilots who conduct aerial firefighting and crop management activities. Despite this, the committee recognises that current regulation does not provide adequate protections for pilots operating aircraft in the vicinity of wind turbines. In its submission, AAAA noted that the wind industry needs to be 'as a minimum, regulated to provide a national database of tower locations for bona fide low level aviation operators and be required to be marked in accordance with NASAG (Department of infrastructure) guidelines'.⁷³ In addition, the committee notes the National Airports Safeguarding Framework contains a voluntary provision for obstacle lights and a section on turbulence 'in making decisions regarding the marking and lighting of wind farms and wind monitoring towers, wind farm operators should take into account their duty of care to pilots and owners of low flying aircraft.'⁷⁴

72 Grain Producers SA, *Submission 175*, p. 2. See also: Mr Darren Arney, *Committee Hansard*, Adelaide, 10 June 2015, p. 50. Mr Arney noted that farmers adjacent to wind turbines will experience 'significant financial loss due to a decrease in the value of their farmland due to changes in the way they are able to go about their farming'.

73 AAAA, *Submission 20*, p. [1].

74 Australian Government Department of Infrastructure, *National Airports Safeguarding Framework Principles and Guidelines—Guideline D: Managing the Risk of Wind Turbine Farms as Physical Obstacles to Air Navigation*, May 2015, https://infrastructure.gov.au/aviation/environmental/airport_safeguarding/nasf/nasf_principles_guidelines.aspx (accessed 8 July 2015).

5.60 It is the committee's view that in the interests of pilot and community safety that these voluntary standards relating to obstacle marking are made compulsory for all current and future wind turbines.

Chapter 6

Committee view and recommendations on the issues raised in chapters 2–5

6.1 This chapter presents the committee's recommendations arising from the evidence of the previous four chapters. Clearly, there is significant overlap between issues of research into the impact of wind turbines on human health (chapter 2), the processes for planning wind farm developments and engaging with communities on these plans (chapter 3), and systems for monitoring and ensuring compliance (chapters 4 and 5). There is need for a national framework that incorporates and connects these issues.

6.2 This chapter presents the committee's vision of what this framework should look like. There are ten recommendations. The focus of these recommendations is to establish a robust regulatory framework which:

- establishes a central point of expert scientific advice (recommendations 1, 2);
- provides a basis for funding this advice and for putting this advice into effect (recommendation 9 and recommendation 6 of the committee's interim report);
- tightens the requirements for wind power companies to operate and receive renewable energy certificates (recommendations 3, 5 and 6);
- promotes cooperation between regulatory agencies and levels of government (recommendations 2, 3, 5, 6 and 11); and
- holds regulatory agencies to account for the work they perform (recommendation 10); and

6.3 The recommendations in this chapter should be read in conjunction with the recommendations made in the committee's interim report. The recommendations made here are intended to give effect to the headline recommendations of the interim report.

The Independent Expert Scientific Committee on Industrial Sound

6.4 A key recommendation of the committee's interim report was the need for an independent scientific body to conduct multi-disciplinary, primary research into the possible impact of audible noise, infrasound and vibration from wind turbines on human health. The committee proposed establishing an Independent Expert Scientific Committee (IESC) on Industrial Sound. Importantly, the federal government has supported this recommendation, committing to establish an IESC on Industrial Sound by 1 September 2015.

Recommendation 1

6.5 The committee recommends that an *Independent Expert Scientific Committee on Industrial Sound* (IESC) be established by law, through provisions similar to those which provide for the IESC on Coal Seam Gas and Large Coal Mining Development.¹

6.6 The provisions establishing the IESC on Industrial Sound should state that the Scientific Committee must conduct 'independent, multi-disciplinary research into the adverse impacts and risks to individual and community health and wellbeing associated with wind turbine projects and any other industrial projects which emit sound and vibration energy'.

The responsibilities of the IESC on Industrial Sound

6.7 The committee emphasises the need for the IESC on Industrial Sound to have clearly defined responsibilities. The following three tasks are fundamental to the IESC's role:

- develop national acoustic standards on audible noise, infrasound and vibration from wind turbines;
- respond to requests from State Environment Protection Authorities (EPAs), State Environment Ministers, the federal Minister for Health and the Clean Energy Regulator whether a proposed wind farm project poses risks to individual and community health; and
- establish research priorities and provide oversight of projects.

6.8 These responsibilities will enable the IESC to coordinate the process between Commonwealth and State authorities to identify the risks that new and existing wind turbines may pose to human health. It will ensure that the IESC sets and maintains appropriate acoustic standards and research methodologies to deliver sound advice for stakeholders.

Recommendation 2

6.9 The committee recommends that the federal government assign the *Independent Expert Scientific Committee on Industrial Sound* with the following responsibilities:

- develop and recommend to government a single national acoustic standard on audible noise from wind turbines that is cognisant of the existing standards, Australian conditions and the signature of new turbine technologies;
- develop and recommend to government a national acoustic standard on infrasound, low frequency sound and vibration from industrial projects;

1 Appendix 3 of this report presents Sections 505C and 505D of the *Environment Protection and Biodiversity Conservation Act 1999* relating to the establishment of the IESC on Coal Seam Gas and Large Mining Development and the functions of this committee.

- respond to specific requests from State Environment Protection Authorities for scientific and technical advice to assess whether a proposed or existing wind farm project poses risks to individual and community health;
- provide scientific and technical advice to the relevant State Health, Environment and Planning Minister to assess whether a proposed or existing industrial project poses risks to individual and community health;
- provide advice to the Clean Energy Regulator on whether a proposed or existing industrial project poses health risks to nearby residents;
- provide advice to the federal health minister on whether a proposed or existing industrial project poses health risks to nearby residents;
- publish information relating to the committee's research findings;
- provide to the federal Minister for Health research priorities and research projects to improve scientific understanding of the impacts of wind turbines on the health and quality of life of affected individuals and communities; and
- provide guidance, advice and oversight for research projects commissioned by agencies such as the National Health and Medical Research Council and the Commonwealth Scientific and Industrial Research Organisation relating to sound emissions from industrial projects.

6.10 The committee foresees several lines of useful research inquiry for the IESC. Notably, there is an urgent need for research that determines:

- the dose response relationships for sleep disturbance and physiological stress in people who have been already sensitised to sound energy from chronic exposure;
- the maximum tolerable levels of infrasound, low frequency noise and vibration inside homes required to protect health and protect the ability of residents to sleep in their homes; and
- the required setback distances turbines from homes (see recommendation 7, third dot point).

The need for IESC advice before accrediting wind power operators

6.11 The committee proposed legislative amendments to ensure that the Clean Energy Regulator and the federal Minister for Health must seek the advice of the IESC on Industrial Sound before a wind farm operator is accredited to receive certificates. The committee recommends that provisions to this effect be inserted into Division 3 of the *Renewable Energy (Electricity) Act 2000*.

Recommendation 3

6.12 The committee recommends that the following provision be inserted into a new section 14 of the *Renewable Energy (Electricity) Act 2000*:

If the Regulator receives an application from a wind power station that is properly made under section 13, the Regulator must:

- seek the advice of the *Independent Expert Scientific Committee on Industrial Sound* whether the proposed project poses risks to individual and community health over the lifetime of the project; and
- confer with the federal Minister for Health and the Commonwealth Chief Medical Officer to ascertain the level of risk that the proposed project poses to individual and community health.

If the *Independent Expert Scientific Committee on Industrial Sound* finds that the wind power station does pose risks to human health, the Regulator must not accredit the power station until such time as the federal Minister for Health is satisfied that these risks have been mitigated.

6.13 The committee's interim report recommended that the National Environment Protection Council should establish a National Environment Protection (Wind Turbine Infrasound and Low Frequency Noise) Measure (NEPM). The NEPM must be developed through the findings of the IESC on Industrial Sound. The interim report recommended that the Commonwealth Government should insist that the ongoing accreditation of wind turbine facilities under the *Renewable Energy (Electricity) Act 2000* in a State or Territory is dependent on the NEPM becoming valid law in that State or Territory.

6.14 To put effect to this recommendation, the committee makes a further recommendation to insert a provision into the *Renewable Energy (Electricity) Act 2000* (REE Act) to make compliance with the proposed NEPM a condition of eligibility for RECs.

Recommendation 4

6.15 The committee recommends that a provision be inserted into *Renewable Energy (Electricity) Act 2000* stipulating that wind energy generators operating in states that do not require compliance with the National Environment Protection (Wind Turbine Infrasound and Low Frequency Noise) Measure (NEPM) are ineligible to receive Renewable Energy Certificates.

The need for the IESC's work to be reflected in health policy advice and research

6.16 The committee believes that the IESC's work—setting national acoustic standards for audible noise, infrasound and vibration, and its advice and research into existing and proposed industrial projects—should be carefully considered by federal and state health Ministers and officials and the National Health and Medical Research Council. It is important that there is a formal mechanism through which the work of the IESC can be incorporated into the policy advice provided to federal and state health Ministers.

6.17 The Environmental Health Standing Committee (enHealth) is responsible for developing national advice on environmental health matters to the Australian Health

Ministers' Advisory Council.² enHealth is based on 'significant collaboration and consultation with Federal and state and territory agencies, departments and organisations that deal with environmental health matters'.³ Its membership includes representatives from Commonwealth, State and Territory health departments, the New Zealand Ministry of Health and the National Health and Medical Research Council. enHealth regularly engages with the federal Department of Environment as well as local government associations and non-government organisations such as Environmental Health Australia. It meets face-to-face twice a year, generally at the beginning and end of the calendar year. It also holds regular videoconference and teleconference meetings.⁴

6.18 The committee believes that a body with enHealth's remit and coordination is well-placed to coordinate the advice of the IESC. It is a useful forum to inform and involve key decision-makers of the IESC's work, including federal and state health Ministers and officials, the NHMRC, the federal Environment Department and local government associations.

6.19 The committee envisages that the IESC on Industrial Sound should formally instruct enHealth to coordinate the flow of information to the relevant State authorities—Health, Planning and the EPA. It must relay and discuss its advice and research priorities relating to industrial projects and human health. The IESC should not only keep enHealth informed of its work in setting acoustic standards and assessing industrial project proposals, but should engage enHealth in conducting and seeking funding for research priorities.

Recommendation 5

6.20 The committee recommends that the *Independent Expert Scientific Committee on Industrial Sound* (IESC) establish a formal channel to communicate its advice and research priorities and findings to the Environmental Health Standing Committee (enHealth). The IESC should explain to enHealth members on a regular basis and on request:

- **the national acoustic standards for audible noise and infrasound and how these standards are set and enforced to monitor industrial projects;**
- **the methodology of its research and findings relating to how infrasound and vibration can impact on human sensory systems and health; and**

2 enHealth is a standing committee that falls under the auspices of Australian Health Protection Principal Committee (AHPPC). AHPPC and enHealth work with reference to the *National Environmental Health Strategy 2012–2015*.

3 Australian Government Department of Health, *Environmental Health Standing Committee (enHealth)*, January 2014, <http://www.health.gov.au/internet/main/publishing.nsf/Content/ohp-environ-enhealth-committee.htm> (accessed 15 July 2015).

4 Correspondence from enHealth secretariat, Office of Health Protection, Department of Health, received 22 July 2015.

- **research priorities and possible strands of research that the National Health and Medical Research Council (a member of enHealth) could fund and commission.**

National Wind Farm Guidelines

6.21 The interim report recommended that the Commonwealth Government establish National Wind Farm Guidelines. Again, the committee is pleased that the federal government has agreed to seek agreement from the States and Territories to implement National Wind Farm Guidelines as recommended by the IESC.

6.22 The National Guidelines will outline best practice standards relating to planning processes and operation of wind energy facilities. They do not seek to interfere with State planning and development frameworks and processes. However, the committee did recommend in its interim report that eligibility to receive Renewable Energy Certificates should be made subject to general compliance with the National Wind Farm Guidelines and specific compliance with the NEPM.

6.23 The committee notes the wind farm auction rating system used by the ACT Government to give 20 per cent weighting to the community engagement strategies of a proposal, as outlined in chapter 3.⁵ This committee believes that such a system to reward best practice operators could work in tandem with systems that sanction wind farm operators that breach minimum standards.

6.24 The committee believes the proposed licencing system would work well if the conditions for holding and retaining the licence were linked to compliance with National Guidelines' standards on sound, buffer zones and community engagement (among other matters).

Recommendation 6

6.25 The committee recommends that the proposed *Independent Expert Scientific Committee* on Industrial Sound develop National Windfarm Guidelines addressing the following matters:

- **a national acoustic standard on audible sound (see recommendation 2);**
- **a national acoustic standard on infrasound and low frequency sound (see recommendation 2);**
- **a national standard on minimum buffer zones;**
- **a template for State Environment Protection Authorities to adopt a fee-for-service licencing system (see recommendation 9, below);**

5 The Hon. Simon Corbell MLA, Deputy Chief Minister of the ACT, 'Wind auction result delivers renewable energy and economic benefits to the ACT', Media Release, 2 February 2015. Minister Corbell noted that 'the auction outcome has also set a new benchmark for wind farm community engagement practices in Australia and should provide a strong incentive for new projects to engage with local communities in a more meaningful and co-operative manner, for the benefit of proponents and communities alike'.

- a Guidance Note proposing that State Environment Protection Authorities be responsible for monitoring and compliance of wind turbines and suggesting an appropriate process to conduct these tasks;
- a Guidance Note on best practice community engagement and stakeholder consultation with the granting and holding of a licence conditional on meeting this best practice;
- a Guidance Note that local councils should retain development approval decision-making under the relevant state planning and development code for local impact issues such as roads;
- national standards for visual and landscape impacts;
- aircraft safety and lighting;
- indigenous heritage;
- birds and bats;
- shadow flicker;
- electromagnetic interference and blade glint; and
- the risk of fire.

6.26 As per recommendation 4 of the committee's interim report, eligibility to receive Renewable Energy Certificates should be made subject to general compliance with the National Wind Farm Guidelines and specific compliance to the National Environment Protection Measure.

Enhancing the powers of the Clean Energy Regulator

6.27 The committee believes there is a need for legislative change federally to strengthen the powers of the Clean Energy Regulator. The federal government must establish a stricter framework within the *Renewable Energy (Electricity) Act 2000* (REE Act) and the *Renewable Energy (Electricity) Regulations 2000*. It is not acceptable that wind farm operators can continue to receive the financial benefits of the RET scheme while failing to meet planning approval conditions. Compliance with the proposed National Wind Farm Guidelines is only part of the solution.

6.28 Section 8 of the REE Act lists various grounds for suspending a power station's registration. Subsection 30D lists factors that may warrant the suspension of a power station. The committee recommends that the Australian Government amend the REE Act and/or the REE Regulations to:

- enable partial suspension, and point in time suspension, of renewable energy certificates for wind farm operators that are found to have:
 - breached the conditions of their planning approval;
 - had their operating licence suspended or cancelled;
- establish 'show cause' powers for breaches of statutory obligations; and
- link the issuing of renewable energy certificates with confirmed greenhouse gas reduction.

Recommendation 7

6.29 The committee recommends that the Australian Government amend the *Renewable Energy (Electricity) Act 2000* and the *Renewable Energy (Electricity) Act Regulations 2000* to enable partial suspension and point in time suspension of renewable energy certificates for wind farm operators that are found to have:

- breached the conditions of their planning approval;
- had their operating licence suspended or cancelled;
- establish powers to be used when breaches of statutory obligations occur that require energy generators to 'show cause' ; and
- link the issuing of renewable energy certificates with certified net greenhouse gas reduction in the electricity sector.

6.30 The committee recommends that the Clean Energy Regulator cannot accredit a power station until it is wholly constructed, fully commissioned and all post construction approval requirements have been met.

Shifting responsibility to State Environment Protection Authorities

6.31 The committee strongly supports efforts to shift responsibility for monitoring and compliance to State Governments. The State EPAs should perform this role and they should seek the advice of the IESC to do so.

6.32 The current state of affairs in Victoria highlights the need for this shift. It is anomalous that the Victorian State Government is the decision-maker on compliance matters but does not conduct any monitoring or compliance activities. Local councils rightly complain that the Victorian Government does not have the operational expertise to properly judge whether their decision is sound.

6.33 The committee draws attention to the New South Wales experience. In June 2013, responsibility for regulating wind turbines was shifted from local councils to the State EPA. The State Government explain the rationale for this decision as follows:

As the regulatory work for the ARA [appropriate regulatory authority] of large-scale wind farms is likely to increase, the Government decided to transfer the ARA responsibility under the POEO Act [*Protection of the Environment Operations Act 1997*] from local councils to the EPA. As the State's dedicated environmental regulator, the EPA is better placed to deal with complex noise issues, has the necessary expertise and has a robust regulatory framework for regulating large-scale wind farms.⁶

6.34 The committee considers that both the decision-making capacity and the operational capacity for monitoring and compliance should rest at a State level. Should the State EPA find an operator non-compliant, it is important that the authority has the financial resources to be able to take legal action against the operator. It would be of concern if local councils were expected to take multinational companies to court.

6 NSW Environment Protection Authority, *Questions and answers on wind farm regulation*, <http://www.epa.nsw.gov.au/licensing/windfarmfaq.htm#Q3> (accessed 15 July 2015).

6.35 The committee has no qualms with arrangements whereby State EPAs sub-contract monitoring responsibilities to the local Councils. In certain cases, this may be a prudent use of State resources, particularly in the short-term when there will be operational expertise within local councils. It is important, however, that State EPAs develop operational competence in compliance and monitoring. Further, if they do engage in sub-contracting with local councils, it must be clear that the State Government is accountable to the public through the Parliament.

6.36 The committee reaffirms the importance of recommendation 7 in its interim report in which it stated that 'the data collected by wind turbine operators relating to wind speed, basic operation statistics including operating hours and noise monitoring should be made freely and publicly available on a regular basis'.⁷ In evidence to the committee, Dr Les Huson, acoustician noted that:

I cannot see why that information should not be made available. It is my view that withholding that information is detrimental to an open process.⁸

Publication of this data would allow third parties to examine correlations between reported illness and the operation of the turbines. Whilst correlation does not always equate with causation, the availability of the data would allow the scientific community to conduct independent compliance assessments.

Recommendation 8

6.37 The committee recommends that all State Governments consider shifting responsibility for monitoring wind turbines in their jurisdiction from local councils to the State Environment Protection Authority.

A fee-for-service licencing system

6.38 Chapter 4 of this report discussed the Municipal Association of Victoria's (MAV) suggestion of a fee-for-service licencing system. The committee believes that while this is ultimately an operational matter for State and Territory Governments, the idea has real merit.

6.39 As this report has discussed in some detail, the wind sector in Australia is suffering from a crisis in community confidence. There is deep scepticism within many local communities about the way in which wind operators are monitored and the complicit role of State Governments in fudging results that find compliance. Local councils are recognised not to have the resources or the expertise to do the job asked of them.

6.40 A properly administered licencing system, paid for by wind farm operators, would go a long way to resolving this mistrust and cynicism. As MAV has indicated, a licencing system would also offer regulatory certainty for the wind farm industry,

7 Senate Select Committee on Wind Turbines, *Interim Report*, June 2015, http://www.aph.gov.au/Parliamentary_Business/Committees/Senate/Wind_Turbines/Wind_Turbines/Interim_Report (accessed 20 July 2015).

8 Dr Les Huson, *Proof Committee Hansard*, Melbourne, 9 June 2015, p. 61.

equity between different types of electricity generators and remove the noise compliance and monitoring impost on councils.

6.41 A licence would be awarded to an operator when upon meeting planning approval conditions, sound standards and community engagement and consultation standards. If an operator is found not to be compliant with these standards, State EPAs should have the capacity to suspend or cancel a licence.

The New South Wales licencing system

6.42 The committee believes that the wind farm licencing system established in New South Wales as part of the June 2013 amendments to the State *Protection of the Environment Operations Act 1997* is a good template for other jurisdictions to consider. In New South Wales, large-scale wind farms have been brought within the State EPA's existing environmental licencing framework. As the State Government explained:

Bringing large-scale wind farms into the EPA's established environment protection licensing regime is the best approach for EPA regulation of the sector. The licensing regime is well established, strong, flexible and fit-for-purpose. Licensing provides an appropriate check-and-balance to ensure that the growing wind farm sector meets appropriate environmental performance requirements.⁹

Environment protection licences are a more flexible and effective tool for regulating environmental issues compared to development consents. However, the consent authority (usually the Department of Planning and Infrastructure (DP&I)) is also able to respond if it is necessary and warranted.¹⁰

6.43 The State EPA's approach to regulating these wind farms is consistent with its approach to regulating all other industries. The conditions of a wind operator's environment protection licence must be 'substantially consistent' with the development consent, as required under Part 4 of the *Environmental Planning and Assessment Act 1979*. Further:

Following planning approval, the EPA cannot refuse to issue an environment protection licence if it is necessary for carrying out the approved SSD [State significant development] and the licence must be substantially consistent with the development consent. Importantly for wind farms, this means that noise limits prescribed in the development consent will be transferred directly into the environment protection licence.¹¹

9 NSW Environment Protection Authority, *Questions and answers on wind farm regulation*, <http://www.epa.nsw.gov.au/licensing/windfarmfaq.htm#Q3> (accessed 15 July 2015).

10 NSW Environment Protection Authority, *Questions and answers on wind farm regulation*, <http://www.epa.nsw.gov.au/licensing/windfarmfaq.htm#Q27> (accessed 15 July 2015). Most States and Territories already have a licencing regime in place for other environmentally sensitive activities.

11 NSW Environment Protection Authority, *Questions and answers on wind farm regulation*, <http://www.epa.nsw.gov.au/licensing/windfarmfaq.htm#Q7> (accessed 15 July 2015).

6.44 Regular licence renewal 'provides another opportunity for the EPA to address any environmental performance issues that may have arisen since the licence was issued, in consultation with the licensee and other stakeholders'.¹² However, licences must be reviewed annually, not every five years as is currently the case in New South Wales. It is important that the conditions of the licence are flexible so as to incorporate the scientific findings—and appropriate regulatory response—of the IESC.

6.45 The NSW licencing system is supported through administrative fees payable by wind farm operators based on their annual generating capacity.

Recommendation 9

6.46 The committee recommends that State Governments consider adopting a fee-for-service licencing system payable by wind farm operators to State Environment Protection Authorities, along the lines of the system currently in place in New South Wales.

Oversight of the IESC and State Environment Protection Authorities

6.47 The committee recommends in this report a tiered regulatory system. At a national level, the IESC will be empowered, among other things, to develop national sound standards from wind turbines and National Windfarm Guidelines. State Governments will have responsibility for monitoring and enforcing these standards and guidelines.

6.48 It is important that State Governments put in place a framework that requires wind farm operators to act in accordance with the proposed National Wind Farm Guidelines. If there is non-compliance with permits, there must be immediate, mandatory and appropriate consequences which could include immediate suspension of Large-scale Renewable Energy Target accreditation and injunctions to stop operating the power stations until non-compliance is rectified.

6.49 The committee is concerned that State governments have a poor track record in wind turbine compliance matters. In the past, State Governments have allowed power stations to operate irrespective of the power station's status of compliance with the terms of conditionally issued consent. Box 4.2 in chapter 4 notes the case of the Victorian State Government's failure to enforce compliance at the Waubra wind farm.

6.50 The committee recognises that if significant responsibilities for advising and regulating on the operations of wind turbines are assigned to the IESC and the State EPAs, it is important to have systems in place that hold these bodies accountable.

6.51 By statute, it is intended that the IESC on Industrial Sound will be answerable to the federal Minister for the Environment and the federal Minister for Health. The Ministers and the members of the IESC will also be answerable to the Parliament.

12 NSW Environment Protection Authority, *Questions and answers on wind farm regulation*, <http://www.epa.nsw.gov.au/licensing/windfarmfaq.htm#Q26> (accessed 15 July 2015).

6.52 In addition, the committee recommends that the federal Department of the Environment prepare a quarterly report—to be tabled in the federal parliament—which records the wind farm monitoring and compliance activities of the State EPAs. This process should be coordinated through the IESC on Industrial Sound with secretarial assistance from the Department of the Environment.

Recommendation 10

6.53 The committee recommends that the federal Department of the Environment prepare a quarterly report collating the wind farm monitoring and compliance activities of the State Environment Protection Authorities. The report should be tabled in the federal Parliament by the Minister for the Environment. The Independent Expert Scientific Committee on Industrial Sound should coordinate the receipt of State data and prepare the quarterly report. The Department of the Environment should provide appropriate secretarial assistance.

The National Health and Medical Research Council

6.54 This report has noted various shortcomings in the way that the NHMRC has conducted its desktop research on the issues of wind turbines and human health. Chapter 2 noted that the Council's 'systematic review' had particular flaws, not the least of which was its selective consideration of primary evidence.

6.55 The NHMRC's advice is clearly important in how regulatory settings have developed at local, State and national level in Australia. Most notably, the Council's position that infrasound emitted from wind turbines is at levels too low to harm human health has meant that the issue of infrasound has not been considered by regulators. Companies, turbine manufacturers, peak medical associations, local councils and state governments all refer to the NHMRC's advice. As the NHMRC has done the 'research', they argue, there is no need to worry about anything more than complying with the existing standards. The NHMRC sets the bar both in terms of compliance and in terms of duty of care.

6.56 The situation needs to change. The establishment of the IESC on Industrial Sound will be an important first step. As mentioned earlier, the NHMRC, through its membership of enHealth, will be kept continually informed of the IESC's work on wind turbines and human health. The committee believes that the NHMRC could undertake to fund and commission research that the IESC believes is necessary. The NHMRC should also continue to monitor research findings outside of the work of the IESC.

Recommendation 11

6.57 The committee recommends that the National Health and Medical Research Council (NHMRC) continue to monitor and publicise Australian and international research relating to wind turbines and health. The NHMRC should also fund and commission primary research that the Independent Expert Scientific Committee on Industrial Sound identifies as necessary.

The need for political cooperation and corporate endorsement

6.58 The recommendations in this chapter offer a roadmap for what should be done to improve the regulatory framework for wind turbines in Australia and which bodies should be responsible for making this system work. The committee reiterates, however, that these reforms require political will. It is, of course, pleased that the federal government has endorsed the recommendations made in its interim report. The recommendations in this chapter will strengthen and give effect to this framework.

6.59 The committee is mindful that recommendations 8 and 9 of this report are directed to State Governments. These two recommendations are critically important because they give effect to broader initiatives such as the proposed National Wind Farm Guidelines with the IESC's national acoustic standards and buffer zones. Without an efficient and effective State-based system of planning, monitoring and compliance, the federal framework of national guidelines supported by the work of the IESC and the CER will have little impact.

6.60 There is a question of what should happen if the States fail to cooperate and implement a monitoring and compliance system that meets the national guidelines. One solution is for the federal government to assume responsibility of monitoring and enforcement. This could be done either by empowering the IESC, or by legislating to establish a second statutory body for this purpose. The government could use the Corporations Power under Section 51(xx) of the Constitution. This head of power has been interpreted broadly such as to empower the federal government to make laws regulating and controlling the activities of corporations formed within the limits of the Commonwealth.

Recommendation 12

6.61 The committee recommends that under circumstances where the regulatory framework provided for pursuant to recommendations 8 and 9 cannot be enforced due to a lack of cooperation by one or more states, a national regulatory body be established under commonwealth legislation for the purpose of monitoring and enforcing wind farm operations.

6.62 However, the committee believes that there will be sufficient political goodwill across the three tiers of government to embrace and implement these reforms. This will be forged through cooperation and information-sharing between the three tiers. Recommendations 2, 3, 5 and 6 (above) are intended to formally promote this cooperation. Local and State governments should be encouraged to share their experiences and their resources in issues of planning and monitoring wind farm developments. The federal and State governments should seize the opportunity to put in place a national framework for developments that are already occurring at State level.

6.63 It is also important that wind farm operators themselves support the agenda set out in this chapter. The regulatory framework that has been proposed by the committee will greatly enhance the reputation and standing of the wind sector in the community. It will show that wind companies are prepared to be transparent in their dealings and responsive to genuine community concerns. Wind companies will benefit

by not only spending less time handling hostile actions from community groups, but from broader financial rewards that an enhanced corporate reputation will offer.

Chapter 7

The effect of wind power on retail electricity prices

7.1 The first term of reference for this inquiry directs the committee to examine the effect of wind power on household power prices and the merits of consumer subsidies for wind farm operators. Put another way, it asks the committee to consider the impact of wind power generation on consumers' electricity bills, and whether the Renewable Energy Target's (RET) assistance to wind power in Australia is justified on public policy grounds.

7.2 Significantly, there is no publicly available Australian evidence on the direct impact of wind power on retail electricity prices. There is limited information on the impact of wind on the wholesale price, and information on the impact of renewables on the retail price.

7.3 This chapter argues that isolating and analysing the impact of wind on retail electricity prices is an area worthy of research. It is important for the policy-makers, the energy sector and the public to know how different renewable energy sources affect household power prices, and how the cross subsidy through the RET from thermal power sources impacts on what households pay.

Structure of the chapter

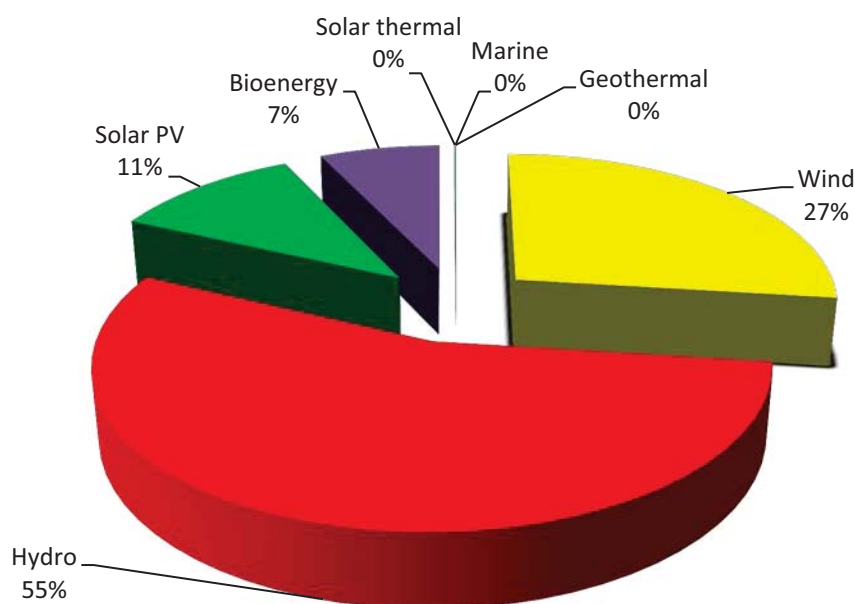
7.4 This chapter has four parts:

- (a) The first looks at some preliminary issues that set the scene for later discussion on the impact of subsidies on the wind industry, and of wind power on household prices. The key questions are:
 - what proportion of total electricity generation comes from wind power and how does this contribution compare with generation from renewable and non-renewable sources;
 - what has been the trend in wind power generation—relative to generation from other energy sources—over time; and
 - what is the marginal long-run cost of wind energy and how does this compare with the costs incurred by other energy sources?
- (b) The second part looks at how the RET supports wind power and the impact of the RET on wholesale and retail prices.
- (c) The third part of the chapter considers the impact of renewables, and wind energy in particular, on retail prices.
- (d) The fourth part of this chapter considers the merit of consumer subsidies for wind farm operators. What is the public policy case for assisting wind companies through the RET? What is the case for reducing this assistance after the cost of capital is recovered?
- (e) The final part of the chapter notes the long-term power purchase agreements between power generators and retailers.

Wind power in the renewables market

7.5 To begin, it is useful to place the contribution of wind power in the context of the renewable energy sector. Public policy in Australia has treated renewables—wind, solar and hydro energy—as a block rather than tailoring policies to particular industries. In 2013, wind power accounted for a little over one-quarter of the energy generated by renewables in Australia.¹

Figure 7.1—Electricity generation by renewable energy source



Source: Clean Energy Council, Report 2013, p. 7

7.6 The Clean Energy Australia Report found that for the 2013 calendar year, renewables accounted for 14.76 per cent of all electricity generation in Australia. The contribution of wind energy to total Australian energy generation for the calendar year of 2013 was under four per cent.²

7.7 The Australian Energy Market Operator (AEMO) noted:

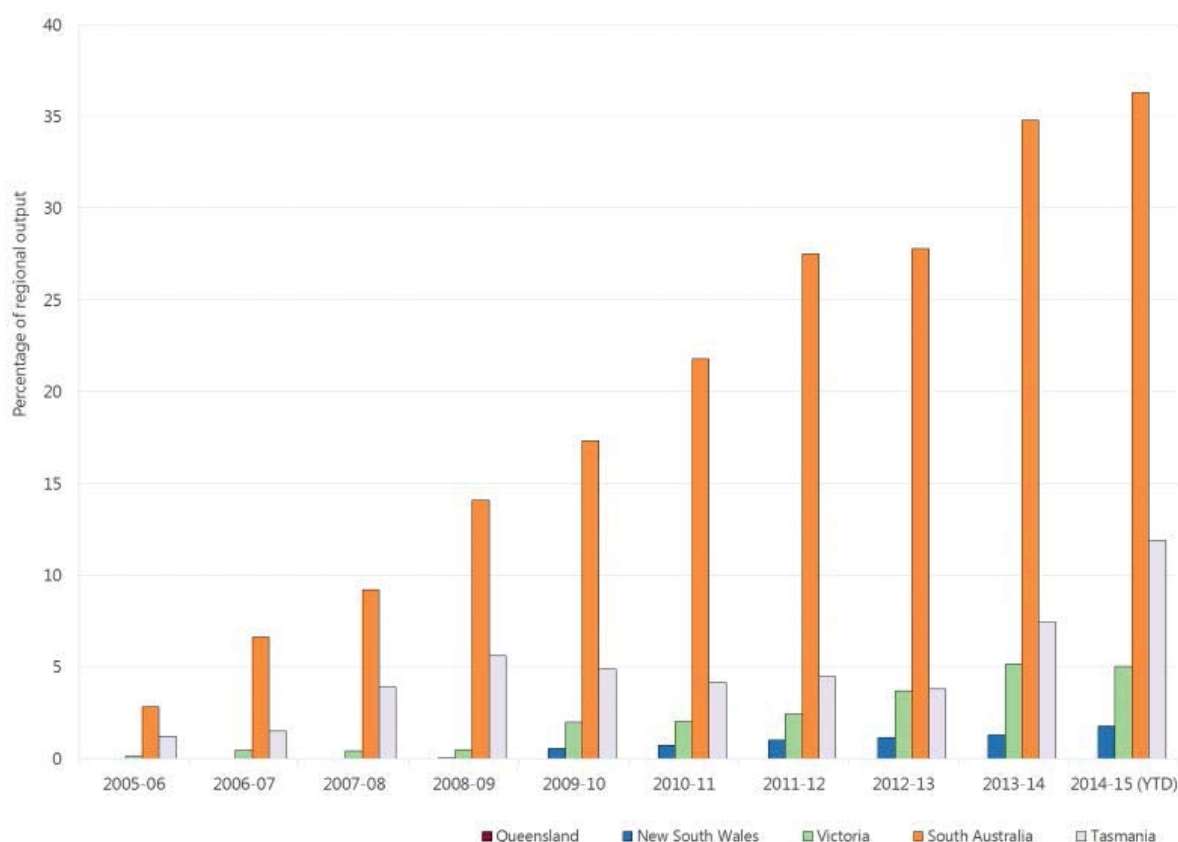
In the 2014-15 year to 1 April, wind generated 4.7% of grid-connected NEM generation supply. As seen by the figure below, wind energy has been growing rapidly, and is most concentrated in the South Australian region of the NEM.³

1 Clean Energy Council, *Clean Energy Australia Report*, 2013, p. 7.

2 Clean Energy Council, *Clean Energy Australian Report*, 2013, p. 8.

3 Australian Energy Market Operator, *Submission 469*, p. 5.

Figure 7.2: Wind output as a percentage of regional output



Source: AER “State of the Energy Market’ derived from AEMO data.

7.8 A spot check of the National Electricity Market (NEM) using RenewEconomy.com.au found that at 3.10 pm on 27 May 2015, wind power in the five eastern states was generating 1107 MW or 4.6 per cent of total power into the NEM. This was 32 per cent of the power generated by renewables—wind, hydro, large and small solar.⁴

7.9 However, as many submitters and witnesses to this inquiry have noted, the input of wind into the NEM is highly variable. On 2 June 2015 at 4.25pm, wind accounted for only 80 MWh in Tasmania, Victoria, South Australia and New South Wales. (Queensland did not record any wind power generation and South Australia

4 RenewEconomy, *NEM Watch*, <http://reneweconomy.com.au/nem-watch> (accessed 27 May 2015, 3.10pm). The site uses data published by the Australian Energy Market Operator (AEMO) and the Australian Photovoltaic Institute. On notice, the committee asked AEMO for its opinion of the accuracy and reliability of the analysis by RenewEconomy.com.au. AEMO responded in *Submission 469, Response to Question 2*, (received 29 June 2015):

The site developed and maintained by RenewEconomy.com.au draws data from the NEMWatch tool produced by Global-Roam Pty Ltd. Global-Roam is a well-known and reputable firm specialising in repackaging AEMO data into readily accessible formats. AEMO has not audited the site and is not aware of the detailed definition of data displayed. However the data appears reasonable and we have no reason to question the veracity of the Global-Roam product.

recorded only 4 MWh). This represented only 0.3 per cent of total electricity generation (26 266 MWhs) in the NEM at the time.⁵

7.10 One submitter to the inquiry quantified the contribution of wind power to the grid for the whole of the 2014 calendar year. Mr Peter Bobroff personally analysed the five minute data from AEMO for every day of 2014. He found that:

- coal fired generators dispatched between 'about 12 and 20 Gigawatts with an average of 16.6 GW';
- gas fired generators dispatched between 'about 2 to 4 GW with an average of 2.9 GW';
- hydro generators dispatches 'about 1 to 3 GW with an average of 2.9 GW'; and
- wind generators dispatched less than 3 GW with an average of 0.96 GW.

7.11 Mr Bobroff concluded:

...coal dominates the grid. It provides the base load power, never less than 12GW. Gas and hydro provide the peak loads with their reliable quick responses. Sometimes only a little peaking is required, but their rapid responsive reserve is always needed for overall grid reliability. Wind, with all it's [sic] special privileges, has over 40% probability of producing almost nothing.⁶

7.12 The committee asked AEMO to comment on the accuracy and reliability of Mr Bobroff's analysis. It responded:

AEMO has reviewed this submission and a related blog. We have not attempted to verify Mr Bobroff's analysis, however the figures and quantities appear reasonable and broadly consistent with our own reports.⁷

7.13 The Australian Energy Regulator commented in a 2014 report:

...almost 1200 megawatts (MW) of wind capacity have been added in the past two years. Nationally, wind generators accounted for 6.3 per cent of capacity and contributed 4.4 per cent of output in 2013–14. AEMO projected wind generation will drive much of the growth in electricity generation over the next 20 years.⁸

5 Renew Economy, *NEM Watch*, <http://reneweconomy.com.au/nem-watch>. The average household lightbulb uses sixty watts. One thousand watts equals one kilowatt (kW); one thousand kilowatts (one million watts) equals one megawatt (MW); and one thousand megawatts (one billion watts) equals one gigawatt. Typically, the rate of energy generated (or consumed) per unit of time is measured as watt hours (wH), kilowatt hours (kWh), megawatt hours (MWh), and gigawatt hours (GWh).

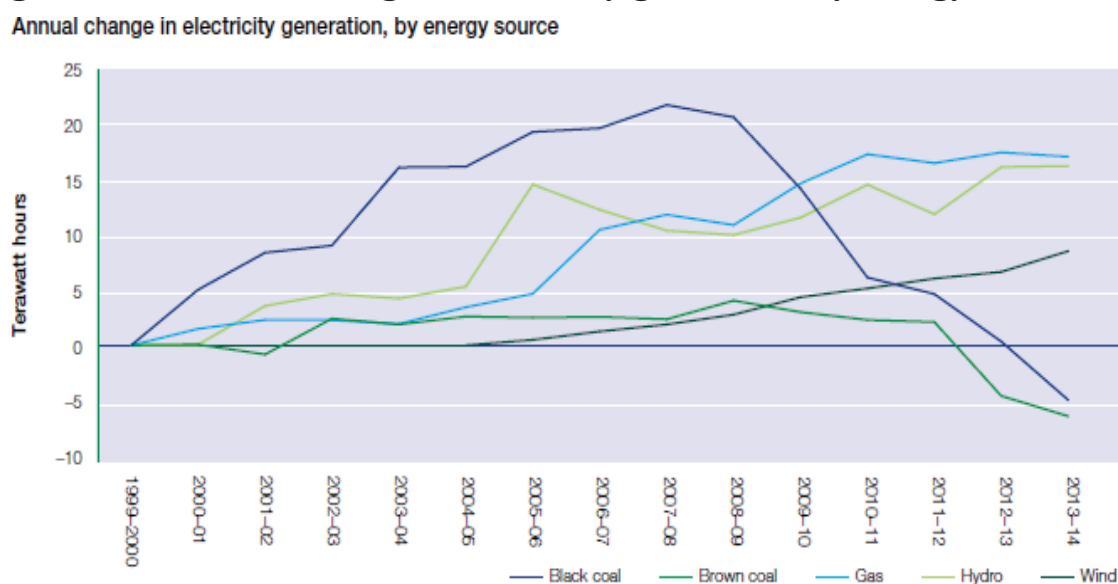
6 Mr Peter Bobroff, *Submission 91*, p. 2.

7 AEMO, *Submission 469, Response to Question 2*, received 29 June 2015.

8 Australian Energy Regulator, *State of the Energy Market*, 2014, p. 27.

7.14 Figure 7.3 below, from the same report, shows that since 2005, wind power is the only energy source to have annually increased the amount of power that it puts into the NEM. Further, the report noted that as of June 2014, wind power accounted for nearly 60 per cent of all major proposed generation investment in Australia.⁹ Coal accounted for only 10.5 per cent.

Figure 7.3—Annual change in electricity generation by energy source



Source: Australian Energy Regulator, *State of the Energy Market*, 2014, p. 27.

The Renewable Energy Target cross subsidy

7.15 In 2001, the Howard Government introduced the Mandatory Renewable Energy Target. The goal of the MRET or RET as it is now known, was—and remains—to promote additional electricity generation from renewable sources with the aim of reducing greenhouse gas emissions in the electricity sector.¹⁰

7.16 The RET works by establishing a 'market' for renewable energy in the form of renewable energy certificates. One certificate is issued for one MW of power produced. The Clean Energy Regulator (CER) awards these certificates to accredited generators of renewable electricity when these generators feed renewable energy into the grid. Electricity retailers ('RET liable entities') are then required to purchase a certain amount of certificates from the generators and surrender them to the CER. The number of certificates that retailers are required to buy is set annually by the CER based on projections to meet the 2020 target. This is shown in Figure 7.4.

7.17 The certificate 'market' thereby creates an artificial demand for renewable energy in preference to thermal energy sources. Under the RET, renewable energy

9 Australian Energy Regulator, *State of the Energy Market*, 2014, p. 35.

10 Australian Energy Regulator, *State of the Energy Market*, 2014, p. 27.

companies can invest and produce energy in the knowledge that electricity retailers must purchase their product. Certainly, wind power companies have created many millions of large scale generation certificates (LGC) since the RET was introduced as Figures 7.5 and 7.6 show.¹¹ LGC's obtain the lion's share of the certificate market.

7.18 Effectively, therefore, the RET is a cross subsidy to the renewables sector. As the 2014 report into the Review of the RET stated:

The RET has been successful in promoting additional generation from renewable sources, with renewable energy generation almost doubling from 2001 to 2013. This reflects the considerable cross subsidy that the RET delivers to owners of renewable energy power stations and small-scale systems, estimated to be about \$9.4 billion over the same period.¹²

7.19 The cost of investment in renewable energy is higher than investment in thermal energy sources (coal and gas). This reflects the substantial cost of building renewable energy infrastructure such as wind and solar farms. Energy retailers pass the cost of the RET onto consumers through their retail prices.

7.20 Wind energy has been the main form of energy invested in due to the RET. As AGL stated: 'most large scale projects under the RET to date have been wind farms, and virtually all wind farm development in Australia has occurred as a direct result of this scheme'.¹³ RECs make up more than half the revenue that a wind farm earns. The other component is the wholesale price for electricity.¹⁴

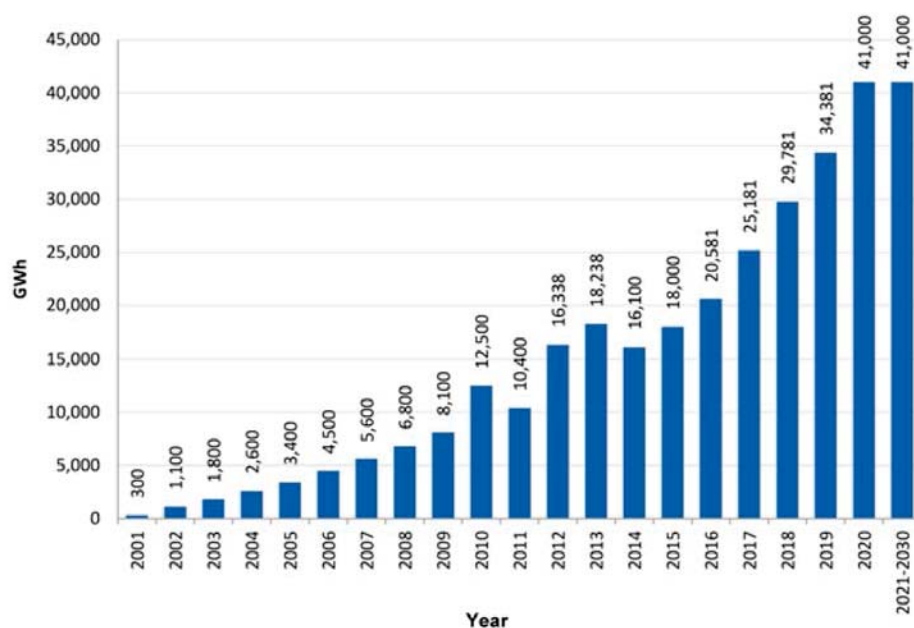
11 See: Australian Government Clean Energy Regulator, *Large Scale Generation Certificates and Small Scale Technology Certificates*, <http://www.cleanenergyregulator.gov.au/RET/Scheme-participants-and-industry/Power-stations/> (accessed 13 July 2015). Large-scale generation certificates (LGC) are generally issued to commercial electricity generators such as wind and solar farms; whereas Small-scale technology certificates (STC) are generally issued to households with small scale renewable energy technology such as rooftop solar photovoltaic systems and solar water heaters.

12 Renewable Energy Target Scheme: Report of the Expert Panel, August 2014, p. 14.

13 AGL Energy, *Submission 83*, p. 2.

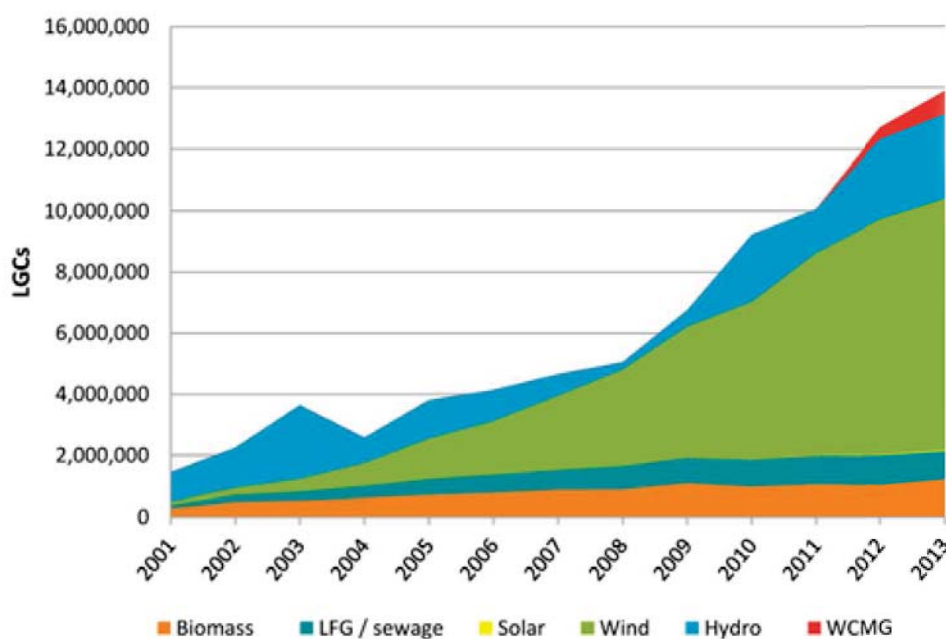
14 Tristan Edis, 'Ignore Abbott, renewable energy certificate prices should rise', *Business Spectator*, <http://www.businessspectator.com.au/article/2014/7/2/renewable-energy/ignore-abbott-renewable-energy-certificate-prices-should-rise> (accessed 13 July 2015).

Figure 7.4—Profile of annual targets under the RET¹⁵



Annual targets exclude allowance for waste coal mine gas generation.
source: Derived from data on the Clean Energy Regulator website.

Figure 7.5—LGCs created by fuel source, 2001–2013¹⁶

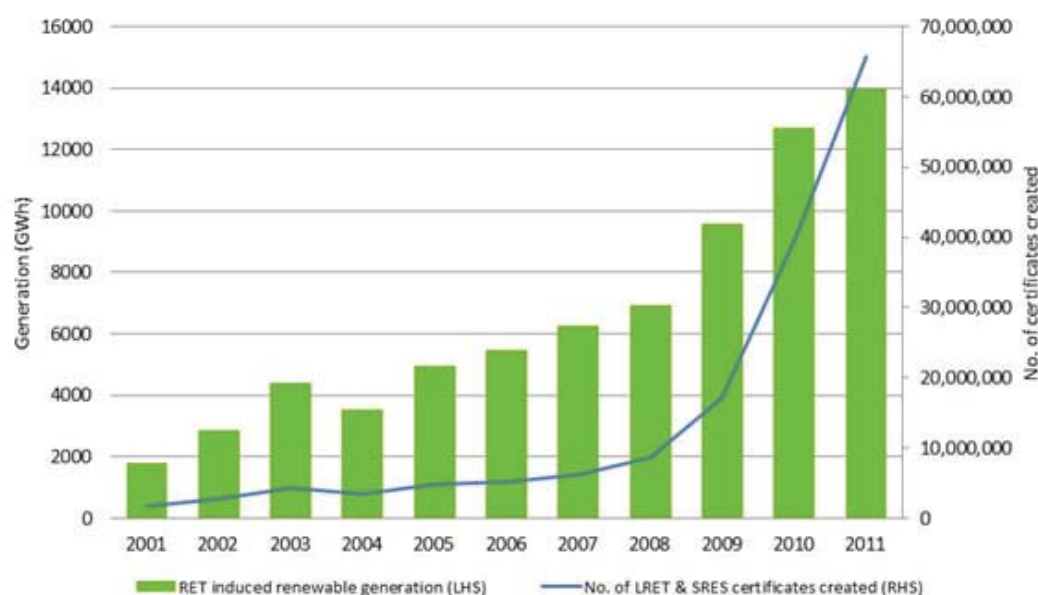


Source: Clean Energy Regulator *Register of Large-scale Generation Certificates*, current at 3 June 2014

15 See: *Renewable Energy Target Scheme: Report of the Expert Panel*, August 2014, p. 3, https://retreview.dpmc.gov.au/sites/default/files/files/RET_Review_Report.pdf (accessed 13 July 2015).

16 *Renewable Energy Target Scheme: Report of the Expert Panel*, August 2014, p. 9.

Figure 7.6—RET induced renewable generation and the number of LRET Large-scale Renewable Energy Target (LRET) and Small-scale Renewable Energy Scheme (SRES) certificates created¹⁷



REC prices in the LGC market

7.21 The spot price for LGCs (minimum parcel of 5000 certificates) in the six months from October 2014 to May 2015 is presented in Figure 7.7. Spot prices for certificates have increased sharply since February 2015 to \$50 in March 2015 and again in May 2015.

7.22 If the marginal cost for a wind farm company to produce 1 MWh of energy is around \$80, the RET at current prices offers a significant subsidy (\$50 of the \$80). In other words, at current REC prices, wind companies have only to raise \$30 per MWh from the electricity itself.

7.23 The high REC price in the LGC market essentially reflects renewed confidence in the RET. One of the main brokers, Green Energy Market, has noted that the rising LGC REC price is an indicator of growing confidence that a political deal would be done on the RET.¹⁸

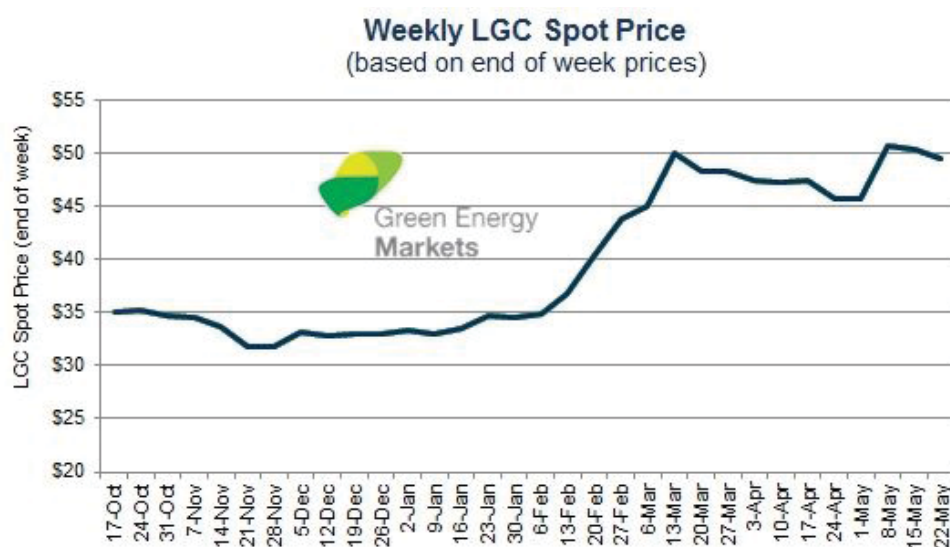
7.24 Green Energy Market has noted that at the time the Warburton Review was announced in early 2014, the spot price was around \$32. It then fell to an equal record low of \$21 in June 2014. Green Energy Market attributed the sharp rise in the spot

17 Climate Change Authority, *Final Report, Renewable Energy Target Review*, December 2012, p. 8, <http://www.climatechangeauthority.gov.au/reviews/2012-renewable-energy-target-review> (accessed 13 July 2015).

18 Green Energy Markets, *Quarterly Renewables Report, Q1 2015*, 17 April 2015 <http://greenmarkets.com.au/news-events/quarterly-renewables-report-q1-2015> (accessed 2 June 2015).

price from June 2014 to the announcement by the Palmer United Party that it would not support changes to the RET.¹⁹

Figure 7.7—Weekly LGC spot price, October 2014 to May 2015



Source: Green Energy Markets <http://greenmarkets.com.au/resources/lgc-market-prices>

7.25 The steep rise in the price of the LGC will impact on the consumer as retailers pass on the price.

The impact of the RET on wholesale and retail electricity prices

7.26 In terms of the impact of the RET on wholesale and retail electricity prices, there is a higher retail price from the requirement for retailers to purchase RECs. Reflected in the cost of certificates is the higher infrastructure cost of establishing energy from renewable sources.

The wholesale market

7.27 In Australia, future energy generation is offered to the market by generators to AEMO in five minute intervals. The bids of generators are then accepted starting with the lowest cost generator and finishing with the highest cost. This is called the 'merit order effect'. This effect essentially reflects that the low marginal cost generation of renewables can underbid coal and gas-fired generators. The extent to which renewables outbid thermal sources will determine who bears the financial cost of the RET. The committee asked Frontier Economics who pays for the large-scale renewable energy subsidy. It responded: 'It is the retail electricity customers via a levy on their electricity bills'.²⁰

7.28 As part of the 2014 review of the RET, ACIL Allen found that in most cases, scenarios modelled with a higher RET resulted in lower annual residential bills by 2030. This is largely explained by the downward pressure that large generators such as

19 Green Energy Markets, *Quarterly Renewables Report, Q1 2015*, 17 April 2015.

20 Mr Matt Harris, Frontier Economics, *Proof Committee Hansard*, 29 June 2015, p. 17.

windfarms would exert on the wholesale price of electricity. In terms of the wholesale price over the next decade, the report stated:

NEM regions commence with prices around \$44/MWh in calendar year 2014 and fall to mostly below \$33/MWh in 2015 due to it being the first full year without carbon pricing. Prices rise slightly through 2016 and 2017, influenced by additional demand in Queensland and reduced output from gas-fired generation. Through 2017 to 2020 significant amounts of new wind capacity enter the market driven by the LRET and this tends to hold prices at an average of around \$30/MWh until around 2025. Some incumbent capacity is mothballed late in the decade due to low profitability as observed within our simulation model. Capacity withdrawal is required to accommodate the additional wind entry and to increase wholesale prices to a sustainable level for incumbent plant operators. Prices begin to slowly rise from 2025 onwards as demand growth has largely absorbed the additional renewable capacity and mothballed plant is reintroduced to service.²¹

7.29 AEMO noted in its submission that it does not publish any data or research on the extent to which renewables (and wind in particular) 'push out' other generation. It did note that 'it can be reasonably assumed that all renewable output in the NEM substitutes for non-renewable output'.²²

7.30 AEMO also noted that some commentators have analysed AEMO's data on individual days and postulated wholesale prices would have been higher had renewable energy not been operating. However:

Such analyses should be treated with caution, as they do not consider the complex long-term feedback loops that exist in the real market. For example, when wholesale prices are suppressed for a period of time, non-subsidised plant is likely to withdraw. This in turn has the effect of bringing wholesale prices back up to a new equilibrium over time.²³

7.31 The extent to which renewables lower the wholesale price will affect the revenue that generators receive and the overall impact of the RET. As the Climate Change Authority commented in its 2014 review of the RET:

Existing generators are affected in two ways. Increased generation displaces fossil-fuelled plant output. Also, lower wholesale prices mean they make less money for the electricity they sell. The impact on households and other retail customers depends on the relative size of the wholesale and retail

21 ACIL Allen, *Report to RET Review Expert Panel: RET Review Modelling—Market modelling of various RET policy options*, August 2014, p. 9, https://retreview.dpmc.gov.au/sites/default/files/files/ACIL_Report.pdf (accessed 13 July 2015).

22 Australian Energy Market Operator, *Submission 469*, p. 9.

23 Australian Energy Market Operator, *Submission 469*, pp 8–9.

price effects. For a particular level of renewable capacity, the larger the wholesale price effect, the smaller the overall cost impact on consumers...²⁴

7.32 The downward pressure that wind energy places on wholesale prices may only be temporary if its effect is to force wholesale generators out of business. As the Australian Energy Market Commission (AEMC) noted in its 2014 Residential Price Trends report:

In the short term, subsidised wind generation under the LRET has the effect of increasing supply and putting downward pressure on wholesale energy purchase costs. However, this may only be temporary, as depressed wholesale prices will likely force unprofitable generators to exit the market and the consequent reduction in supply will eventually put upward pressure on wholesale prices. Without lower wholesale prices, the costs of the LRET will become more apparent to consumers through their retail bills.²⁵

7.33 The AEMC report also noted that in jurisdictions where the share of wind as a proportion of total energy generation is higher, the impact of the RET is likely to be less given greater reductions in the wholesale price. As it explained:

...LRET costs are spread equally between retailers in Australia, and therefore consumers, based on their total consumption. As investment in renewable generation has primarily been concentrated in the southern states, any reduction in wholesale energy costs in one jurisdiction is unlikely to be proportionate to the share of the scheme's costs recovered in that jurisdiction.

Consumers in jurisdictions with a high proportion of wind generation subsidised under the LRET, such as South Australia and Victoria, may experience a decrease in wholesale energy costs that offset the costs of the policy in the short term. Conversely, consumers in jurisdictions without significant wind investment from the LRET will not experience lower wholesale energy costs to the same degree, and are therefore likely to face a higher proportion of the costs of meeting the LRET.²⁶

7.34 AEMC concluded in its 2014 *Residential Price Trends* report that environmental policies account for eight per cent of a consumer's retail electricity bill. It noted that while the repeal of the carbon tax led to a fall in residential electricity prices in 2014–15 in most states and territories, the cost of the RET is 'expected to increase in the years ahead'. The following table, drawn from the report, shows the anticipated price increases in each jurisdiction.

24 Climate Change Authority, *Renewable Energy Target Review Report*, December 2014, <http://www.climatechangeauthority.gov.au/sites/prod.climatechangeauthority.gov.au/files/files/CCA-RET-Review-published-updated.pdf> (accessed 27 May 2015).

25 AEMC, *Residential Price Trends*, 2014, pp 16–17, <http://www.aemc.gov.au/getattachment/ae5d0665-7300-4a0d-b3b2-bd42d82cf737/2014-Residential-Electricity-Price-Trends-report.aspx> (accessed 13 July 2015).

26 AEMC, *Residential Price Trends*, 2014, pp 16–17.

Table 7.1—Impact of the RET by jurisdiction

	2013–14	2014–15	2015–16	2016–17
New South Wales	0.60	0.65	0.77	0.97
Victoria	0.59	0.64	0.77	0.96
South Australia	0.63	0.68	0.82	1.03
Tasmania	0.81	0.79	0.88	1.03
Queensland	0.58	0.63	0.75	0.94

Source: AEMC, Residential Price Trends, 2014

7.35 The 2014 ACIL Allen report provided modelling of the breakdown of retail price components for average residential electricity bills. It found that:

Network costs remain by far the largest cost component, accounting for 50–55%, followed by wholesale energy costs at 20–25%. The RET currently comprises around 3.7% of total costs, with this projected to rise to around 6.6% by 2020. After 2020, RET costs decline as a proportion of total retail prices...²⁷

The impact of the RET on retail prices

7.36 In August 2014, the expert panel commissioned to review the RET reported to the government. The Review commented on the impact of renewables on the wholesale price and the impact of the RET on retail prices. Significantly, it noted that the wholesale price is also affected by the impact of the RET in generating greater electricity supply and the lower demand for electricity in Australia:

Analyses suggest that, overall, the RET is exerting some downward pressure on wholesale electricity prices. This is not surprising given that the RET is increasing the supply of electricity when electricity demand has been falling. Artificially low wholesale electricity prices can distort investment decisions in the electricity market and are unlikely to be sustained in the long term. Over time, all other things being equal, wholesale electricity prices could be expected to rise to better reflect the cost of generating electricity.

The direct costs of the RET currently increase retail electricity bills for households by around four per cent, but modelling suggests that the net impact of the RET over time is relatively small. The impact on retail electricity prices for emissions-intensive trade-exposed businesses and other businesses is significantly greater. The RET does not generate an increase in wealth in the economy, but leads to a transfer of wealth among participants in the electricity market.²⁸

7.37 The ACIL Allen report, on which the final report to Government was based, noted that the RET causes wealth transfers from existing generators to both renewable proponents and consumers. However, it added that:

27 *Renewable Energy Target Scheme: Report of the Expert Panel*, August 2014, p. 22.

28 *Renewable Energy Target Scheme: Report of the Expert Panel*, August 2014, p. i.

7.38 This pattern of price changes does not hold under low demand conditions. This is due to the inability of new renewable generation to further suppress wholesale prices below levels which are unsustainable for incumbent generators to keep operating. Under these conditions, removal of the direct compliance costs is not offset by wholesale price movements and consumers are better off under a Repeal scenario. This is particularly interesting in the current NEM environment in which demand for electricity has fallen every year since 2008–2009 and the largest uncertainty is with respect to future demand growth/decline.²⁹ Ergon Energy noted in its submission that:

...across the 2010-2015 regulatory control period green schemes such as the Carbon Tax, Large Scale Renewable Energy Target (LRET), Small Scale Renewable Energy Scheme (SRES), Gas Electricity Certificates (GECs) and the Solar Feed in Tariff (FiT) will cost regional Queensland customers around \$1580 million. This equates to an average liability per customer of \$2,229 over the five year period. Prior to the removal of the carbon tax this average liability was expected to be \$2,654 per customer, noting actual impacts vary according to consumption. For the average residential customer these costs represent approximately 8.5% of their retail bill. Environmental allowances such as the LRET, SRES and GECs account for 37 per cent of the impact and the costs of the Solar FiT and associated network costs account for around 26 per cent. Specifically the estimated cost of the FiT and associated costs is \$413 million, with the costs of the SRES estimated to be \$280 million. This equates to an average cost of \$990.49 per customer over the five years, with the average cost being \$311.87 in 2013-14 alone.³⁰

7.39 The committee notes that there is some conjecture as to whether electricity retailers pass on the lower wholesale costs from renewable energy to the consumer. Wind Prospect Pty Ltd noted in its submission that:

South Australia's Essential Services Commission has directed energy companies to pass on the savings from lower wholesale prices and cut retail prices by 8.1 percent effectively lowering the average power bill by \$160 a year. This coincides with the growth of wind energy in South Australia where wind energy currently contributes 35% of the state's electricity requirements.³¹

The effect of lowering the RET

7.40 In June 2015, during the course of this committee's inquiry, the Australian Parliament passed the Renewable Energy (Electricity) Amendment Bill 2015. The bill reduces the RET from 41 000 GWh to 33 000 GWh by 2020.³²

29 ACIL Allen, *Report to RET Review Expert Panel: RET Review Modelling—Market modelling of various RET policy options*, August 2014, p. 127.

30 Ergon Energy, *Submission 84*, p. 3.

31 Wind Prospect Pty Ltd, *Submission 167*, p. 2.

32 Parliament of Australia, *Renewable Energy (Electricity) Amendment Bill 2015*, http://www.aph.gov.au/Parliamentary_Business/Bills_Legislation/Bills_Search_Results/Result?bld=r5463 (accessed 13 July 2015).

7.41 The effect of lowering the RET would be to curb the excess supply of electricity in the market. There will be fewer RECs created than would otherwise have been the case and the downward pressure on the wholesale price will not be as pronounced.

7.42 In 2014, Schneider Electric was commissioned by five large energy users to examine the electricity price impact of key price drivers in the electricity market—such as the carbon price, the RET scheme, decreasing electricity demand, and increasing gas prices. The study found that reducing the LRET target would result in a minimal reduction in electricity prices in 2016 followed by much larger increases later.³³

7.43 Figure 7.8 shows the sensitivity of wind power generation to changes in the RET. As the Schneider Electric report noted:

Increasing the LRET target (LRET Increased) results in a significant increase of wind generation capacity (~40%). In contrast, decreasing the LRET target (LRET Decreased) reduces the amount of installed wind generation capacity by ~40% compared to the Reference scenario [the status quo], whilst removing the scheme reduces the amount of installed wind generation capacity by 53% compared to the Reference scenario.³⁴

7.44 The South Australian Government noted in its submission the ACIL Allen analysis showing that the effect of removing the RET would be to increase power prices in the longer-term:

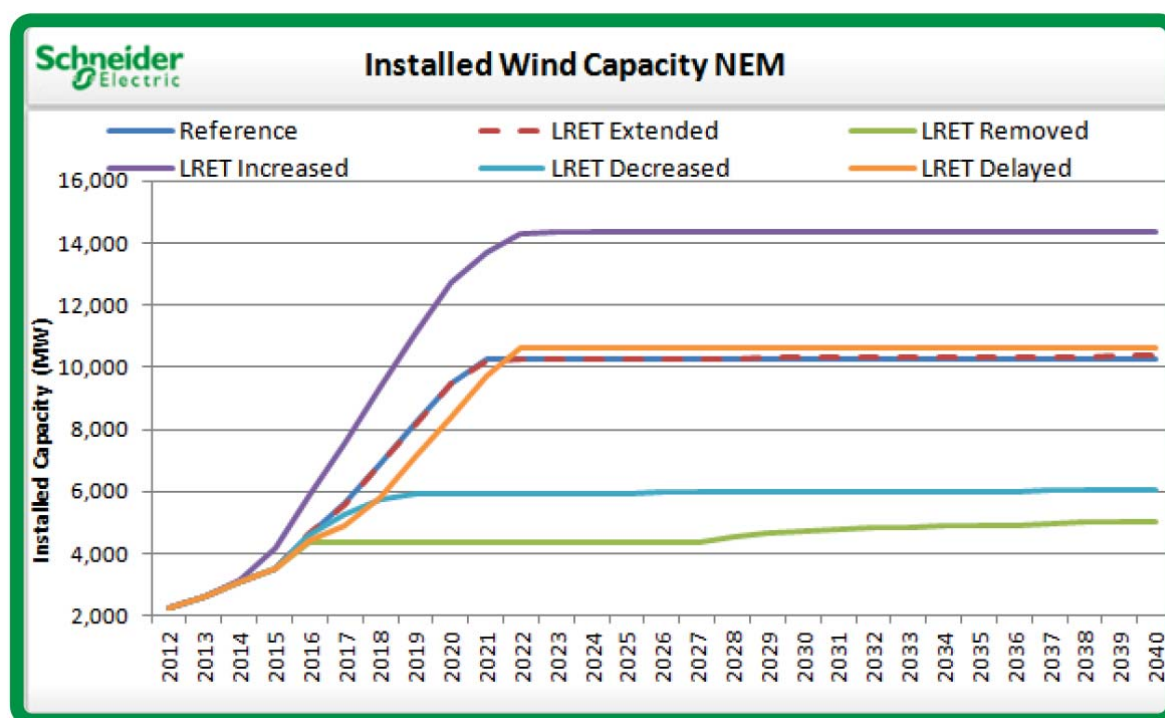
The subsequent modelling showed the removal of the RET would initially lead to lower retail electricity prices, but in the longer term, as a result of additional low marginal cost renewable energy generation, retail prices would be on average 3.1% higher for residential, commercial and industrial customers.³⁵

33 Jasper Noort, Simon Venderzalm, Brian Morris and Lisa Zembrodt, Schneider Electric, *Australia's large-scale renewable energy target: Three Consumer Benefits*, 2014.

34 Jasper Noort, Simon Venderzalm, Brian Morris and Lisa Zembrodt, Schneider Electric, *Australia's large-scale renewable energy target: Three Consumer Benefits*, 2014, pp 6–7.

35 South Australian Government, *Submission 59*, p. 5.

Figure 7.8—Sensitivity of wind power generation to changes in the RET



Source: Jasper Noort, Simon Venderzalm, Brian Morris and Lisa Zembrodt, Schneider Electric, Australia's large-scale renewable energy target: Three Consumer Benefits, 2014, pp 6–7.

The impact of wind energy on retail prices

7.45 The terms of reference for this inquiry direct the committee to consider the impact of wind energy on household electricity prices. The committee notes the lacuna of research in Australia that isolates the impact of wind on household electricity prices. The information before the committee is a judgment of this impact based on research into the impact of renewable energy on retail prices.

7.46 Various submitters have drawn the committee's attention to a June 2013 report by the consultancy Sinclair Knight Merz titled *Estimating the impact of Renewable Energy Generation on Retail Prices*. This report assessed the impact of the RET on electricity retail prices by calculating 'the changes to wholesale prices caused by the injection of new supply into the market, minus the cost of running the scheme and paying for the certificates that are created under the scheme'. The report found that:

...customers in Australia are on average likely to have a price reduction over the period to 2020 as a result of the LRET, albeit that there may be a modest increase in prices from sometime after 2020...

The price reduction is due to the wholesale price effect of the LRET, which - at approximately \$12/MWh over the period 2011-2025 (in real mid-2012

dollars) - more than outweighs the impact of increased liabilities for certificates as the target grows.³⁶

7.47 The report added:

In addition, to the extent that competition amongst retailers is limited, and to the extent that the LRET creates greater contestability through the creation of economically sustainable new entrant retailers, there will be further downward pressure on the retail margins. Under such conditions, the RET scheme may, by providing an opportunity for the creation of integrated new entrants, increase retail contestability and, hence, retail prices. SKM has not sought to quantify this effect in this report, but recognises that this may be a further benefit of the RET.³⁷

7.48 Another study found that the price impact of renewables differs depending on the type of consumer (residential consumers and small businesses). Dr Iain MacGill, Ms Johanna Cludius and Mr Sam Forrest from the Centre for Energy and Environmental Markets at the University of Sydney found that:

...some energy-intensive industries are benefiting from lower wholesale electricity prices whilst being largely exempted from contributing to the costs of the scheme. By contrast, many households are paying significant RET pass through costs whilst not necessarily benefiting from lower wholesale prices. A more equitable distribution of RET costs and benefits could be achieved by reviewing the scope and extent of industry exemptions and ensuring that methodologies to estimate wholesale price components in regulated electricity tariffs reflect more closely actual market conditions.³⁸

7.49 As of June 2015, the Independent Pricing and Regulatory Tribunal (IPART) of NSW estimates that in New South Wales, around 21 per cent of retail electricity customers pay regulated retail prices—that is, they pay prices not set by the competitive market. For those customers paying regulated prices, IPART makes a decision as to the appropriate price band. It noted:

In June 2014 we made a decision on the average changes each Standard Retailer could make in these regulated retail prices for the next two years, after an extensive public consultation and review process. We assessed the Standard Retailers' proposals against our own estimate of the change in the efficient costs of supplying gas over the two-year period – including

36 Sinclair Knight Merz, *Estimating the Impact of Renewable Energy Generation on Retail Prices: Final Report*, 20 June 2013, p. 1, <http://images.smh.com.au/file/2013/06/25/4518185/SKM.pdf> (accessed 13 July 2015).

37 Sinclair Knight Merz, *Estimating the Impact of Renewable Energy Generation on Retail Prices: Final Report*, 20 June 2013, p. 1.

38 Centre for Energy and Environmental Markets, *Distributional Effects of the Australian renewable Energy Target (RET) through Wholesale and Retail Electricity Price Impacts*, November 2013, p. 2, http://ceem.unsw.edu.au/sites/default/files/documents/13_11_20_CEEM_RET_Distribution_FI_NAL.pdf (accessed 13 July 2015).

wholesale gas costs, network prices and retail costs. We decided regulated retail prices could increase by an average of 11.2% across NSW in 2014-15, and by a further average of 4.2% in 2015-16. We also undertook to update our decision on the average price changes in 2015-16 in June 2015 to take account of the latest information on gas network prices and forecast inflation.³⁹

7.50 Australian retail electricity provider Ergon Energy noted in its submission the cost of 'green schemes' for electricity consumers. It stated:

...policies that seek to stimulate renewable energy increase costs to consumers under current pricing arrangements. Ergon Energy analysis shows that across the 2010-2015 regulatory control period green schemes such as the Carbon Tax, Large Scale Renewable Energy Target (LRET), Small Scale Renewable Energy Scheme (SRES), Gas Electricity Certificates (GECs) and the Solar Feed in Tariff (FiT) will cost regional Queensland customers around \$1580 million. This equates to an average liability per customer of \$2,229 over the five year period. Prior to the removal of the carbon tax this average liability was expected to be \$2,654 per customer, noting actual impacts vary according to consumption. For the average residential customer these costs represent approximately 8.5% of their retail bill. Environmental allowances such as the LRET, SRES and GECs account for 37 per cent of the impact and the costs of the Solar FiT and associated network costs account for around 26 per cent. Specifically the estimated cost of the FiT and associated costs is \$413 million, with the costs of the SRES estimated to be \$280 million. This equates to an average cost of \$990.49 per customer over the five years, with the average cost being \$311.87 in 2013-14 alone.⁴⁰

The merit of the RET cross-subsidy

7.51 The terms of reference for this inquiry direct the committee to consider the merit of consumer subsidies for the wind industry. Several submitters to this inquiry have questioned the underlying principle for these subsidies. Even if one accepts the need to promote renewables, in a free market, should the renewables sector be supported through the generous RET scheme, with the cost ultimately borne by the consumer? More specifically, is it fair that highly profitable wind companies effectively receive subsidies (through the creation of a market for certificates) that effectively cover up to 60 per cent of the cost of producing a MWh of wind energy?

7.52 The economic case against current RET arrangements and the benefit that it provides the wind industry is built on the following five criticisms:

- that the RET distorts the market by diverting investment from elsewhere in the economy and by increasing energy supply above existing demand;

39 IPART, *Review in regulated retail gas tariffs and charges for 2015–16*, June 2015, http://www.ipart.nsw.gov.au/Home/Industries/Gas/Reviews/Retail_Pricing/Review_of_regulated_retail_gas_tariffs_and_charges_for_2015-16 (accessed 13 July 2015).

40 Ergon Energy, *Submission 84*, p. 2.

- that wind should be—and on some assessments will soon be—self-sufficient and capable of competing in the energy market without subsidies;
- that the RET promotes an unbalanced mix in the development of renewables, disproportionately promoting the development of wind above other renewable energy sources;
- that the RET is not the most cost-effective option for reducing emissions; and
- that large-scale wind turbines will not be as effective a mechanism to reduce emissions in the future.

Market distortions

7.53 By any reckoning, the wind industry receives a substantial and generous cross subsidy from the RET. On a conservative estimate, each RET-eligible company receives in excess of \$500 000 a year for each turbine. On the basis of there being 2 077 wind turbines in Australia, the RET provides \$1.09 billion per annum to the wind industry. On this basis, and assuming the RET operates for another 15 years, the RET cross-subsidy for existing turbines from now until 2030 will be in the vicinity of \$9.3 billion. Given that the wind industry plans significant future investment, the subsidy is likely to be considerably more than \$9.3 billion.

7.54 The 2014 Review of the RET estimated that the future cost of the RET across all renewables:

...would require a further \$22 billion cross-subsidy to the renewables sector in net present value (NPV) terms over the remainder of the scheme (in addition to the \$9.4 billion cross-subsidy provided from 2001 to 2013) and encourage more than \$15 billion (in NPV terms) of additional investment in renewable generation capacity to 2020. This investment comes at the expense of investment elsewhere in the economy and the additional generation capacity is not required to meet the demand for electricity.⁴¹

7.55 Several submitters and witnesses to this inquiry have argued that these subsidies should stop on the basis that they distort the market. Regulation Economics, for example, argued that subsidised renewable energy has been 'sucking capital into worthless investments'.⁴² It added:

The costs to Australia in continuing to force electricity customers to incorporate uncommercial renewable energy within their aggregate supply are considerable. By 2020 they will amount to over \$3.5 billion a year in electricity bills plus expenditures via the budget which are also paid for by consumers. The program, should it run its course, will impose an aggregate cost on the economy of between \$30 and \$53 billion. Not only does this inflict a direct cost on electricity consumers but it also undermines

41 *Renewable Energy Target Scheme: Report of the Expert Panel*, August 2014, p. i.

42 Regulation Economics, *Submission 4*, p. 3.

Australia's comparative advantage as a low cost electricity supply source, with adverse implications for industry development.⁴³

7.56 Dr Alan Moran of Regulation Economics noted that a renewables subsidy could be borne by taxpayers without there being any increase in the underlying market price. He explained that the subsidy:

...would need to be set at the difference between the long run marginal cost of commercially available power and the long run marginal cost of the cheapest form of renewable energy that is eligible for the subsidy. And for it to have no effect on prices it would need to be in the form of a direct subsidy from taxpayers rather than, as is largely the case at present, the subsidy coming about by regulatory requirements that retailers include specific proportions of designated renewable energy.⁴⁴

Wind should be self-sufficient

7.57 Several submitters to this inquiry emphasised that the wind industry would not be economically viable in Australia without the certificate market. The noted Australian geologist, Professor Ian Plimer, argued:

No wind farm could operate without generous taxpayer subsidies and increased electricity charges to consumers and employers. These subsidies are given irrespective of whether the wind farm produces any consumable energy or not and are paid even when a wind farm is shut down due to strong winds. Wind farmers have been more successful in harvesting massive subsidies from taxpayers than harvesting the wind.⁴⁵

7.58 Parkesbourne/Mummel Landscape Guardians argued in its submission that wind power is an inefficient form of energy production and uncompetitive in the open market. It queried:

Why does wind energy need this indirect subsidy? It is not because of high research and development costs, or high construction costs, or high labour costs. It is because wind farms are a very inefficient producer of their own product. Because they cannot produce reliable power, given the intermittency and variability of the wind, they cannot compete in the open market.

For the same reason, their inefficiency and unreliability, they are an ineffective way to reduce greenhouse gas emissions. Because they need constant back-up (coal-fired plants in 'spinning reserve' or open cycle gas turbines), the net reduction of greenhouse gas emissions becomes negligible in comparison with other, more reliable sources of power. If we wish to reduce greenhouse gas emissions, the only serious options are closed cycle gas turbines, hydro, and nuclear.

43 Regulation Economics, *Submission 4*, p. 1.

44 Pyrenees Shire Council, *Answer to question on notice number 3*, received 7 April 2015.

45 Professor Ian Plimer, *Submission 381*, Extract from *Not for Greens*, Connor Court Publishing, 2014, p. 91.

...

If wind farms cannot serve any useful function, then they should not be subsidized.⁴⁶

7.59 Mr Mike Baner argued in his submission that current subsidies through the RET should be redirected:

The dollar value placed towards subsidies would be better utilised in research and development activities to improve generating technologies and power storage facilities which would lead to a more efficient use of existing resources resulting in a reduction of Australia's carbon emissions.⁴⁷

7.60 Other submissions highlighted the international experience to urge that Australia should discontinue subsidies through the RET. Ms Jenny Holcombe noted the Spanish experience where, following the removal of subsidies to the wind industry in 2012, projects proceeded based on their economic viability. As she explained:

In January 2012, the Spanish Government abolished subsidies to windfarms. In Spain's least windy State, Extremadura, a hundred wind projects that had applied for approval abruptly decided not to proceed.

In contrast, last Wednesday, 18th March, the first windfarm to operate without subsidies began operating in the State of Galicia, Spain's windiest region. And 83 per cent of windfarms in the pipeline for Galicia at the time the subsidies ceased will also be built. All without subsidies. They will be backed up by four reversible hydro-electrical plants to store the energy produced when not needed.

For years, wind farms in Spain had been paid twice for the electricity they produced: the market price and an equivalent amount as subsidy. With subsidies withdrawn, the former wastage is revealed: non-viable projects do not proceed; viable projects proceed without need of subsidies.⁴⁸

7.61 Ms Marie Burton expressed her concern with the international evidence of the long-term dependence of wind power on subsidies:

Consumer subsidies are backing a non helpful business with the wind industry because overseas they are turning away from wind due to the enormous costs involved. Emily Gosden (12 No.2014) stated wind farm developers receive 115,000 pounds for every person employed and is now expected to be 1.8 billion pounds annually. John Constable said "large numbers of soft subsidized jobs indicates low productivity, high cost energy" is supported by the UK Energy Research Centre (govt. funded).⁴⁹

46 Parkesbourne/Mummel Landscape Guardians, *Submission 119*, p. 5.

47 Mr Mike Baner, *Submission 334*, p. 2.

48 Ms Marie Burton, *Submission 66*, p. 1.

49 Ms Marie Burton, *Submission 66ss*, p. [2].

7.62 Interestingly, there are some strong advocates for renewables who argue that the wind industry may not need the assistance of the RET. For example, environmental consultant Dr Kim Forde told the committee:

The phenomenal drop in the cost of solar generation in the last five years is evidence that with investment and a profile, and sales to a willing public will ensure the viability of these industries. Wind generation costs have also dropped significantly over the last 15 years. The need for any 'subsidy' is almost past, as the price parity of solar and wind has been achieved, or exceeded, traditional costs.⁵⁰

The RET and the renewables mix

7.63 Another theme of this inquiry has been that the RET has promoted wind power above other forms of renewable energy. Clearly, wind has been the major benefactor of the RET. It has been the cheapest of the renewable energy sources in Australia and has therefore benefitted disproportionately from the RET. It also has the lowest current capital costs. Questions must be asked, however, about whether government assistance should be promoting a better mix of renewable energy sources:

- should policy-makers reconsider the policy mix to see how it is currently advantaging the development of wind power over other renewables?
- should the RET be redesigned to cap the subsidies from any given renewable source, thereby promoting a more diverse renewables mix?

7.64 In this context, CWP Renewables recognised that a higher RET would disproportionately benefit consumers without rooftop solar panels:

The reduction in household electricity costs, although acknowledged to be modest, will result in greater benefit to those households without rooftop solar panels as they pay a larger relative residential bill than those that have invested in rooftop solar.⁵¹

7.65 Frontier Economics noted that eligibility for the RET could be broadened to include low emissions energy sources and have a similar cost impact on consumers as the present scheme. It explained the impact of a broadened RET scheme as follows:

We consider that a [Low Emissions Target] LET, which broadens the criteria for eligible creation of LGCs, is a "no-regrets" option: if future gas prices are much higher than what was assumed in our modelling of a LET then there would still be the option to invest in new wind, solar and other renewables. At worst a LET would have a similar resource cost/impact on consumers as the existing RET scheme, but no higher. However, if gas does continue to provide a cheaper abatement option than wind or solar then the LET would entail lower resource/consumer costs than the RET while still delivering emissions abatement, as our modelling found.⁵²

50 Dr Kim Forde, *Answers to Questions on Notice no. 15*, 10 June 2015, p. 10.

51 CWPR, *Submission 261*, p. 3.

52 See: Frontier Economics, *2014 Residential Electricity Price Trends—Final Report*, September 2014, p. 36.

7.66 The August 2014 ACIL Allen report found that:

Wind entry over the period 2016-2020 is significant and displaces primarily black coal generation. Once the wind build necessary to meet the LRET target is completed however, the future fuel mix is relatively static throughout the remainder of the modelling horizon, with most growth met by increased output from existing coal-fired stations.⁵³

Wind and emissions reductions

7.67 The main policy objectives of the RET are to reduce greenhouse gas emissions in the electricity sector through encouraging the additional generation of electricity from renewable sources. The 2014 review of the RET noted ACIL Allen's modelling of the cost of abatement under the (2014) RET. It found that:

The cost of abatement of the current RET policy is estimated to be \$35 to \$68 per tonne over the period 2014 to 2030, with the SRES being higher than the LRET at \$95 to \$175 per tonne in comparison with \$32 to \$62 per tonne to 2030.⁵⁴

7.68 ACIL Allen used two models to calculate the cost of abatement from the RET:

Both used the present value of the change in resource costs (the numerator), while one method applied a discount factor to the change in emissions (the denominator). In addition to the choice of methodology, the cost of abatement estimate depends on modelling assumptions, particularly capital costs.⁵⁵

7.69 The committee has received evidence from Dr Joseph Wheatley, the Managing Director of the Irish consultancy *Biospherica Risk Ltd*. Dr Wheatley's research shows that as the proportion of wind generation increases, the CO₂ abatement effectiveness of wind energy decreases. As he states in his submission:

The best empirical estimate is that wind power avoided 6.2MtCO₂-e, a reduction in total emissions of 3.5%. Wind power contributed 4.5% of system demand and therefore the emissions displacement effectiveness of wind power was 3.5%/4.5% or 78% in 2014. Several factors acted to limit the effectiveness of wind power in reducing emissions in 2014. A significant fraction of South Australia's wind output displaced low-emissions gas generation. Wind power tended to displace black coal plant in New South Wales rather than higher emissions brown coal plant in Victoria. Part-load inefficiency costs and system losses also degraded effectiveness. Wind power becomes less effective in displacing emissions from thermal plant as installed capacity increases. The evidence in this

53 Frontier Economics, *Submission 87*, p. 3.

54 *Renewable Energy Target Scheme: Report of the Expert Panel*, August 2014, p. 42.

55 *Renewable Energy Target Scheme: Report of the Expert Panel*, August 2014, p. 42.

study suggests that effectiveness in the NEM would fall to 70% if the proportion of energy provided by wind is doubled from 2014 levels.⁵⁶

7.70 Other submitters and witnesses have highlighted the findings of Dr Wheatley's research. With reference to Dr Wheatley's work, Mr Peter Lang argued that by ignoring the factors listed below, analyses have over-estimated the carbon emissions avoided from wind power and, therefore, overestimate carbon abatement effectiveness.

- (a) Wind energy displaces the highest marginal cost generator at the time. This tends to be gas and black coal, rather than brown coal. So wind tends to displace generators whose emissions intensity is less than the grid average emissions intensity.
- (b) Ramping—power stations consume more fuel and emit more CO² per MWh when they are operating at below optimum power and when ramping power up and down to balance the fluctuating power supplied by wind. For comparison a car has higher fuel consumption when continually accelerating and decelerating rather than running at constant speed.
- (c) Cycling—that is, shutting down, starting up, or on standby not generating electricity but consuming fuel waiting to be dispatched to supply power when the wind power drops. This is equivalent to the effect of idling at the traffic lights on your car's average fuel consumption for the trip.
- (d) Transmission losses tend to be higher for wind generation than for fossil fuel generators.
- (e) Auxiliaries refers to the power stations own use of electricity for fans, pumps, conveyor belts, etc. The AEMO figures for the proportion of power used by auxiliaries assumes a linear relationship between electricity generated and the power stations own use (auxiliaries). However some of the own use is proportional to electricity as generated but some is not. The linear assumption understates the emissions at low power (high wind power).⁵⁷

7.71 Mr Lang argued that using the results of Dr Wheatley's analysis and projecting the CO² abatement effectiveness to 2020, 'the estimates of CO² abatement cost quoted in the Warburton Review may need to be increased by around 67%'.⁵⁸

56 Dr Joseph Wheatley, *Submission 348*, pp 5–6. See also: Dr Joseph Wheatley, *Proof Committee Hansard*, Canberra, 19 May 2015, p. 77.

57 Mr Peter Lang, *Answers to questions on notice no.21*, 15 June 2015.
See also: Mr Peter Lang, *Committee Hansard*, Canberra, 19 May 2015, p. 60.

58 Mr Peter Lang, *Answers to questions on notice*, 15 June 2015, p. 3.

7.72 Mr Lang recommended that the CO² abatement cost estimates in the RET Review should be re-estimated taking CO² abatement effectiveness into account. He also argued the need for:

- Australia to collect the data needed to estimate CO² emissions accurately at the frequency needed to estimate the emissions avoided by wind energy; and
- the CER and other agencies to provide guidelines on how to estimate emissions avoided by wind energy and require that economic analyses of abatement cost take the CO² abatement effectiveness into account in their analyses.⁵⁹

Does the geographic dispersion of wind farms in Australia pose a threat to the security and reliability of the National Electricity Market?

7.73 The committee is aware of claims that the geographically large and highly dispersed nature of Australia's wind farm fleet poses 'significant security and reliability concerns to the eastern Australian grid'.⁶⁰ The committee asked AEMO for its comment on this view. AEMO responded:

South East Australia does have occasional very widespread high and low wind patterns, including calms that can affect every large NEM windfarm simultaneously.

Whilst this creates challenges for the NEM, AEMO would not say that it poses "significant security and reliability concerns". AEMO is responsible for overseeing reliability (adequacy of generation to meet demand) and system security (the grid's ability to withstand credible disturbances) and carefully analyses the technical challenges of integrating the current and future levels of renewable energy. When issues arise or are anticipated, AEMO has mechanisms through which they can be addressed.⁶¹

7.74 AEMO did note that it only counts a small percentage of wind generation capacity as reliable to meet peak demand in reliability forecasts:

This means that installation of wind generation capacity only slightly offsets the need for other generation to meet the reliability standard. This should not be interpreted to mean that reliability is necessarily threatened by it. The market is designed to reward generation as required to meet demand, with the high market price cap intentionally selected to provide sufficient income to reward non-intermittent plant that may operate only very occasionally.⁶²

59 Mr Peter Lang, *Submission 259*, pp 1–4.

60 Paul Miskelly, 'Wind farms in eastern Australia—Recent lessons', *Energy and Environment*, Volume 23, No. 8, 2012, p. 1233.

61 Australian Energy Market Operator, *Submission 469*, p. 10.

62 Australian Energy Market Operator, *Submission 469*, p. 11.

The Clean Energy Finance Corporation

7.75 The Clean Energy Finance Corporation (CEFC) is a statutory authority established under the *Clean Energy Finance Corporation Act 2012*. The primary function of the CEFC is to invest, directly and indirectly, in clean energy technologies, which are further defined as energy-efficient technologies, low-emission technologies and renewable energy technologies.

7.76 The CEFC utilises a commercial approach to investment (investing for a positive financial return) to overcome market barriers and encourage investment in renewable energy, energy efficiency and low emission technologies. The CEFC focuses its investment in projects and technologies at the later stage of development which have a positive expected rate of return and therefore have the capacity to service and repay capital.

7.77 The CEFC was intended by the former Australian Government to supplement existing initiatives such as the Renewable Energy Target, to counteract barriers to private investment in the clean energy sector, including the then global financial conditions, the cost of renewable energy and the complex nature of Australia's electricity markets.

7.78 In setting a new policy direction, the Australian Government put forward a package of bills in 2013 collectively known as the carbon tax repeal package. One of the bills sought to abolish the CEFC and transfer its assets and liabilities to the Commonwealth. This reflected the Australian Government's policy change to support clean energy projects through direct action such as the Emissions Reduction Fund and providing strong investment incentives to business through the renewable energy target. This aspect of the amendment package did not pass the Senate and was not enacted.

7.79 While still maintaining its policy position that the CEFC should be abolished, the Australian Government has recently directed the CEFC to change its mandate to restrict investment to new and emerging clean energy technologies, on the basis that projects that are economically viable should be funded through the usual investment mechanisms. This will preclude CEFC investment in existing clean energy projects such as wind farms.

Long-term Power Purchase Agreements

7.80 The material presented above does not reference the rates set between power generators and retailers under long term power purchase agreements (PPAs). PPAs are an avenue through which power generators can mitigate risk associated with selling their product. As the Parliamentary Library has noted:

Because the RET legislation does not guarantee connection to the grid, renewable energy developers must negotiate long-term power purchase agreements (PPAs) with electricity retailers. The availability of these PPAs

is hampered by policy uncertainty as energy retailers are wary of committing to long-term contracts.⁶³

7.81 The committee has viewed one document, tabled in the Senate on 3 September 2014, which gives a strong indication about the effect of wind on retail prices:

Paying ca. [(approximately)] \$32/MWh above market price

AGK booked ca. [approximately] \$280m[illion] of wind development profits in FY [(Financial Year)]07–12 from wind farms it had developed and sold with 25yr offtake contracts, priced at ca. \$112/MWh. As a result, we estimate that AGK is committed to buying ca 1.3TWh/yr through its various wind PPAs at ca. \$32/MWh above the FY15 wholesale market (ex-carbon). At a headline level, it will pay \$40m/yr more for electricity than it would have had to without the wind strategy, resulting in 4–5% NPAT [(Net Profit After Tax)] reduction in FY15E.⁶⁴

7.82 The committee made requests for the production of such agreements from operators. However, those requests have not been forthcoming. Accordingly, the committee cannot make any meaningful finding about the true impact of large-scale wind turbines on household power prices.

7.83 The representations made, and set out above, focus on wholesale power prices which have been declining for a number of reasons. However, they do not address the impact of the cost of the large-scale generation certificates issued to wind power generators of which cost comprises the subsidy paid and which is recovered by retail power bills.

7.84 In the absence of PPAs as requested, the committee recommends that PPAs be made available for the purpose of determining the impact of wind power supplied under the LRET on retail power prices. The Productivity Commission should have free access to PPAs and the NEM data comprising pricing in all relevant electricity markets, including the dispatch, wholesale, retail and derivative markets. Further, the Productivity Commission should investigate and determine the cost impacts arising from:

- improved and/or expanded net worth and grid infrastructure capacity payments required to maintain sufficient reserve capacity to accommodate fluctuations in wind power output, including generators holding spinning reserve, capital costs for reserve capacity held by generators using peaking power plants, such as open-cycle gas turbines; and

63 Ms Anita Talberg, 'Support for renewable energy', *Parliamentary Library*, http://www.aph.gov.au/About_Parliament/Parliamentary_Departments/Parliamentary_Library/pubs/BriefingBook44p/RenewableEnergy (accessed 25 July 2015).

64 Bank of America, Merrill Lynch, 'AGL Energy: Wind strategy biting back', Tabled in the Senate, 23 September 2014. AGK is the Australian Stock Exchange (ASX) abbreviation for AGL Energy.

- any other matter relevant to, and associated with, increasing installed wind power capacity as required to satisfy the LRET.

Recommendation 13

7.85 The committee recommends that the Australian National Audit Office (ANAO) conduct a performance audit of the Clean Energy Regulator's (CER) compliance with its role under the legislation. In particular, the committee recommends that the ANAO examine:

- the information held by the CER on wind effectiveness in offsetting carbon dioxide emissions at both 30 June 2014 (end of financial year) and 3 May 2015;
- the risk management and fraud mitigation practices and processes that are in place and whether they have been appropriate;
- whether all public monies collected in respect of the *Renewable Energy (Electricity) Act 2000* are appropriate;
- whether there are financial or other incentives, including but not limited to, the collection of public monies under the *Renewable Energy (Electricity) Act 2000* that are distorting the CER's role in achieving the objectives of the Act; and
- whether the expenditure of public monies by the CER has been appropriately focused on achieving the *Renewable Energy (Electricity) Act 2000* objectives.

Committee view

7.86 The committee agrees that Government investment in clean energy is best directed at supporting emerging technologies that would otherwise struggle to find early-stage investment. It is only through such investments that existing energy technologies, such as wind farms and solar power, passed the research and development phases to become financially viable energy sources.

7.87 This chapter notes the lack of research isolating the effect of wind power on retail electricity prices. This information is important. It would address many of the issues and concerns raised in this chapter. Accordingly, the committee recommends that the Australian Government direct the Productivity Commission to investigate the impact of wind energy on retail prices.

Recommendation 14

7.88 The committee recommends that the Australian Government direct the Productivity Commission to conduct research into the impact of wind power electricity generation on retail electricity prices.

Renewables and the Emissions Reduction Fund

7.89 One of the key objectives of the Renewable Energy Target is to reduce carbon emissions in the electricity sector. The other objectives, listed under section 3 of the *Renewable Energy (Electricity) Act 2000* are to encourage the additional generation of

electricity from renewable sources and to ensure that renewable energy sources are ecologically sustainable.

7.90 The Renewable Energy Target, however, is a blunt means of reducing carbon emissions. The installation of renewable energy is but one way of reducing carbon emissions among many. Investments in energy efficiency, destroying methane or waste gas in industrial activities, more transport efficient vehicles, vegetation management and agricultural practices to retain more carbon in soils are other ways of achieving the same goal. By restricting the ways of meeting the end goal of reducing emissions, the Renewable Energy Target has the potential to increase the cost of meeting any particular emission reduction target.

7.91 Indeed, the risk of the Renewable Energy Target being a costly way of reducing emissions in the Australian context is higher given the structure of our electricity market. Australian electricity production is dominated by coal fired power stations, our gas resources tend to be more expensive to exploit than those in other countries such as the United States and we have limited sources of hydropower. These intrinsic characteristics of Australia's resource endowments makes the cost of moving the electricity sector from existing sources to low carbon emission sources a costly exercise. As the former Chairman of the Productivity Commission, Gary Banks, said:

Crucially — and this point seems not to be widely understood — it will not be efficient from a global perspective (let alone a domestic one) for a carbon-intensive economy, such as ours, to abate as much as countries that are less reliant on cheap, high-emission, energy sources ... it's commonsense that achieving any given level of abatement is likely to be costlier in a country with a comparative advantage in fossil fuels.⁶⁵

7.92 The limitations of the Renewable Energy Target are not a surprise. Its original design envisaged that it would be a temporary measure until more generic carbon reduction policies had been adopted. In 2009, COAG made a decision to replace various state and territory renewable energy programs with an expanded Renewable Energy Target. In making the decision COAG announced that:

It is expected that renewable energy targets will no longer be required after 2030 as the CPRS [Carbon Pollution Reduction Scheme] will drive the deployment of renewable energy.⁶⁶

7.93 Australian governments have adopted more generic and widespread ways of reducing carbon emissions so the ongoing rationale for the Renewable Energy Target is not clear to the Committee. The former Gillard Labor government established a carbon tax in 2012. While this has been removed by the Abbott Coalition government, the Coalition government has adopted an Emissions Reduction Fund that provides subsidies for carbon emission projects on a "reverse auction" basis. Climate change policies are likely to remain a matter of political controversy, however, both major

65 Banks, G. 2011, Presentation to BCA/AIGN Carbon Pricing Forum, Parliament House, Canberra, 23 March.

66 Council of Australian Governments, Hobart Meeting Communique, 30 April 2009, p. 8, <https://www.coag.gov.au/sites/default/files/2009-04-30.pdf> (accessed 2 August 2015).

political parties are committed to policies that seek to reduce emissions from a range of projects rather than focus on individual sectors. In that context, maintaining a policy that narrowly seeks to reduce emissions through only investment in renewable energy is anomalous.

7.94 The Committee considers that these issues can be addressed through targeted modifications to the Government's existing carbon emissions policies—the Renewable Energy Target and Emissions Reduction Fund subject to annual audits of compliance.

7.95 The Renewable Energy Target should be amended so that all new investments in renewable energy between 2015 and 2020 will be eligible to create renewable energy certificates for a period of no more than five years. Existing investments in renewable energy should be grandfathered so that they continue to receive renewable energy certificates under the Act.

7.96 In conjunction with this change, eligibility criteria for the Emissions Reduction Fund should be amended to allow renewable energy projects to receive funding. In practical terms, this would mean that the Government would develop a methodology that would detail how many carbon credits⁶⁷ would be created for investment in different types of renewable energy. Under this model, renewable energy investors could "bid" in Emission Reduction Fund auctions for a subsidy for a given level of carbon reduction according to the approved methodologies. A renewable energy investment would only receive government funding if it could compete against other forms of carbon emission reduction and demonstrate that it was the lowest cost way of reducing carbon emissions.

7.97 Consistent with evidence provided to this Committee, any methodology under the Emissions Reduction Fund should consider the net lifecycle reductions in carbon emissions from renewable technologies. That is, the estimated reductions in carbon emissions from a specific renewable energy investment should consider the carbon emissions generated in its construction (for example, steel, concrete, etc), the displacement of more carbon intensive forms of electricity generation and the need for any power generation backup to renewables.

7.98 The Committee sought information on the carbon payback period for the carbon costs associated with the manufacturing process of wind turbines. Mr Terry James Johannesen, Project Development Manager, RATCH-Australia Corporation Ltd. stated:

[W]e are guided by the information we have received from wind turbine suppliers. We asked them how long it takes to pay back the manufacturing costs, the transport costs, the installation costs and all the fuel that is burnt incorporated in that. A number of those companies that provide the turbines to us have undertaken studies in that regard. Generally, they look at it being

⁶⁷ Or 'Australian Carbon Credit Units' under the Emission Reduction Fund.

around about a 12- to 18-month period for all of that carbon intensive manufacturing cost to be paid back.⁶⁸

7.99 On the question of intermittency of power generated by wind turbines, Dr Moran told the Committee:

[T]here are some backup costs caused by the inherent unreliability of wind and indeed of solar, and these increase exponentially with the increased share of renewables.⁶⁹

7.100 Another cost that would also need to be considered is the carbon cost in additional transmission infrastructure required by renewables to bring the power to where it is used due to the need to locate the generating capacity in sites with suitable wind characteristics and available land which are often farther away from the major cities than traditional forms of electricity generation.

7.101 These are important questions. While definitive answers are beyond the scope of this Committee, resolving such issues is essential for promoting sound energy policy in Australia and would appropriately be considered in the development of an Emissions Reduction Fund methodology.

7.102 A methodology for renewable energy technologies will require some consultation and there should be a transition period between moving new renewable projects from the narrow Renewable Energy Target to a broader policy such as the Emissions Reduction Fund. The appropriate period of time is a matter of judgement, but the Committee views that a period of around five years should be sufficient to develop the methodology and provide time for renewable energy operators to adjust. This would mean that the Renewable Energy Target would cease to be open to new entrants by the end of 2020. One rationale for employing such a timeframe is that it matches the existing structure and timeline of the Renewable Energy Target, which has been designed to increase until 2020 and then be maintained at the level of 33 000 GWh. (Originally the target was 41 000 GWh).

Committee view

7.103 In the view of the Committee the changes outlined above would, if implemented as a package, provide a more efficient, consistent and sustainable policy framework for reducing Australia's carbon emissions going forward, which would provide substantial benefits to businesses and individuals across Australia. In particular, it provides a means of addressing the clear anomaly resulting from current policy settings which partition the renewables sector apart from other ways of reducing carbon emissions and thus unnecessarily inflate the costs of achieving carbon reduction outcomes.

7.104 It is the view of the Committee that if the Government rejects the approach outlined above, the Government should instead seek to limit eligibility for receipt of Renewable Energy Certificates to five years after the commissioning of turbines in the

⁶⁸ Mr Terry Johannesen, RATCH, *Proof Committee Hansard*, Cairns, 18 May, p.7.

⁶⁹ Dr Alan Moran, *Proof Committee Hansard*, Canberra 19 May, p.23.

electricity sectors. This would help constrain the additional costs of the Renewable Energy Target to a defined period.

Recommendation 15

7.105 The Renewable Energy Target should be amended so that all new investments in renewable energy between 2015 and 2020 will be eligible to create renewable energy certificates for a period of no more than five years. Existing investments in renewable energy should be grandfathered so that they continue to receive renewable energy certificates under the Act subject to annual audits of compliance.

7.106 The Government should develop a methodology for renewable energy projects so that they can qualify for Australian Carbon Credit Units. The Government should develop this methodology over a five year period in consultation with the renewable energy industry and the methodology should consider the net, lifecycle carbon emission impacts of renewable energy.

7.107 If the Government does not adopt the above changes, the Government should instead limit eligibility for receipt of Renewable Energy Certificates to five years after the commissioning of turbines.

A handwritten signature in black ink, appearing to read "John Madigan", is written over a light grey rectangular background.

**Senator John Madigan
Chair**

Australian Labor Party Senators' Dissenting Report

1.1 Australia's wind energy industry remains small in comparison both with its potential size and with the total size of wind energy installed around the world. However, to date it has played a vital role in abating the greenhouse gas emissions of Australia's electricity generation sector and has contributed the majority of new generation capacity under the Renewable Energy Target (RET) scheme.

1.2 The explosion of wind energy production around the world and Australia's relatively small participation in this growth to date was well summarised in evidence given before the committee:

Wind energy has had one of the most sustained and rapid growth rates of any industry on the planet. According to the Global Wind Energy Council, 15 years ago there were only 13,000 megawatts of wind energy installed world wide. That is about three times what we have installed here, in Australia, now. Three years later, wind generation doubled. Three years later, it doubled again. Three years later, it doubled—again. Three years later it doubled yet again. And three years later the exponential growth finally slowed down to only 50 per cent, partly due to the GFC. This is phenomenal success, by any measure. I challenge you to think of another good or service that has had such a long-running and rapid growth rate.

Last year the entire electrical generational capacity of Australia's national electricity market was matched around the world by the building of new wind farms. And how is Australia doing? We have installed just a bit over one per cent of the world's wind turbines. In fact, 14 countries have more wind energy installed than Australia. Five countries have over five times as much wind energy installed than we do, even though we have one of the largest—and windiest—countries on the planet. Australia is not in any way, shape or form the proving ground for wind energy. Wind farms have been operating for decades overseas and the industry has been extremely successful.¹

1.3 Far from being a pioneer of an experimental and possibly dangerous new technology, Australia has to date adopted a relatively limited amount of what is a very well-established method of electricity generation around the world. Furthermore, the Australian wind energy industry has successfully worked within some of strictest planning controls found anywhere in the world.

1.4 Australia's largest electricity generator, AGL, has stated that three-quarters of Australia's thermal plant is at the end of its useful life² and has committed to closing its own coal plants by 2050. In this context, it is undeniable that Australia must

1 Mr Jonathan Upson, *Committee Hansard*, 19 May 2015, p. 67.

2 Nelson, T., Reid, C., and McNeill, J., *Energy only markets and renewable energy targets: complementary policy or policy collision?*, AGL Applied Economic and Policy Research Working Paper No. 43, August 2014, p. 15. <http://aglblog.com.au/wpcontent/uploads/2014/08/No-43-energy-only-and-renewable-targets-FINAL.pdf>, (accessed 14 June 2014)

develop public policy that will encourage the development of low-cost, renewable energy sources to replace outdated thermal plants.

1.5 The benefits of wind energy generation in terms of greenhouse gas abatement are well established, as are the minimal impacts wind farms have on their local environment. The integration of wind energy into electricity grids has been successfully managed around the world and Australia has been no exception in this regard. Furthermore, the wind energy industry has provided a much-needed source of employment and income in regional communities.

1.6 Labor Senators are disappointed that recognition of the levelised costs of different energy sources was absent from the majority report. We note that it is well-established that wind farms have among the lowest levelised cost of any form of new electricity generation capacity, whether it be renewable or non-renewable.

1.7 The Clean Energy Council commissioned an independent study on wind farm investment, jobs and carbon abatement from consultants SKM in 2012. SKM looked at existing wind farm financial data and interviewed companies with experience in numerous wind farm projects. The report presents a breakdown of investment during the construction and operations phases of a major wind farm, collated from actual data provided by developers, contractors, advisers and consultants.³

1.8 The report found that for every 50 megawatts of capacity, a wind farm:

- has an estimated average construction workforce of 48 people with each worker spending \$25,000 per year in the local area, equating to some \$1.2 million per year flowing into hotels, shops, restaurants, and other local service providers.
- employs around five staff for operations and maintenance, equating to an ongoing local annual influx of \$125,000;
- provides up to \$250,000 annually in payments to farmers, a proportion of which flows into the local community; and
- provides a community contribution of up to \$80,000 per year for the life of the project.⁴

1.9 With this background in mind, Labor Senators reiterate their strong support for the wind energy industry in Australia. The Australian Labor Party has recently announced a strengthened commitment to renewable energy generation in Australia by stating its intention that 50 per cent of Australia's large scale electricity production come from renewable sources by 2030. As it currently provides the lowest cost renewable energy source, the wind energy industry will play a large role in meeting this target.

3 Clean Energy Council, *Wind farm investment, employment and carbon abatement in Australia*, July 2012, available at: <http://www.cleanenergycouncil.org.au/technologies/wind-energy.html>.

4 Clean Energy Council, 'Wind Energy', <http://www.cleanenergycouncil.org.au/technologies/wind-energy.html>, accessed 30 July 2015.

1.10 Labor Senators believe this inquiry has been prevented from arriving at a balanced view of the wind industry by several factors.

1.11 First, the terms of reference for the inquiry exclude from consideration the specific environmental benefits provided by wind energy generation and the broader imperative of reducing the carbon intensity of the world's energy production in order to mitigate the impact of climate change. The terms of reference also exclude any comparison of wind energy generation with the impacts of other forms of energy generation on human health, the local environment and climate change. In short, the terms of reference have been framed so as to avoid consideration of the primary issues that must be addressed by public policy regarding Australia's energy generation mix.

1.12 Second, the terms of reference focus on a series of topics that have been repeatedly raised by opponents of wind energy generation and found to be without substance in numerous previous inquiries and reviews. Thus, the purported health impacts of wind farms have again featured most prominently in this inquiry and all expert testimony provided to the committee has again found such claims to be without foundation, as has occurred in numerous previous inquiries. There simply is no evidence of any causal link between the operations of wind turbines and human health impacts.

1.13 This pattern has been repeated with regard to the following baseless theories that:

- wind farms do not provide any greenhouse gas abatement;
- the energy consumption of wind turbine manufacturing outweighs their lifetime energy production;
- wind farms have led, via the RET scheme, to significant cost imposts on electricity consumers;
- wind farms have an intolerable impact on the local bird and bat populations;
- wind farms present a significant fire risk and hamper the work of firefighters; and
- wind farms present a significant threat to aviation operations.

1.14 As discussed in detail under each term of reference, Labor Senators believe evidence presented to the inquiry convincingly refutes each of these claims.

Response to majority report recommendations

1.15 It is pleasing to note that the majority report states that:

The committee acknowledges the need for Australia's renewable energy sector to develop and prosper. It also recognises that a properly regulated wind industry should be an important part of the sector's future growth.⁵

5 Senate Select Committee on Wind Turbines, *Final Report*, August 2015, p.4

1.16 However, Labor Senators are extremely concerned that the recommendations put forward in the majority report stand in direct contrast to this statement. If enacted, they would threaten Australia's ability to secure a low-cost, clean energy mix into the future by making future wind farm investment unviable.

1.17 For this reason, Labor Senators strongly disagree with most of the recommendations and findings of the committee majority.

1.18 Labor Senators were particularly disappointed that members of the committee majority have chosen to discount the overwhelming evidence from government bodies, both state and federal, academics, health experts, acousticians and economists in order to recommend new and onerous regulations in the interim report.

1.19 The willingness of the Government to adopt these recommendations, even before the committee provided its final report, must be seen in the light of other recent actions it has taken to hamper the expansion of renewable energy generation in Australia, including the repeal of an effective carbon pricing regime, the reduction of the RET and directing the Clean Energy Finance Corporation (CEFC) not to invest in wind and solar generation projects.

1.20 In light of the fact that there is no credible scientific evidence to causally link wind turbines with human health impacts, Labor Senators strongly oppose recommendations put forward by members of the committee majority that appear to rely on such discredited claims.

1.21 Labor Senators note that the Clean Energy Council provided a strong response to an article published in the *Australian* which outlined leaked recommendations from the majority report. This response gives a clear indication of the damage that these recommendations would do to future investment:

Adopting these reckless recommendations would damage Australia's international investment reputation, right when we are finalising major agreements with some of our biggest trading partners," Mr Thornton said. Business needs stability and confidence to invest, and this has only recently been restored to the renewable energy sector after 18 months of uncertainty.

Hundreds of millions of dollars' worth of projects have been announced since a deal on the Renewable Energy Target was legislated, and these will create hundreds of jobs and major investment in regional and rural areas of the country.

Adopting the headline recommendation of this report would be economically reckless, and shows some of the senators are out of touch with the business community and the Australian people, who overwhelmingly support renewable energy.⁶

1.22 Labor Senators concur with the assessment of the Clean Energy Council.

6 Clean Energy Council, Media release, 'Senate Inquiry Blows it on Wind power', 31 July 2015, <http://www.cleanenergycouncil.org.au/media-centre/media-releases/July-2015/senate-inquiry-blows-it-on-wind-power.html>, accessed 3 August 2015.

1.23 Labor Senators believe the regulatory regime, and associated research, that would be imposed by the majority recommendations would be enormously expensive, duplicative and unworkable.

1.24 Proposals to significantly alter the distribution of responsibilities between the Federal Government and the states and territories with regard to land use planning and environment protection are also not supported by evidence gathered by the committee. No systemic problems with the planning, monitoring and compliance regimes governing wind farms have been identified during this inquiry. Furthermore, no evidence was produced that would warrant the Commonwealth imposing onerous bureaucratic measures on a single industry to the exclusion of other comparable industries.

1.25 Thus, Labor Senators do not support the proposal to establish a 'National Wind Farm Ombudsman' or 'Wind Farm Commissioner'. This proposal should not be proceeded with. It would constitute a misuse of resources by replicating existing complaint-handling mechanisms in each state and territory and would be a considerable administrative burden for the wind energy industry.

1.26 Labor Senators also do not support the creation of an 'Independent Expert Scientific Committee on Industrial Sound', nor the imposition of a levy to fund such a body. As detailed in discussion under term of reference (c), the National Health and Medical Research Council (NHMRC) already provides advice on this topic and has acted professionally with regard to its evaluation of the scientific evidence in this area.

1.27 The attempt to establish a parallel scientific advisory body is simply a means to sidestep the findings of the NHMRC, which are inconvenient for those who wish to assert such a link between human health effects and wind farms. Labor Senators believe this dismissive attitude to scientific evidence and to the work of the NHMRC represents a highly irresponsible approach to setting public health protection measures.

1.28 Labor Senators do not support the establishment of a 'National Environment Protection (Wind Turbine Infrasound and Low Frequency Noise) Measure'. The committee has been presented with no scientific evidence to support the claim that infrasound at the sound pressure levels generated by wind turbines is harmful to human health. Evidence provided to the committee suggests that there is no precedent anywhere in the world for using infrasound as part of a noise regulation regime for wind farms.

1.29 Labor Senators strongly disagree with any recommendation that undermines the bipartisan agreement made in 2015 regarding the Renewable Energy Target. We are particularly concerned with the concept of using the Emissions Reductions Fund as a substitute mechanism for supporting renewables projects.

1.30 The renewables industry has been in limbo for 18 months as a result of the government's failure to keep its election promise that there would be no changes to the Renewable Energy Target. Investment has just started again after bipartisan agreement was reached on a 33,000 GWh target by 2020. Proposing further

amendments at this point in time is extremely short-sighted and will be seriously damaging to investor confidence.

1.31 This recommendation would not only see the death of renewables investment in Australia, along with thousands of jobs in regional communities, but it would put a massive impost on the Federal Budget, as the Emissions Reductions Fund is a direct taxpayer-funded subsidy.

1.32 This recommendation fundamentally misunderstands the intent of the renewable energy target, which has the dual goals of reducing carbon emissions and providing a catalyst for the transition of Australia towards a future low-carbon energy mix.

1.33 The Emissions Reduction Fund is an inefficient, expensive waste of taxpayers' money that will not achieve meaningful emissions reductions.

1.34 In contrast, the government's own Renewable Energy Target review concurred with the majority of modelling that the Renewable Energy Target will actually lead to lower electricity bills for consumers from 2020. This is discussed in detail in Section (a).

1.35 To switch renewable energy support from an efficient market mechanism to an inefficient taxpayer-funded subsidy would be both expensive and destructive.

1.36 Labor Senators note that this recommendation also seeks to misrepresent the realities of life-cycle emissions from wind farms. The majority report has ignored the advice of turbine manufacturers and government agencies that wind turbines generally repay the costs of energy expended within three to seven months of operation, as discussed in detail under term of reference (h).

1.37 The recommendation also falsely implicates renewable energy in the levels of back up energy generation in Australia. It is unfortunate that the majority report privileges the opinion of Alan Moran over the advice of the national grid operator, the Australian Energy Market Operator, which has refuted claims that the introduction of greater levels of wind has required an increase in capacity dedicated to maintaining the stability of the grid. This is also discussed in detail under term of reference (h).

1.38 Labor Senators are also concerned by the fallback recommendation to make Renewable Energy Certificates expire in five years. This would make wind farm investment completely unviable and almost certainly guarantee that no new wind energy would be installed in Australia. We also hold concerns that this recommendation would push up electricity prices for consumers by removing the downward pressure on wholesale prices provided by renewable generation supported by the RET.

1.39 Labor Senators believe the recommendation to compel State Governments to comply with National Wind Farm Guidelines and the NEPM by linking compliance to the issuance of Renewable Energy Certificates is extremely heavy-handed and shows little understanding of the distinction between state and federal planning responsibilities.

1.40 Labor also notes the suggestion that there should be ‘general compliance’ with National Wind Farm Guidelines, but ‘specific compliance’ with the NEPM without providing any definition as to what constitutes ‘general’ or ‘specific’ in this context.

Labor Senators do not support the recommendation for the Productivity Commission to undertake research into the impact of wind power electricity generation on retail electricity prices. This recommendation would constitute a misuse of resources as the government’s own Renewable Energy Target Review and independent modelling has found that renewable energy puts downward pressure on wholesale electricity prices and the RET leads to lower electricity prices for consumers. This is discussed in detail in Section (a).

1.41 Labor Senators note that the majority report recommendation for a performance audit of the Clean Energy Regulator fundamentally misunderstands the mandate and duties of this body and seeks inquiry into areas that are completely outside the remit of the CER. The CER’s remit and performance is discussed in detail in Section (b).

1.42 Labor Senators are highly doubtful that the states will decide to participate in the onerous regime proposed in the report and believe the recommendation of a federal takeover in the event of non-cooperation is completely inappropriate and unrealistic and would present a massive cost burden to the Federal Budget.

Dissenting report recommendations

Recommendation 1

1.43 Labor Senators recommend that the Federal Government not proceed with the recommendations made to it in the majority report.

1.44 Labor Senators further recommend that the Federal Government reassure the wind energy industry, which is both an important source of income and employment in rural areas and a vital means of abating Australia’s greenhouse gas emissions, that it is not intent on preventing its further development based on unsubstantiated claims of negative health, environment and economic impacts.

Recommendation 2

1.45 Labor Senators recommend that the Federal Government publicly acknowledge that:

- wind farms are an important means of reducing greenhouse gas emissions from Australia’s electricity sector, thereby contributing to our greenhouse gas emissions reduction goals;
- the health impacts of fossil fuel extraction and generation are acknowledged by the medical and scientific community;
- there are no causal links between wind turbines and impacts on human health;

- **the wind industry is a growing industry at a time when Australia's manufacturing sector is undergoing significant change and downsizing and that it provides valuable employment opportunities in regional Australia; and**
- **the continued growth of the renewable energy industry, including wind, is a positive thing for Australia's economy and its environment.**

1.46 Although no systemic failings with the current regime governing wind farm developments were identified in the inquiry, Labor Senators believe that discussion on the following topics highlighted some areas where improvements can be made.

1.47 As discussed in detail under term of reference (d), the committee received evidence that the distribution of planning, monitoring and compliance responsibilities between state and local governments is a point of tension. Specifically, some local government bodies explained that the complex and technical nature of wind farm planning approvals and compliance work are beyond their expertise and resourcing.

1.48 Labor Senators note that several states have moved to centralise planning approvals for wind farms at the state level to address this problem. While this may lessen the burden that falls on local governments, the task of conducting compliance work will still require significant resourcing.

1.49 While noting that the best distribution of resources and responsibilities is a matter for determination by each state jurisdiction, Labor Senators believe local governments should be sufficiently resourced to effectively meet their responsibilities.

Recommendation 3

1.50 Labor Senators recommend that state governments ensure that local governments are adequately resourced to undertake their monitoring and compliance roles under state planning laws.

1.51 As also discussed under term of reference (d), Labor Senators note that the Clean Energy Council has developed, with the support of a range of wind energy companies, the *Community Engagement Guidelines for the Australian Wind Industry*. This document was developed by the Australian Centre for Corporate Social Responsibility and, given the vital role effective community engagement plays in successful wind farm developments, Labor Senators believe the best-practice recommendations it contains could be given a more formal status.

Recommendation 4

1.52 Labor Senators recommend that state and territory governments consider the codification of community engagement guidelines based on the Clean Energy Council's *Community Engagement Guidelines for the Australian Wind Industry* to ensure a greater level of community confidence and input is generated by wind farm planning, construction and operation.

1.53 As discussed under term of reference (e), Labor Senators note that post-construction noise monitoring is generally conducted by acoustic consultants retained by wind farm developers. Labor Senators do not question the professionalism of these acoustic consultants and believe evidence provided to the committee supports

the view that this arrangement has not affected their independence or the nature of their advice.

1.54 However, Labor Senators believe that the community's perception of independence might be enhanced if this arrangement were reformed to implement an 'arm's length' relationship with developers.

Recommendation 5

1.55 **Labor Senators recommend that state and territory government consider reforming the current system whereby wind farm developers directly retain acoustic consultants to provide advice on post-construction compliance.**

(a) the effect on household power prices, particularly households which receive no benefit from rooftop solar panels, and the merits of consumer subsidies for operators

1.56 Before addressing the effect of the RET scheme on household power prices, Labor Senators emphasise that, contrary to repeated assertions made during the inquiry, the scheme does not involve any taxpayer subsidy of renewable power generation. The scheme does not impose any costs on the federal budget beyond the administrative costs of the Clean Energy Regulator (CER).

1.57 As explained by the CER, the RET scheme works by creating a market for renewable energy certificates which must be purchased and surrendered by electricity retailers, not by funding from the federal budget:

The Renewable Energy Target works by allowing both large-scale power stations and the owners of small-scale systems to create certificates for every megawatt hour of power they generate. Certificates are then purchased by electricity retailers who sell the electricity to householders and businesses. These electricity retailers also have legal obligations under the Renewable Energy Target to surrender certificates to the Clean Energy Regulator, in percentages set by regulation each year. This creates a market which provides financial incentives to both large-scale renewable energy power stations and the owners of small-scale renewable energy systems.⁷

1.58 The Chief Executive Officer of the CER, Ms Chloe Munro, emphasised this point when she appeared before the committee:

There is no taxpayer funding of the renewable energy targets. The way that it operates is that certificates are created on the one hand and purchased and surrendered on the other hand entirely within the electricity market. So the payment for those certificates is made essentially by electricity retailers⁸

1.59 This is not a tax and does not involve a subsidy from the federal government to clean energy generators. As discussed further below, while the cost of the scheme is passed on to consumers by electricity retailers, this direct cost is offset by the downward pressure on wholesale prices that is also a result of the scheme.

1.60 When evaluating the impact of wind generation on household electricity prices, it is important to note that the expansion of renewable generation capacity under the RET affects power prices in two opposing ways. The overall effect on household electricity prices depends on which of these two opposed effects are stronger. These price pressures are described briefly below.

1.61 As explained by the Department of the Environment, wind power, once installed, has lower operating costs than fossil fuel competitors because it can operate

7 Clean Energy Regulator, 'About the Renewable Energy Target', <http://www.cleanenergyregulator.gov.au/RET/About-the-Renewable-Energy-Target>, accessed 22 July 2015.

8 Ms Chloe Munro, *Committee Hansard*, 19 May 2015, p. 7.

at around zero marginal cost—that is, it does not have any ongoing fuel costs. As a result:

Wind farms are able to bid their capacity into the National Electricity Market at relatively low prices to ensure their generation is dispatched. By displacing gas or coal generation, wind power places downward pressure on wholesale electricity prices in the short to medium term. To the extent these lower prices are passed on to homes and businesses through competitive tension, wind power can lead to lower power costs for consumers.

To the extent that the policy initiatives stimulate an excess of new wind generation beyond that required by the market, the downward pressure on wholesale prices can be amplified.⁹

1.62 The countervailing price effect arises from the RET and other cross-subsidy schemes, which aim to overcome the fact that wind farms have relatively high capital costs such that they are not yet commercially viable without support. The RET 'enables new renewable energy projects, including wind farms, to earn additional revenue through the creation and sale of tradeable certificates for renewable generation. The Renewable Energy Target Rules oblige electricity retailers to purchase and surrender these certificates, the costs of which are passed on to electricity users.'¹⁰

1.63 As calculated by the Australian Energy Market Commission, the cost of the RET cross subsidy has been estimated to make up a small proportion of retail electricity bills at approximately four per cent.¹¹ As wind makes up approximately half of renewable generation under the RET, it follows that the cross subsidy specifically directed to wind power makes up approximately two per cent of household bills.¹² This impact is, however, offset by the impact of increasing renewable generation on wholesale prices.

1.64 To determine the impact of downward pressure on wholesale electricity prices, modelling has been undertaken by a number of organisations. The majority of this modelling concurs that, in the long term, the downward pressure on wholesale electricity prices will outweigh the increased costs from the RET cross subsidy, leaving consumers better off than they would be in the absence of the RET.

1.65 Modelling undertaken by ACIL Allen for the recent Warburton Review, which was undertaken prior to the recent reduction of the RET, confirmed this conclusion. The Department of the Environment summarised their findings as follows:

9 Department of the Environment, *Submission 358*, p. 1.

10 Department of the Environment, *Submission 358*, p. 1.

11 Australian Electricity Market Commission, *Final report: 2014 residential electricity price trends*, December 2014, p. 179, <http://www.aemc.gov.au/getattachment/ae5d0665-7300-4a0d-b3b2-bd42d82cf737/2014-Residential-Electricity-Price-Trends-report.aspx>, accessed 17 July 2015.

12 Department of the Environment, *Submission 358*, p. 1.

...the ACIL Allen modelling indicates that while the currently legislated Renewable Energy Target would cumulatively add around \$250 in net present value terms to average household electricity bills over the period 2015 to 2020, this cumulative impact would fall virtually to zero by 2030 as the downward pressure on wholesale electricity prices comes to outweigh the certificate cost impost after 2020.¹³

1.66 While the cumulative cost over the five years between 2015 and 2020 has been estimated at \$250, the Climate Institute has noted that this amounts to an impost of approximately \$1 per week for the average household and, as noted above, lower wholesale prices are projected to offset this amount by 2020.¹⁴

1.67 Labor Senators therefore emphasise that the RET has delivered a substantial boost in renewable energy generation in Australia, with attendant greenhouse gas emissions abatement, without a significant increase in retail costs over the longer term.¹⁵

1.68 Labor Senators also note that recent modelling by a variety of firms has also found that removing or substantially reducing the RET would cost more money than it saves.¹⁶ One example of such modelling is that developed by Schneider Electric for their client group of large energy consumers. Schneider Electric informed the committee that their research suggested the Large-scale Renewable Energy Target (LRET) would have three benefits:

Firstly, we found that the LRET would act as a hedge against increasing natural gas prices. The LRET directly influences the generation mix and, by reducing the reliance on gas-fired generation, the LRET reduces the sensitivity of the electricity markets to gas prices. The LRET therefore acts as a hedge against rising gas prices, which are expected to increase in the long term, due to linkage of the Australian east coast gas market to the global markets via the exporting of LNG and growing global and domestic gas demand. Secondly, we found that the LRET acted as a hedge against carbon emissions, and may keep carbon emissions lower in the longer term. By reducing carbon emissions, the LRET reduces exposure to the market—and our customers—to carbon costs, acting as a potential hedge against rising taxes or permit prices into the future. In addition, the low-emission volumes under the RET may also help keep carbon prices lower.

Finally, and most importantly for our customers, we found the impact of the LRET was on the long-term wholesale price. The LRET is forecast to result in a generation mix with lower marginal cost, lower carbon emissions and

13 Department of the Environment, *Submission 358*, p. 2.

14 The Climate Institute, 'Would reducing the Renewable Energy Target significantly lower power bills?', March 2014, http://www.climateinstitute.org.au/verve/resources/TCI_ReducingRET_ImpactOnBills_FactCheck.pdf, accessed 30 July 2015.

15 The Australia Institute, *Submission 67*, p. 1; for information on abatement levels achieved by the RET, see discussion below under term of reference (h).

16 For a summary of this modelling see Clean Energy Council, *Submission 450*, p. 5.

increased competition in the wholesale electricity market, all which serve to reduce prices. The scenarios investigated under the RET in its current form result in lower wholesale electricity prices than the scenarios of a reduced version of the RET or the repeal of the RET.¹⁷

1.69 The Clean Energy Council submitted the following estimated costs to households of the abolition of the RET:

Analysis by the CEC using the results of the Review Panel's modelling has shown that by early 2020 the average household power bill would be an estimated \$35 a year higher if the target is repealed compared to leaving it unchanged. By 2030 prices are expected to be more than \$70 a year higher under a Repeal scenario on average.¹⁸

1.70 The committee was presented with evidence from Frontier Economics, stating that its modelling of the RET had found that the downward pressure on wholesale prices may not in fact be sufficient to fully counteract the direct cost to consumers:

Our modelling has tended to show that that target would lead to higher retail prices than the reduced target. Our submission pointed to that acknowledgement from another economic consulting firm, Roam Consulting, which said that this merit order effect or the suppressing of wholesale prices is likely to be transient and models may overstate this effect.¹⁹

1.71 Labor Senators note that this finding is contradicted by modelling undertaken by a number of other organisations, as discussed above, and that conclusions as to the balance of these price effects is highly dependent on assumptions. In this regard, Labor Senators note criticisms that have been made in the past about assumptions used by Frontier Economics in its modelling, particularly with regard to the cost of renewable generation projects, the cost of fossil fuels for other forms of generation, and the ability of industry to meet the RET.²⁰

1.72 In light of these findings, Labor Senators believe there is no case for the further reduction or abolition of the RET based on its impact on household power prices.

1.73 Labor Senators emphasise that the recent reduction of the RET to 33,000 GWh by 2020, brought about by the passage of the Renewable Energy (Electricity) Amendment Bill 2015 on 23 June 2015, was agreed to with great reluctance by the Labor Party. Prior to this compromise being reached, the uncertainty over the future of RET had effectively halted new investment in the industry and placed at risk its future viability, a situation which the Labor Party could not allow to continue.

17 Mr Brian Morris, *Committee Hansard*, 29 June 2015, p. 22.

18 Clean Energy Council, *Submission 450*, p. 6.

19 Mr Matt Harris, *Committee Hansard*, 19 May 2015, p. 19.

20 See, for example, Giles Parkinson, 'Modelling wars: moulding data to kill renewables', *Renew Economy*, 20 June 2015, <http://reneweconomy.com.au/2014/modelling-wars-mould-data-kill-renewables-82732>, accessed 22 July 2015.

1.74 At the time this compromise position was reached, the Labor Party made it clear that it viewed this reduced target as a floor on which to build, rather than a ceiling. It has since announced its support for a more ambitious target of sourcing at least 50 per cent of Australia's large scale generation from renewables by 2030.²¹

1.75 Labor Senators note evidence from the CER that it has accredited 440 power stations under the LRET and that this includes 82 wind farms with a combined installed capacity of around 4,100 MW.²² The recent growth in wind generation means that it now accounts for 60 per cent of Large-scale Generation Certificates (LGCs) created by power stations annually.²³

1.76 Wind accounts for the majority of LGCs currently produced because 'the levelised cost of energy from wind is cheaper than other renewable sources.'²⁴

1.77 The 2012 *Australian Energy Technology Assessment* report of the Bureau of Resources and Energy Economics, Australian Energy Technology Assessment table over the page shows that wind is a cheaper source of energy than coal and renewables such as solar and geothermal.

Table 1—Levelised costs of energy in 2012 Australian dollars

	AETA (A\$/MWh)	AETA (excl CO ² price) (A\$/MWh)	International Energy Agency (A\$/MWh)
Black coal	176–189	125	109
Black coal with CCS	193–253	183–243	110
Supercritical pulverised black coal	135–145	84–94	103
Combined cycle gas turbine	96–108	81–93	97
Combined cycle gas turbine with carbon capture and storage	142–166	137–161	122
Solar thermal	330–402	330–402	380
PV – non tracking	212–264	212–264	391
Wind—onshore	111–122	111–122	83
Geothermal	150–163	150–163	55
Nuclear (Gen3+)	94–99	94–99	91

Source: Bureau of Resources and Energy Economics, *Australian Energy Technology Assessment*, 2012, p. 96.

21 Mark Kenny, 'Bill Shorten to unveil 50% renewable energy target at Labor conference', *Canberra Times*, 22 July 2015, <http://www.canberratimes.com.au/federal-politics/political-news/bill-shorten-to-unveil-50-renewable-energy-target-at-labor-conference-20150721-gih4bp.html>, accessed 22 July 2015.

22 Clean Energy Regulator, *Submission 93*, p. 6.

23 Clean Energy Regulator, *Submission 93*, p. 7; see graph on this page for comparison with number of LGCs generated by other renewable sources.

24 The Australia Institute, *Submission 67*, p. 1.

1.78 The Bureau of Resources and Energy Economics estimates that by 2030, solar photovoltaic and wind are expected to have the lowest LCOE of all of the evaluated technologies.

1.79 Wind-generated, onshore electrical power has low long-term marginal power generation costs because:

- the fuel source is renewable, sustainable and free, but the resource itself is area-specific, and also variable;
- the power generation does not produce polluting gases and emissions, which need to be mitigated and/or incorporated into the full costs of electricity generation; and
- it has no water usage.²⁵

1.80 The Australian Energy Market Operator (AEMO) also provided the committee with tables comparing the levelised cost of generation options for renewable and non-renewable technologies (Table 2). These figures illustrate that wind power remains the most competitive form of renewable generation and with solar being the second most competitive.²⁶

Table 2—LCOE across renewables technologies

Technology	Fuel type	Max Capacity factor (%)	2014		2015	
			CO ₂ emissions (kgCO ₂ -e/MWh)	Minimum LCOE (\$/MWh sent out)	CO ₂ emissions (kgCO ₂ -e/MWh)	Minimum LCOE (\$/MWh sent out)
Wind (100 MW)	Wind	43	-	99	-	99
Biomass	Biomass	70	23	100	23	119
Solar PV (FFP)	Solar	21	-	224	-	149
Solar PV (SAT)	Solar	21			-	183
Solar PV (DAT)	Solar	21			-	240
Solar thermal (CR with storage)	Solar	42	-	277	-	218
Solar thermal (CLF)	Solar	23	-	328	-	284
Solar thermal (PT with storage)	Solar	42	-	302	-	294
Wave ¹⁵⁷	Oceanic	60			-	147
Geothermal - HAS	Geothermal	83	-	137		
Geothermal - EGS	Geothermal	83	-	137		

Source: Australian Energy Market Operator, *South Australian Fuel and Technology Report*, 2015, p. 46. See also AEMO, *Submission 469*.

1.81 Suggestions were put forward during the committee's inquiry that a proportion of LGCs ought to be reserved for particular technologies, such as solar. Labor Senators do not agree with such proposals as reserving a proportion of the LGCs for

25 Parliamentary Library, *Brief to the Select Committee on Wind Turbines*, received 10 February 2015.

26 Australian Energy Market Operator, *Submission 469*, pp 7–8.

renewable technologies with higher levelised costs will reduce the efficiency of the RET in terms its cost per unit of greenhouse gas abatement. Furthermore, the costs of various forms of renewable generation are changing as technology advances, and the RET should remain technology neutral so as to allow the most efficient forms of investment to take place.

1.82 Labor Senators note that the Government has recently demonstrated a similar determination to direct investment to less commercially viable forms of generation by apparently ordering the CEFC not to invest in wind generation projects or in household and small-scale solar projects.²⁷ These directives come after an earlier directive to the CEFC to generate a significantly higher investment return over the medium term without increasing its level of portfolio risk. The Chair of the CEFC stated in response to this directive:

Within the narrow field of investment allowable under the CEFC Act, achieving such increased returns without increasing risk, is highly challenging, and in my experience, outside the scope of normal market opportunities. In this respect, the 2015 Investment Mandate requires the CEFC to seek out additional investments that are outside market norms, in addition to carrying on its existing investment activities.²⁸

1.83 These events highlight the Government's disregard for commercial realities of investment in renewable energy generation and its intention to stymie the CEFC in its mandated task of facilitating financing for clean energy projects. Labor Senators emphasise that the CEFC has been highly successful to date and, far from imposing a burden on the federal budget, has delivered a rate of return on its investments of 3.5 per cent above the benchmark return of the Government five-year bond rate.²⁹

27 Heath Aston, 'Government directive against wind farm investments surprises CEFC, crossbenchers', *Sydney Morning Herald*, 12 July 2015, <http://www.smh.com.au/federal-politics/political-news/government-directive-against-wind-farm-investments-surprises-cefc-crossbenchers-20150712-giagiy.html>, accessed 22 July 2015; Heath Aston, 'Government pulls the plug on household solar', *Sydney Morning Herald*, 13 July 2015, <http://www.smh.com.au/federal-politics/political-news/government-pulls-the-plug-on-household-solar-20150712-gian0u.html>, accessed 22 July 2015.

28 Clean Energy Finance Corporation, 'CEFC responds to the new investment mandate', 5 March 2015, http://www.cleanenergyfinancecorp.com.au/media/107304/cefc_chairs_response_to_treasurer_and_minister_for_finance_re_2015_cefc_investment_mandate.pdf, accessed 22 July 2015.

29 Clean Energy Finance Corporation, 'Investments', <http://www.cleanenergyfinancecorp.com.au/investments.aspx>, accessed 22 July 2015.

(b) how effective the Clean Energy Regulator is in performing its legislative responsibilities and whether there is a need to broaden those responsibilities

1.84 Any judgements regarding the effectiveness of the CER must be based on a sound understanding of its mandate. Labor Senators note that the committee received a number of submissions that questioned the effectiveness of the CER, but in most cases these submissions appeared confused about its responsibilities.

1.85 The CER is an independent statutory authority established by the *Clean Energy Regulator Act 2011*. It administers a number of clean energy schemes, but it is the RET scheme, more specifically the LRET component, that is relevant to this inquiry. The RET is administered in accordance with the *Renewable Energy (Electricity) Act 2000*.

1.86 As summarised by the Department of the Environment, the responsibilities of the CER in relation to wind farms are limited to 'managing the tradable certificate markets established under the scheme legislation', which includes the following activities:

Accrediting eligible renewable energy power stations under the Renewable Energy Target scheme;

Managing the online Renewable Energy Certificate Registry (including the issue, transfer and surrender of certificates);

Maintaining registers of accredited power stations, large-scale generation certificates and applications for accredited power stations: and

Monitoring and enforcing compliance by certificate market participants with the Renewable Energy Act and regulations.³⁰

1.87 It is important to note that the CER is not responsible for:

matters relating to wind farm siting (planning and approval processes) and operation (including health and safety impacts) of wind farms. Under Australia's constitutional arrangements, these matters are properly the responsibility of the states and territories. The Regulator is required to take account of compliance with the relevant laws of the states and territories.³¹

1.88 The CER noted in its submission that the RET has been the subject of three reviews in the last four years, twice by the Climate Change Authority in 2012 and 2014, and most recently in the Warburton RET Review.³² The Warburton review commented specifically on the administration of the RET by the CER, but did not adopt any suggestions for improvements:

The Panel has investigated opportunities to reduce administration and compliance costs of the RET scheme while allowing it to meet its

30 Department of the Environment, *Submission 358*, p. 4.

31 Department of the Environment, *Submission 358*, p. 4.

32 Clean Energy Regulator, *Submission 93*, p. 2.

objectives. The majority of the submissions to the review indicate satisfaction with the administration of the scheme with only a few proposals for improving administrative arrangements.³³

1.89 With regard to these reviews, the Department of the Environment also commented that:

...none these has included findings that would cast doubt on the Regulator's effectiveness in performing its legislative responsibilities or recommendations to broaden the Regulator's responsibilities in relation to wind farms. In relation to the latter, steps in that direction could run the risk of exceeding the Commonwealth's constitutional jurisdiction, duplicating state and territory regulations and creating additional costs for business that are difficult to justify.³⁴

1.90 The division of responsibilities between the states and territories and the Commonwealth with regard to regulation of wind farms is discussed further under terms of reference (d) and (e).

1.91 The role of the CER in accrediting power stations to participate in the LRET attracted considerable comment during the inquiry. The CER emphasised that the accreditation process is only for the purpose of allowing participation in the LRET, not for the purpose of 'certifying that the relevant power station has met State or Territory environmental, planning or work health and safety approvals and requirements.'³⁵

1.92 LRET accreditation is dependent on the power station generating some or all of its power from an eligible energy source and on the power station meeting the following prescribed requirements set out in subregulation 4(1) of the *Renewable Energy (Electricity) Regulations 2001*:

- (b) a power station that is in the national electricity market must use NEM standard metering; and
- (c) a power station that is not in the national electricity market must use metering that enables the Regulator to determine the amount of electricity generated by the power station; and
- (d) the power station must be operated in accordance with any relevant Commonwealth, State, Territory or local government planning and approval requirements.³⁶

1.93 Some witnesses suggested that the CER has failed to act on evidence that power stations are breaching the requirement that power stations 'must be operated in

33 Dick Warburton, Brian Fisher, Shirley In't Veld, Matt Zema, *Renewable Energy Target Scheme: report of the Expert Panel*, 15 August 2014, p. 114.

34 Department of the Environment, *Submission 358*, pp 4–5.

35 Clean Energy Regulator, *Submission 93*, p. 4.

36 *Renewable Energy (Electricity) Regulations 2001*, <https://www.comlaw.gov.au/Details/F2015C00555>, accessed 16 July 2015.

accordance with any relevant Commonwealth, State, Territory or local government planning and approval requirements'.

1.94 The CER explained that it requires power stations to regularly declare that they are in compliance with all laws and it also follows up with state, territory or local authorities when it becomes aware of suggestions that power stations are not in compliance.³⁷

1.95 However, the CER cannot act to suspend the accreditation of a power station merely on the suspicion that it is not meeting requirements under state and territory law. It is not an appropriate body to adjudicate on whether a power station meets state or territory planning requirements. Rather, it must wait for objective evidence that such a breach is occurring, which would generally be a state or territory planning body or court making a definitive finding to that effect.³⁸

1.96 The CER's General Counsel, Mr Purvis-Smith, noted that the power to suspend the accreditation of a power station under the LRET had not been exercised to date. He explained that this is because definitive findings had not been arrived at by state and territory authorities:

The process works. The difficulty is that we rely on that objective evidence. In doing that, we rely on the states and territories to a large degree to form a view as to whether a contravention has occurred. It is state based law. These are approvals that have been put in place by state and local authorities. Of course, we are going to listen to what they have to say. We have not been in the situation where a state or territory has made a definitive finding that there has been a breach of their local laws. There has been conjecture but no-one, to my knowledge, has ever moved to a final declaration finding, court proceeding, to say there has been a contravention of the law.

We do not necessarily have to wait for the states and territories to find a contravention. If there was an admission of a breach, that would be sufficient. It is not a closed inquiry, in that sense. We are open to other avenues of finding out that information.³⁹

1.97 Labor Senators believe that, with regard to its administration of the LRET, the CER has effectively fulfilled its legislated responsibilities to date. Suggestions that the CER has failed to properly address concerns about the planning compliance of certain wind farms are founded on the mistaken belief that the CER is in a position to override or prejudge planning determinations at the state and territory and local government levels.

1.98 Labor Senators do not agree with suggestions raised during the inquiry that the remit of the CER should be increased such that it would have a direct role in evaluating the compliance of power stations with state and territory regulations or in monitoring the sound levels of power stations.

37 Mr Geoff Purvis-Smith, *Committee Hansard*, 19 May 2015, p. 2.

38 Mr Geoff Purvis-Smith, *Committee Hansard*, 19 May 2015, p. 2.

39 Mr Geoff Purvis-Smith, *Committee Hansard*, 19 May 2015, pp. 2-3.

1.99 The CER, which is an economic regulator with a very specific mandate, does not possess the expertise to properly address such matters. Even if it were possible to acquire such expertise, a highly undesirable situation would emerge in which the CER would be attempting to determine compliance with state and territory based planning laws in parallel with state and territory planning bodies or, alternatively, attempting to determine compliance with an as yet non-existent Commonwealth planning regime governing wind farms.

1.100 Labor Senators therefore do not believe there is any justification for broadening the remit of the CER in an attempt to address perceived failings of state and territory based planning regimes. State and territory planning decisions governing all types of development are inevitably subject to controversy from time to time. No case has been made as to why wind farm developments require the specific intervention of the Commonwealth.

1.101 This position is consistent with that of the CER itself:

It is the respectful submission of the Regulator that its responsibilities do not need to be broadened. The Clean Energy Regulator is an economic regulator, charged with the responsibility of ensuring that the RET scheme is administered appropriately. The Clean Energy Regulator does not have, and should not have, responsibility for matters that are currently within the remit of the relevant State or Territory authorities (for example planning approvals, work health and safety obligations and environmental protection).⁴⁰

1.102 Finally, Labor Senators note that many submissions that were critical of the performance of the CER focussed on the claim that LGCs have been invalidly issued because greenhouse gas emissions reductions are not in proportion to the amount of renewable electricity generated by certified power stations. These criticisms are also founded on a misconception of the RET as LGCs are issued on the basis of eligible electricity generated, not on the basis of emissions reductions. This matter is discussed further below under term of reference (h).⁴¹

40 Clean Energy Regulator, *Submission 93*, p. 16.

41 Clean Energy Regulator, *Submission 93 – supplementary submission*, pp. 1-2.

(c) the role and capacity of the National Health and Medical Research Council in providing guidance to state and territory authorities

1.103 Labor Senators note that the committee received a number of submissions and also took evidence at public hearings from people who attribute a wide variety of health symptoms to the operation of wind farms and put forward a number of mechanisms by which these effects are supposed to have been induced, including by exposure to infrasound.⁴² Labor Senators do not question that these submitters and witnesses have experienced such symptoms. However, Labor Senators also emphasise that the suggestion that these symptoms have been directly caused by wind farms is entirely without scientific basis. No credible evidence has been presented to this inquiry to establish such a direct causal link.

1.104 Labor Senators note that the committee majority report states:

...it would seem that the NMHRC's assessment of the lack of consistent evidence coexists with significant empirical, biological and anecdotal evidence that many people living nearby wind turbines suffer similar symptoms and identify the wind turbines as the cause for their symptoms.⁴³

1.105 Labor Senators do not accept this characterisation of the evidence put before the committee. While the committee heard a large amount of anecdotal evidence regarding the supposed health impacts of wind turbines, it did not in fact receive any empirical or biological evidence to this effect.

1.106 Labor Senators emphasise that the confusion of anecdote with reliable empirical evidence is characteristic of the irresponsible approach taken by majority senators in this inquiry.

1.107 The NHMRC is 'Australia's leading body for supporting health and medical research, developing evidence-based health advice, and setting standards in ethics in health care and research, within a single national organisation.'⁴⁴ In the opinion of Labor Senators, it is the appropriate body to assess and report on the evidence regarding health effects of wind farms.

1.108 The NHMRC is established as an independent statutory body under the *National Health and Medical Research Council Act 1992* and comprises the CEO, the council, and its principle committees. The council is itself made up of state and territory chief health or medical officers, the Chief Medical Officer of the Australian Government and a range of health and medical research experts.⁴⁵

1.109 Under section 7(1)(a) of this act, the NHMRC is required to inquire into, issue guidelines on, and advise the community on matters relating to:

42 For a list of such submissions, see footnote 2 at Senate Select Committee on Wind Turbines, *Interim Report*, June 2015, p. 3.

43 Senate Select Committee on Wind Turbines, *Final Report*, August 2015, p. 11, p. 34.

44 National Health and Medical Research Council, *Submission 102*, p. 1.

45 National Health and Medical Research Council, *Submission 102*, p. 1; p. 4.

- (i) the improvement of health; and
- (ii) the prevention, diagnosis and treatment of disease; and
- (iii) the provision of health care; and
- (iv) public health research and medical research; and
- (v) ethical issues relating to health;

1.110 Under section 7(1)(b), the NHMRC is also required to advise and make recommendations to the Commonwealth, states and territories on these matters.

1.111 The NHMRC's activities are guided by the priorities identified in the *NHMRC Strategic Plan 2013–2015*. Its recent work on wind farms and human health has taken place under priority area 8 in this plan, which identifies, among other matters, 'emerging community concerns about the health impacts of new technologies' as a matter requiring an 'evidence-based approach'.⁴⁶

1.112 The NHMRC first addressed the issue of wind farms and human health in 2009 by conducting a rapid review of published scientific literature to determine whether existing evidence supported concerns regarding infrasound, noise, electromagnetic energy, shadow flicker and blade glint. This work culminated in a 2010 public statement which concluded that 'there is currently no consistent evidence that wind farms cause adverse effects in humans'.⁴⁷

1.113 The NHMRC continued to monitor evidence in this area, and hosted a scientific forum in June 2011, which included 'state and territory health, planning and environment authorities and other key stakeholders, including environmental health experts and researchers, acoustic engineers, public interest groups involved with wind farms in Australia and international experts from countries with substantial experience in wind turbines.' After consideration of the results of this forum, the NHMRC commenced a systematic literature review focused on the possible health impacts of audible noise and infrasound. The findings of this systematic review have been used to develop a statement and information paper. As with its earlier rapid review, the information paper finalised in 2014 concludes that 'there is currently no consistent evidence that wind farms cause adverse health effects in humans'.⁴⁸

1.114 The NHMRC advised the committee that the following steps were taken to ensure evidence was appropriately identified, assessed and summarised in this process:

- Establishment of the Wind Farms and Human Health Reference Group under Section 39 of the Act from 1 February 2012 to 31 January 2015
- Appointment of two observers to the Reference Group

46 National Health and Medical Research Council, *Submission 102—Attachment 1*, p. 8.

47 National Health and Medical Research Council, *Submission 102*, p. 5.

48 National Health and Medical Research Council, *Submission 102*, pp. 5–6.

- Disclosure of any interests by Reference Group members and observers (published on the NHMRC website).
- An independent systematic review of evidence up to October 2012
- Independent methodological review of the systematic review of evidence.
- Public consultation on the draft Information paper for period of 45 days from February 2014 (providing 36 submissions).
- Review of draft Information Paper by six expert reviewers.
- An independent review of additional evidence up to May 2014, including additional references submitted during public consultation and expert review.⁴⁹

1.115 In examining evidence produced to date on the health effects of wind farms the NHMRC's expert reference group established there 'were only a small number of poor quality papers that directly examined the health outcomes of wind farm emissions.'⁵⁰ As such, the NHMRC announced a targeted call for research into wind farms and human health on 24 March, which closed on 6 May 2015 after receiving four applications. The NHMRC outlined the intention of this call for further research:

There are obvious limitations in existing direct evidence on wind farms and human health outcomes, and, in funding the TCR, NHMRC intends to stimulate the research required to build a robust body of evidence to establish whether there are adverse health effects from exposure to wind turbine emissions. Up to \$2.5 million over five years is available for this work and outcomes of the TCR are expected to be announced in December this year. However, NHMRC will only fund high quality research which will provide answers to some of the difficult issues that have been raised by the review.⁵¹

1.116 Dr Elizabeth Hanna, a member of the NHMRC Wind Farm and Human Health Reference Group, informed the committee that, in her opinion, sufficient evidence had already been gathered for the health and scientific communities to decide that there was no direct link between wind farms and health problems. She commented as follows on a recent Health Canada study, which came to the conclusion that there is no association between exposure to wind turbine noise and any self-reported illnesses:

I would argue that it has reached the satisfaction level, particularly, when you incorporate the Health Canada study, which actually did use world's best practice and which did go through a very rigorous methodology to be able to identify—it was large, it accurately measured noise. Again, it goes back to the key things of research. If you want to show causation—and this is the core issue here: is it the wind farm that is actually causing real and

49 National Health and Medical Research Council, *Submission 102*, pp. 5–6.

50 Ms Samantha Robertson, *Committee Hansard*, 19 June 2015, p. 15.

51 Ms Samantha Robertson, *Committee Hansard*, 19 June 2015, p. 15.

genuine health problems?—then you have to go back to the basic tenets. You have to show that exposure to a hazard exists. You have to show that there are actual, real and genuine health harms. We have to show a dose response, such that if there is no exposure there is no health problem. If there is exposure, health problems do exist. Then the dose response is a factor—you increase the exposure and you increase the health issues.⁵²

1.117 In response to the suggestion that no amount of research will be sufficient to address the concerns of those opposed to wind farm development, Professor Chapman commented:

I agree that it is impossible to prove a negative. However there are many research questions where such lack of proof does not continue to stimulate serious research into the as yet unproven phenomenon...We have repeatedly seen anti-wind farm interests reject any findings that do not accord with their beliefs. The rejection by such interests of the recent large scale Health Canada study is a prime example of this. The manifest opposition to wind farms of a majority of this Committee is a sad chapter in the erosion of evidence-based attempts at policy making in Australia.⁵³

1.118 Labor Senators reject the criticisms outlined in the majority report of the NHMRCs process and methodology.

1.119 Labor Senators fully support the work of the NHMRC and believe it is the appropriate body to assess the evidence relating to the health effects of wind farms and to coordinate further research, should that be deemed worthwhile. The process conducted to date has been open, transparent and in accord with its established procedures. Labor Senators note that the NHMRC is currently assessing proposals submitted in response to its call for further research on this matter.

1.120 In light of the NHMRC's engagement with the issue and the nature of its findings, Labor Senators strongly disagree with proposals put forward in the committee's interim report to establish an alternative source of advice on human health.

1.121 Labor Senators also strongly oppose further recommendations that flow from this proposal in the committee's report, including that a new *National Environment Protection (Wind Turbine Infrasound and Low Frequency Sound) Measure* be established by the National Environment Protection Council based on advice from this proposed new scientific body.

1.122 These recommendations simply assume, contrary to the available scientific evidence, that wind turbines do directly cause harm to human health.

52 Dr Elizabeth Hanna, *Committee Hansard*, 19 June 2015, p. 20; Health Canada, 'Wind Turbine Noise and Health Study: Summary of Results', <http://www.hc-sc.gc.ca/ewh-semt/noise-bruit/turbine-eoliennes/summary-resume-eng.php>, accessed 24 June 2015.

53 Professor Simon Chapman, Answers to questions on notice arising from 29 June public hearing.

Experts advise there is no evidence that wind farms harm human health

1.123 The committee was informed that the NHMRC's position is in keeping with that of other peak scientific and medical bodies around the world. A representative of Infigen Energy, Mr Jonathan Upson, noted:

I am not aware of any government, scientific, medical or regulatory organisation in the world that has come to the conclusion that wind turbines have a detrimental impact on health.⁵⁴

1.124 Indeed, not only has no medical or scientific peak body come to such a conclusion, it appears that 'wind turbine syndrome' has never been written up in any indexed medical journal in the world. Professor Simon Chapman made this point, among a series of others, in his appearance before the committee:

Why have there been no case series or even single case studies of so-called wind turbine syndrome published in any reputable medical journal? Why has no medical practitioner come forward with a submission to any committee in Australia about having diagnosed disease caused by a wind farm? Where in the world is there even a single example of an accredited acoustics, medical or environmental association which has given any credence to direct harmful effects of wind farms? Why has no complainant anywhere in the world ever succeeded in a common-law suit for negligence against a wind farm operator if this is a real phenomenon?⁵⁵

1.125 Labor Senators note that the majority report made claims about court proceedings against wind farms. However, it failed to provide evidence that the court cases it listed resulted in damages due to human health impacts resulting from wind farm operations⁵⁶.

1.126 The conclusions arrived at by the NHMRC have been endorsed by or agree with the positions of other relevant peak bodies, including the Australian Medical Association (AMA). The AMA issued a statement on wind farms in 2014 outlining its position:

The available Australian and international evidence does not support the view that the infrasound or low frequency sound generated by wind farms, as they are currently regulated in Australia, causes adverse health effects on populations residing in their vicinity. The infrasound and low frequency sound generated by modern wind farms in Australia is well below the level where known health effects occur, and there is no accepted physiological mechanism where sub-audible infrasound could cause health effects.⁵⁷

1.127 Labor Senators respect the decision of the AMA not to participate in the inquiry. Labor Senators also accept that the AMAs position statement is evidence-

54 Mr Jonathan Upson, *Committee Hansard*, 19 May 2015, p. 68.

55 Professor Simon Chapman, *Committee Hansard*, 29 June 2015, pp 28–29.

56 Senate Select Committee on Wind Turbines, *Final Report*, August 2015, p.22.

57 Australian Medical Association, *AMA position statement – wind farms and health 2014*, p. 1, <https://ama.com.au/position-statement/wind-farms-and-health-2014>, accessed 23 July 2015.

based, clear and unequivocal. We reject the assertion in the majority report that 'It has been left to wind farm companies to confirm the AMA's current position'.⁵⁸

1.128 The PHAA expressed a similar position to the AMA in its submission to the inquiry:

1. Health impacts of wind turbines, including “Wind Turbine Syndrome” and “Vibroacoustic Disease” have been raised as concerns in the media and some of the literature, but these collections of symptoms are not recognised medical conditions.
2. Despite some limitations to the availability of relevant studies, many reviews of the literature have failed to identify evidence that infrasound (that is low frequency sound, in the range less than [20 Hz]) has adverse effects on health at the levels produced by modern wind turbines. Symptoms which people claim are consequent to wind turbine exposure, may be common in the community and may sometimes be attributed to psycho-social factors. In general, a relative minority of those exposed to wind turbines report being affected, and annoyance is higher in those who are unhappy about the presence of wind turbines.
3. A review of over 60 scientific review articles on wind turbine noise and health states that "based on the findings and scientific merit of the available studies, the weight of evidence suggests that when sited properly, wind turbines are not related to adverse health".⁵⁹

1.129 Associate Professor Simon Carlile of the University of Sydney told the committee:

I would like to start out by saying that as a neuroscientist, I know of no good neuroscientific evidence that wind turbines are harmful to human health. I also believe that wind turbines will play an indispensable part in our energy solutions for the future.⁶⁰

1.130 The Climate and Health Alliance, which represents 28 health sector organisations, addressed the issue of wind turbine infrasound, which some individuals believe leads to human health impacts:

The available Australian and international evidence does not support the view that the infrasound or low frequency sound generated by wind farms causes adverse health effects for people living or working in proximity to them.

...

At distances beyond 500 metres, infrasound and low frequency sound generated by wind farms in Australia is thought to be below the level

58 Senate Select Committee on Wind Turbines, *Final Report*, August 2015, p. 24.

59 Public Health Association of Australia, *Submission 276—Attachment 1*, p. 2.

60 Associate Professor Simon Carlile, *Committee Hansard*, 29 June 2015, p. 69.

capable of causing health effects to occur, and there is no accepted physiological mechanism where subaudible infrasound from wind farms could cause health effects.⁶¹

1.131 The Australian Association of Acoustical Consultants has published a position statement which confirms there is no evidence that infrasound from wind farms is causally related to any human health impacts.

Infrasound (frequencies below 20Hz for the purpose of this statement) is generated by both natural sources (such as people, wind, waves, thunder and earthquakes) and mechanical sources (such as fossil fuel power generation, travelling in a car with windows open, traffic, industry, air conditioners, aircraft and wind turbines). Investigations have found that infrasound levels around wind farms are no higher than levels measured at other locations where people live, work and sleep. Those investigations conclude that infrasound levels adjacent to wind farms are below the threshold of perception and below currently accepted limits set for infrasound.⁶²

1.132 Labor Senators note with concern that the majority report has implied that the World Health Organization (WHO) has found the operations of wind turbines are causally linked to adverse health effects, including cardiovascular disease and cancer.⁶³ This stands in direct contrast to statements made by the WHO in a background briefing paper:

The increased use of renewable energy, especially wind, solar and photovoltaic energy, will have positive health benefits, some of which have been estimated.

...

The ExternE Project considered wind energy to have the lowest level of impacts (health and environmental), of all the fuel cycles considered.⁶⁴

Research findings

1.133 Labor Senators absolutely respect the testimony of individuals who claim their health has been impacted by exposure to wind farms and do not doubt that some individuals are legitimately experiencing symptoms. We do, however, recognise that there is no evidence of a causal link between the activities of wind turbines and any physical complaints and are particularly concerned that genuine medical concerns could be going undiagnosed as individuals mistakenly attribute legitimate symptoms to the operation of wind turbines.

61 Climate and Health Alliance *Submission 331*, pp 5–6.

62 Association of Australian Acoustical Consultants, Position Statement on Wind Farms, *Supplementary Submission 194*.

63 Senate Select Committee on Wind Turbines, *Final Report*, August 2015, p.17.

64 World Health Organization, *Energy, sustainable development and health. Background document for the Fourth Ministerial Conference on Environment and Health*, 23-25 June 2004, Geneva. p. 85; p. 100.

1.134 Many submitters to the inquiry recognised the great contribution of the Health Canada 'Wind Turbine Noise and Health Study' to the body of knowledge on the potential impacts of wind farms on human health. This \$2.1 million epidemiological study, conducted in conjunction with Statistics Canada is the largest of its kind yet conducted. It incorporated a random sample of over 1,200 houses at varying distances from wind turbines at six different wind farms, 4,000 hours of acoustic data, acoustic and medical expertise, self-reported health questionnaires and objective health measures including hair cortisol, blood pressure and heart rates.⁶⁵

1.135 Health Canada released preliminary research findings in November 2014. Notably, they failed to find any link between wind turbine noise (WTN) exposure and health impacts:

The following were not found to be associated with WTN exposure:

- self-reported sleep (e.g., general disturbance, use of sleep medication, diagnosed sleep disorders);
- self-reported illnesses (e.g., dizziness, tinnitus, prevalence of frequent migraines and headaches) and chronic health conditions (e.g., heart disease, high blood pressure and diabetes); and
- self-reported perceived stress and quality of life.

*While some individuals reported some of the health conditions above, the prevalence was not found to change in relation to WTN levels.*⁶⁶

1.136 Health Canada did recognise, however, that 'annoyance toward several wind turbine features (ie. Noise, shadow flicker, blinking lights, vibrations and visual impacts)' were 'statistically associated with increasing levels of WTN'.⁶⁷

1.137 Dr Elizabeth Hanna expressed the view that annoyance towards wind farms is likely to be a very relevant factor in reported health symptoms:

The weight of evidence that I reviewed during my term on the wind farm panel has led me to believe that there is indeed no evidence that wind farms cause health problems. Also, I think it is very unlikely that there are direct health effects. The pathway that I believe is most likely is through annoyance, and this can generate health symptoms as reported, and these are very, very real. So at no stage do we discredit the view of people that report health symptoms, that they are not real in themselves. But the evidence is such that, when you are of the mindset that you are against a wind farm, or indeed exposure to anything else, such as RSI—which was

65 Health Canada, 'Wind Turbine Noise and Health Study', <http://www.hc-sc.gc.ca/ewh-semt/noise-bruit/turbine-eoliennes/summary-resume-eng.php>, accessed 3 August 2015.

66 Health Canada, 'Wind Turbine Noise and Health Study: Summary of Results', <http://www.hc-sc.gc.ca/ewh-semt/noise-bruit/turbine-eoliennes/summary-resume-eng.php>, accessed at 3 August 2015.

67 Health Canada, 'Wind Turbine Noise and Health Study: Summary of Results', <http://www.hc-sc.gc.ca/ewh-semt/noise-bruit/turbine-eoliennes/summary-resume-eng.php>, accessed 3 August 2015.

'kangaroo paw' years ago, from repetitive strain injury—again, it was shown that, if people had a negative attitude, they were the ones that had a much higher rate of showing symptoms. This has been shown in several research papers...⁶⁸

1.138 Health Canada's findings concur with an analysis of Public Benefit Scheme prescription data undertaken by the Head of Medicine at Adelaide University, Professor Gary Wittert. *Four Corners* has reported that this study found no evidence that people living near wind farms were taking more medication.⁶⁹

1.139 Labor Senators note that 'Wind turbine syndrome' has been credited with causing an impossibly wide range of symptoms, which further reduces its plausibility.

1.140 Professor Simon Chapman has compiled a list of symptoms, diseases and aberrant behaviours, currently including 244 entries, attributed to wind turbine exposure.⁷⁰

1.141 Labor Senators also note that Professor Chapman has compiled an up to date list of 25 reviews of the research literature relevant to the wind farms and health effects, all of which support the conclusion that there is currently no evidence that wind farms directly cause health problems.⁷¹

1.142 Labor Senators also draw attention to a study undertaken by Professor Chapman that examined the historical and geographical variations in complaints regarding noise or health effects from wind farms in Australia. The results of this study are as follows:

There are large historical and geographical variations in wind farm complaints. 33/51 (64.7%) of Australian wind farms including 18/34 (52.9%) with turbine size >1 MW have never been subject to noise or health complaints. These 33 farms have an estimated 21,633 residents within 5 km and have operated complaint-free for a cumulative 267 years. Western Australia and Tasmania have seen no complaints. 129 individuals across Australia (1 in 254 residents) appear to have ever complained, with 94 (73%) being residents near 6 wind farms targeted by anti wind farm groups. The large majority 116/129(90%) of complainants made their first

68 Dr Elizabeth Hanna, *Committee Hansard*, 19 June 2015, p. 16.

69 ABC News online, 'Research challenges wind farm illness link', 25 July 2011, <http://www.abc.net.au/news/2011-07-25/research-challenges-wind-farm-illness-link/2808824>, accessed 3 August 2015.

70 Professor Simon Chapman, *Symptoms, Diseases and Aberrant Behaviours Attributed to Wind Turbine Exposure*, updated 8 Jan 2015, <http://ses.library.usyd.edu.au/handle/2123/10501>, accessed 28 July 2015. For a discussion of this array of symptoms, see Professor Simon Chapman, 'Wind turbine disease: a classic 'communicated' disease', *The Conversation*, 20 July 2012, <https://theconversation.com/wind-turbine-syndrome-a-classic-communicated-disease-8318>, accessed 28 July 2015.

71 Professor Simon Chapman and Teresa Simonetti, *Summary of main conclusions reached in 25 reviews of the research literature on wind farms and health*, updated 10 April 2015, http://ses.library.usyd.edu.au/bitstream/2123/10559/7/WindHealthReviews_3.pdf, accessed 28 July 2015.

complaint after 2009 when anti wind farm groups began to add health concerns to their wider opposition. In the preceding years, health or noise complaints were rare despite large and small-turbine wind farms having operated for many years.⁷²

1.143 Labor Senators are disappointed that the majority report has attempted to discredit Professor Chapman's eminent professional qualifications, which he outlined for the committee:

I am Professor of Public Health, University of Sydney. I have a PhD in medicine and I am a fellow of the Academy of the Social Sciences in Australia. I have 500 publications in peer-reviewed journals which have been cited over 9,600 times. My Order of Australia was for distinguished service to medical research, particularly in the area of public health policy.

...

I have published five papers and four letters on wind farms and health in peer-reviewed journals, and I believe I am the most published Australian researcher in this area. Five of these have been read online over 47,600 times. I have reviewed research on wind farms and health for the journals *Environmental Research*, *Noise and Health*, the *International Journal of Acoustics and Vibration*, *Energy Policy*, the journal *Psychosomatic Medicine*, and *Cureus*.⁷³

1.144 The findings of Professor Chapman's research suggest that wind turbines themselves are not directly harmful to human health. Rather, as he explained, the highly variable pattern of complaints suggests psychosocial factors play an important role and that campaigns by opponents of wind farms are strongly associated with increased complaints:

I have long formed the view that the phenomenon of people claiming to be adversely affected by exposure to wind turbines is best understood as a communicated disease that exhibits many signs of the classic psychosocial and nocebo phenomenon where negative expectations can translate into symptoms of tension and anxiety. The very obvious differential spatio-temporal distribution of complaints is the key indicator of this. It mirrors many past historical health panics about new technologies that have included the ordinary telephone, trains, television sets, electric blankets,

72 Simon Chapman, Alexis St George, Karen Waller, Vince Cakic, 'The Pattern of Complaints about Australian Wind Farms Does Not Match the Establishment and Distribution of Turbines: Support for the Psychogenic, 'Communicated Disease' Hypothesis', *PLOS ONE*, 16 October 2013, <http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0076584> ; See also Professor Chapman's response to criticisms of the methodology of this study raised by Dr McMurtry (*Committee Hansard*, 29 June 2015, p. 9) at Professor Simon Chapman, Answers to questions on notice arising from 29 June public hearing.

73 Professor Simon Chapman, *Committee Hansard*, 29 June 2015, p. 28; see committee majority comments at Senate Select Committee on Wind Turbines, *Final Report*, August 2015, p. 18.

power lines, computers, mobile phones and towers, and today's wi-fi and smart electricity meters.⁷⁴

The link between expectations and individual's perceptions of health impacts

1.145 The suggestion that the nocebo mechanism, whereby 'negative expectations can translate into symptoms of tension and anxiety', would account for such a pattern of complaints, has found further support in the work undertaken by Ms Fiona Crichton at the University of Auckland.

1.146 It is disappointing that the majority report excludes Ms Crichton's work from its considerations. This work presents very compelling evidence that there is a direct link between people's exposure to anti-wind messages and their perceptions of infrasound from wind farms on their health.

1.147 Ms Crichton commented on how expectations of negative health effects from infrasound, based on misinformation, influence the interpretation of common physiological symptoms:

Exposure to infrasound is a consistent and normal human experience. Infrasound is produced by air turbulence and ocean waves as well as by machinery such as air conditioners and by internal physiological processes such as respiration and heartbeat. Misinformation that exposure to a benign agent may cause health problems can trigger a nocebo response in the presence of that agent. A nocebo response occurs when the expectation of adverse health effects leads to increased symptom reporting. This happens because symptom expectations guide the detection and interpretation of common physiological symptoms, including normal somatic arousal caused by hypervigilance and elevated anxiety.⁷⁵

1.148 Ms Crichton described peer-reviewed and published research she has undertaken to 'test the potential for expectations formed by accessing information disseminated through the media, particularly the internet, to determine subjective health assessment during exposure to both audible and subaudible wind farm sound.'⁷⁶ In summary, this research has demonstrated:

...that expectations can influence symptom and mood reports in both positive and negative directions. The results suggest that how infrasound is framed can have a determinative impact on subjective health responses during exposure to wind farm sound, and that positive framing of sound could reduce reports of symptoms or negative effects. In further experiments, we have used the same experimental paradigm to investigate whether we can shift negative expectations once they are formed. This is important information if we are to address symptom reporting prompted by access to health warnings and negative beliefs about wind farms. We have found promising indications that changing the narrative about wind farms will go some way to improving health complaints.

74 Professor Simon Chapman, *Committee Hansard*, 29 June 2015, p. 28.

75 Ms Fiona Crichton, *Committee Hansard*, 19 June 2015, p. 1.

76 Ms Fiona Crichton, *Committee Hansard*, 19 June 2015, p. 2.

It is important to note that it was consistent across all experiments that providing people with material on the internet suggesting that infrasound produced by wind farms is causing symptoms in people living close to wind farms increased concerns about the health effects of wind farm sounds and resulted in increased symptoms and mood deterioration during simultaneous exposure to audible wind farm sounds and infrasound. However, when the narrative is changed so that more positive expectations or neutral expectations are formed, the experience is completely reversed. There was also consistent evidence across the experiments that negative expectations triggered noise annoyance responses and that positive expectations reduced noise annoyance.⁷⁷

1.149 In a similar vein Dr Geoff Leventhall also suggested that misinformation campaigns by wind farm opponents had played a significant role in exacerbating reported health impacts:

I believe that many opponents of wind turbines have latched onto infrasound and have used it as a stick with which to beat wind turbines. For the past 10 years or more the leading objectors to wind turbines have led a very successful propaganda campaign against wind turbines, partly based on supposed dangers of infrasound. They have tried very hard to inculcate negative attitudes and unhelpful thinking about wind turbines, so setting people up to be adversely affected. We are now in a confused situation in which many people hold sincere beliefs about infrasound, but these beliefs are based on false information which have been fed to them by well-organised objector groups and their allies. This skilful and successful misinformation campaign, which is largely based on repetition, serves only to heighten adverse effects whilst holding back research in significant areas.⁷⁸

1.150 The Australian Psychological Society noted the stress and anxiety that stem from misinformation in its submission:

An important cause of community resistance to wind turbines, therefore, is misinformation that is spread about the impact of wind farms (e.g., on health, fauna, property values etc) through social groups, via anecdotal stories, or through anti-wind lobby groups. Concerns might be fuelled by the popular media, opinion pieces, news articles, websites and word of mouth.

'Misinformation' refers to information that people have acquired that turns out to be incorrect, irrespective of why and how that information was acquired in the first place. Once fear and confusion have been created by misinformation in communities, it can cause ongoing community division and discord. All of this can lead to increased physiological arousal and stress symptoms. Many of the health effects which are reported to arise

77 Ms Fiona Crichton, *Committee Hansard*, 19 June 2015, p. 2.

78 Dr Geoff Leventhall, *Committee Hansard*, 23 June 2015, p. 9.

from wind farms are very common physiological responses to stress and anxiety.⁷⁹

1.151 The Climate and Health Alliance also recognised the link between expectations upon positive or negative health outcomes:

Several studies demonstrated anxiety about the sound source elevates negative responses, and this underpins a potential source of tension. The association between expectations and health outcomes dates back to Hippocrates and is well established in the health psychology literature. The influence of pre-intervention expectations upon positive or negative outcomes is consistently demonstrated across a range of health endpoints, including weight loss, smoking cessation, and post-operative recovery.⁸⁰

The international experience

1.152 Labor Senators note important evidence received that entire countries with significant numbers of installed wind turbines appear to be free of any community concern regarding their alleged negative health effects.

1.153 Professor Chapman stated that concerns about the health impacts of wind farms appear to be largely restricted to English-speaking countries:

When I travel to Europe, which I do often for my work, I am often in the presence of colleagues who are working in public health and I raise this issue with them. Sometimes they say to me, 'Look, what is it that you are asking?' And I have to go through it again carefully, and they say, 'We have never heard of anything like this.' Friends of mine who have gone walking on the pilgrim's walk in northern Spain made an effort to ask local people as they walked across that, 'Are these wind farms that we are seeing affecting you?' The people looked at them as if they must be strange. They had never heard of anything like this.

So it is, as some people have observed, a phenomenon which perhaps speaks English. Of course, people working in other countries which are not anglophone do publish a lot in anglophone journals—in English-speaking journals—so the idea that there would be researchers who have information and are not putting it out in the English-language academic press is also not very credible.⁸¹

1.154 Ms Kim Forde provided similar testimony about her firsthand experience of community attitudes to wind farms in Ireland. She stated that 'the perception of the impact of infrasound, has blown out of all proportion—again, from people who have fears about the wind farm' and commented that:

I agree that the perception of the exposure to antiwind messages certainly leads to uncertainty. I am actually in Ireland at the moment, and I was at an Irish wind farm in the south of Ireland yesterday speaking with people

79 Australian Psychological Society, *Submission 406*, p. 5.

80 Climate and Health Alliance, *Submission 331*, pp 5–6.

81 Professor Simon Chapman, *Committee Hansard*, 29 June 2015, p. 30.

about exactly this process. They were talking about the fact that they have almost no protests here against wind farms and they find it quite amusing that in the places where there are new wind farms being proposed, places like Australia, there is a protest against it—where there is a protest group or people with an interest, or some perceived interest, in preventing them happening. Whereas here, where people have an alternative to wind—potentially nuclear—these people go, 'We want wind. We can't see a problem with it. We have them.'⁸²

1.155 This observation was supported other witnesses. Mr Peter Rae, a former Liberal Senator for Tasmania with extensive experience in the renewable energy sector, informed the committee:

In my experience around the world there are a only few centres where this concern appears to arise and be concentrated.

Overall it is not a matter which arises until the risk of it is raised by people who do not like having wind turbines placed near to where they live.

I have not heard of any occasion where those who work at operating wind farms have expressed the health concern.

It follows that, as the complaints arise selectively, then considerable caution should be adopted in making any findings on the issue and, in particular, in imposing further restrictions and costs based upon that concern.⁸³

1.156 Mr Danny Nielsen, Managing Director of Vestas Australian Wind Technology, also supported this view:

I have worked for Vestas for over 17 years and can nominate many countries including China, Japan, Taiwan, Korea, Pakistan, India, the USA, the Philippines, Ireland, Sweden and Greece where the sort of health claims made by anti-wind energy activists in Australia have not come to my attention during my time there.⁸⁴

1.157 Ms Megan Wheatley of Senvion Australia, in response to a question regarding the highly uneven global distribution of health complaints regarding wind farms, made the following statement:

I will answer that by quoting our global CEO, Andreas Nauen. He was in Australia a few years ago and he was surprised by the level of debate about wind farms and health. At that time, he spoke about having very specific discussions in other countries about things like warning lights for high towers and said:

82 Ms Kim Forde, *Committee Hansard*, 19 May 2015, p. 81.

83 The Hon Peter Rae AO, Documents tabled at 29 June public hearing, p. [9].

84 Mr Danny Nielsen, Answers to questions on notice arising from 9 June 2015 public hearing, p. [4].

It's always a very solution orientated discussion... but this fundamental discussion of wind turbines causing illnesses, I don't see it anywhere else in the world.⁸⁵

1.158 The committee received a submission and heard evidence from Ms Lilli-Ann Green, a resident of the United States, who stated she had conducted interviews with people claiming to be negatively affected by wind turbines in 15 different countries, both English and non-English speaking.⁸⁶

1.159 Ms Green testified that she runs a 'healthcare consultancy', of which she is the only employee, that has delivered 'educational programs' to 300,000 physicians. However, Ms Green was unwilling to provide the name of her company to the committee. Ms Green was also unwilling to provide the committee with transcripts of these interviews or with the names of the interviewees. Ms Green further informed the committee that the subjects of her interviews were a self-selected group with pre-existing grievances about wind farms based either on perceived health effects or other matters. Finally, Ms Green stated that she has no qualifications in health care or medicine.⁸⁷

1.160 Labor Senators caution that, based on the scant detail supplied, Ms Green's series of interviews appears to have no scientific value if taken as a study of community reactions to wind farms in different countries.

1.161 Labor Senators are convinced that there are notable differences in the level and nature of concerns about wind farms in different countries. This uneven distribution of concerns suggests that factors other than direct causal links between wind turbines and health impacts must be considered.

Thousands of wind farm workers suffer no ill-effects

1.162 A further difficulty confronting claims that wind turbines are directly harmful to human health, whether via infrasound emissions or by some other mechanism, is presented by the fact that the workforces of wind turbine manufacturers and operators report no such ill effects, despite working in very close proximity to wind farms on a daily basis. In response to a question regarding the health effects of infrasound, Mr Ken McAlpine of Vestas Australian Wind Technology, stated:

...we have employees who work at close range to wind turbines every day of the year in all sorts of conditions. You would expect from that that, if there were something harmful coming from the machine or its operation, our people would be first in line to cop it.

...

We have 5½ thousand people who work out in the field operating wind turbines. They work inside them. They go up. They have sites that are

85 Ms Megan Wheatley, *Committee Hansard*, 29 June 2015, pp 34–35.

86 Ms Lilli-Ann Green, *Submission 467*; Ms Lilli-Ann Green, *Committee Hansard*, 29 June 2015, pp 1–6.

87 Ms Lilli-Ann Green, *Committee Hansard*, 29 June 2015, pp 4–5.

within hundreds of metres of the turbines themselves. It is not just manufacturing that Vestas does; it is an operator of wind turbines too.⁸⁸

1.163 Senvion Australia, a company that employs over 3,400 people and has installed over 6,000 wind turbines, also submitted that its workforce appeared to be completely unaffected by working in close proximity to wind turbines and wind farms on a daily basis.⁸⁹ Their submission states:

As a company with employees working on operating wind turbines and living near wind farms, we have not seen any ill health effects resulting from wind energy generation.⁹⁰

1.164 Their submission also quoted one of their engineers, James Miele:

I have spent a huge amount of time living and working in the vicinity of wind turbines. I can state without any doubt that neither I or anybody I know has ever experienced any ill effects from wind turbines.⁹¹

Infrasound

1.165 The committee received considerable volumes of evidence relating to infrasound—that is, sound below a frequency of 20 Hz—and devoted time at its public hearings to discussing the possibility that infrasound emitted by wind farms might directly affect human health.

1.166 While the majority report seeks to suggest the World Health Organization supports the proposition that wind turbines have human health impacts, the WHO explicitly outlines the safe level of infrasound exposure:

Sound characterised by frequencies between 1 and 20 Hz is called infrasound and is not considered damaging at levels below 120 dB.⁹²

1.167 Labor Senators note that wind farms constructed under Australian planning regimes would never exceed the levels outlined by the WHO.

1.168 Mr Christopher Turnbull from the Association of Australian Acoustical Consultants explained that infrasound from wind farms is very similar to infrasound from other sources:

Certainly the level of infrasound from wind turbines is very similar to the level of infrasound from other sources. I have personally measured the noise from waves at beaches and at cliffs in the city and in other areas; other members of this panel have, for example, measured the infrasound

88 Mr Ken McAlpine, *Committee Hansard*, 9 June 2015, p. 31.

89 Ms Megan Wheatley, *Committee Hansard*, 29 June 2015, p.

90 Senvion Australia, *Submission 404*, p. 6.

91 Senvion Australia, *Submission 404*, p. 6.

92 World Health Organization, *Occupational Exposure to Noise: evaluation, prevention and control*, p.41, http://www.who.int/occupational_health/publications/occupnoise/en, accessed 2 August 2015; see committee majority comments at Senate Select Committee on Wind Turbines, *Final Report*, August 2015, p.17.

produced by the change in pressure as people walk; and the levels of infrasound from a wind farm are very similar to those levels that we have just described.⁹³

1.169 In relation to whether the research supports the idea that wind farms may have human health impacts, Mr Turnbull said:

I am not aware of any that has found a link between wind turbines and health. I have certainly read some articles which indicate that there is a hypothesis that there might be, but I have certainly not seen any direct link in any paper that I am aware of.⁹⁴

1.170 Dr Renzo Tonin of the AAAC also confirmed that there are no studies confirming that infrasound from wind farms has human health impacts:

All of the research articles that have been published claiming links between wind farm noise and health basically set a hypothesis for a connection between infrasound and the ability of the human body to respond to that infrasound. They do not prove a connection in any way between adverse health and infrasound.⁹⁵

1.171 Dr Tonin went on to explain the research he had personally completed in this area:

Therefore, what I did in my research last year, presented at the Wind Turbine Noise conference just recently, was to take the highest level of measured infrasound, which to date has been at the Shirley Wind Farm and which I believe the senators would be aware of, and consented to 72 participants ranging in age from about 18 to the late 60s I think it was. What we found was that in presenting that level, which is at a level of 90 decibels at 0.8 Hz and the highest measured anywhere in the world to date, there was no correlation between that level of infrasound and a person's reported symptoms—and there were about 20 different symptoms...⁹⁶

1.172 The assertion that there is something unique or different about infrasound from wind turbines that may be leading to human health impacts was disputed by acoustician Dr Norm Broner:

Infrasound level in various situations has now been fully documented. Infrasound level near to wind turbines is really not that different from many other anthropomorphic and natural noise sources—for example, walking on the beach or travelling in a car, train or plane, you are exposed to levels of infrasound either higher or similar to those from wind turbines. I would hazard a guess that where the committee is currently sitting today you are exposed to levels of infrasound similar to that generated by wind turbines.

93 Mr Christopher Turnbull, *Committee Hansard*, 10 June 2015, p.5.

94 Mr Christopher Turnbull, *Committee Hansard*, 10 June 2015, p.5.

95 Dr Renzo Tonin, *Committee Hansard*, 10 June 2015, p.5

96 Dr Renzo Tonin, *Committee Hansard*, 10 June 2015, p.5.

But I do not think any of you would be claiming that you are not feeling well because of it.⁹⁷

1.173 Dr Broner noted work in Japan by Tachibana which found no problems with infrasound from wind turbines.⁹⁸

1.174 Testimony from Mr Peter Dolan of the South Australian EPA supported the position that infrasound from wind turbines is imperceptible by humans:

With infrasound, the lower the frequency, the harder it is to perceive, and it is generally accepted that you cannot perceive infrasound until 85 dBG, which is the range we tend to use. The levels we are finding near wind farms are much, much lower than that; they are in the order of 30 dBG.⁹⁹

1.175 Mr Dolan also rejected the suggestion that individuals are adversely affected by infrasound from wind turbines:

I am not aware of evidence that thousands of people are adversely exposed. I am aware that we probably have three-quarters of the million people in Adelaide exposed to excessive traffic related infrasound. We are really talking about the difference between the nature of infrasound from a wind farm and from other sources, because, clearly, many millions of Australians are affected by infrasound from road traffic.¹⁰⁰

1.176 A study conducted by the South Australian Environment Protection Authority came to the following conclusions regarding infrasound from wind turbines:

From an overall perspective, measured G-weighted infrasound levels at rural locations both near to and away from wind farms were no higher than infrasound levels measured at the urban locations. The most significant difference between the urban and rural locations was that human activity and traffic appeared to be the primary source of infrasound in urban locations, while localised wind conditions appeared to be the primary source of infrasound in rural locations. Of particular note, the results at one of the houses near a wind farm (Location 8) are the lowest infrasound levels measured at any of the 11 locations included in this study.

This study concludes that the level of infrasound at houses near the wind turbines assessed is no greater than that experienced in other urban and rural environments, and is also significantly below the human perception threshold.¹⁰¹

97 Dr Norm Broner, *Committee Hansard*, 29 June, p. 82.

98 Dr Norm Broner, *Committee Hansard*, 29 June 2015, p. 83.

99 Mr Peter Dolan, *Committee Hansard*, 29 June 2015, p. 12.

100 Mr Peter Dolan, *Committee Hansard*, 29 June 2015, p. 13.

101 South Australian Environment Protection Authority, *Infrasound levels near windfarms and in other environments*, January 2013, p. 41,
http://www.epa.sa.gov.au/environmental_info/noise/types_of_noise/wind_farms

1.177 Former President of the United Kingdom Institute of Acoustics, Dr Geoff Leventhall, noted that there is significant misunderstanding regarding infrasound from wind turbines:

There are many misconceptions about infrasound. It has even become associated with surreal and paranormal events or described as a subtle weapon and cause of illness. Much of this misunderstanding arises from not appreciating that the word 'infrasound' used on its own has only a limited meaning related to a frequency range. Full meaning comes from the inclusion of actual frequencies and levels. One should not make claims about infrasound without also giving the relevant frequencies and levels¹⁰².

1.178 Dr Leventhall also rejected the theory that infrasound from wind farms could be causing human health impacts:

In a paper I published nearly 10 years ago about infrasound from wind turbines I said that wind turbines produce infrasound but the levels are very low and of no consequence. Wind turbines produce low-frequency noise, especially when there is turbulence in the inflow air, and the low-frequency noise can sometimes be audible. But we hear low-frequency noise all the time. It is not something to be afraid of.¹⁰³

1.179 Labor Senators support the NHMRC's effort to encourage further rigorous research on wind turbines and human health; however, it is important to note that the inherent characteristics of infrasound make it a very poor candidate as an explanation for the range of symptoms attributed to the operation of wind farms. First, infrasound emissions from wind turbines are not generally of sufficient sound pressure level to make them perceivable.¹⁰⁴ Second, infrasound is present in all environments, both rural and urban, and often at higher levels than those recorded near wind farms.

1.180 Arguments suggesting infrasound emissions from wind farms are dangerous to human health must therefore overcome the obvious difficulties that such emissions are imperceptible and that they are also found, often at higher levels, in non-wind-farm exposed environments without any reported health effects. No convincing evidence to counter these objections was provided to the committee.

The Cape Bridgewater study

1.181 The recent study of Pacific Hydro's Cape Bridgewater wind farm conducted by Mr Steven Cooper of the Acoustic Group Pty Ltd was cited by some as evidence of a direct link between infrasound emissions from wind farms and reported symptoms

102 Dr Geoff Leventhall, *Committee Hansard*, 23 June 2015, p. 9.

103 Dr Geoff Leventhall, *Committee Hansard*, 23 June 2015, p. 12.

104 For a discussion of the threshold of perception for infrasound, see South Australian Environment Protection Authority, *Infrasound levels near windfarms and in other environments*, January 2013, pp 3–5, http://www.epa.sa.gov.au/environmental_info/noise/types_of_noise/wind_farms

of nearby residents.¹⁰⁵ Many of the majority committee members raised particular concern about the implications of this study.

1.182 However, Labor Senators note that Mr Cooper and Pacific Hydro issued a joint statement on 16 February 2015 emphasising, among other things, the following points:

- The Acoustic Group and Pacific Hydro agree that the study was not a scientific study.
- The Acoustic Group and Pacific Hydro agree that the report does not recommend or justify a change in regulations.
- The Acoustic Group and Pacific Hydro agree this was not a health study and did not seek or request any particulars as to health impacts.¹⁰⁶

1.183 Labor Senators assert that the claim in the majority report that 'Mr Steven Cooper found a correlation between infrasound emitting from turbines at Cape Bridgewater and 'sensations' felt, and diarised, by six residents of three nearby homes' is incorrect and has been thoroughly and effectively discredited by multiple witnesses to the inquiry.¹⁰⁷

1.184 Both Pacific Hydro and Mr Cooper have emphasised that the study was undertaken within a very limited brief. The intention of the study was only to 'see whether any links could be established between certain wind conditions or sound levels at Cape Bridgewater and the disturbances being reported by these six local residents' noting that the windfarm is compliant with relevant noise regulations.¹⁰⁸

1.185 Beyond these limitations, the study was also severely criticised by expert acousticians on the basis of apparent flaws in its methodology. For example, the Association of Australian Acoustical Consultants (AAAC) reviewed Mr Cooper's Cape Bridgewater study and came to the following conclusions:

The overall conclusion drawn from the review is that the Study provides no new credible scientific evidence, and further, no scientific evidence to support the media reporting positively of the Study.

The Study measures infrasound at the blade pass frequency and multiples of the blade pass frequency. The level of infrasound is similar to the levels

105 See Pacific Hydro, 'Cape Bridgewater Wind Farm Acoustic Study', <http://www.pacifichydro.com.au/english/our-communities/communities/cape-bridgewater-acoustic-study-report/>, accessed 23 July 2015.

106 Pacific Hydro and The Acoustic Group, 'Joint statement – Pacific Hydro & The Acoustic Group', p. 1, <http://www.pacifichydro.com.au/files/2015/02/Pacific-Hydro-The-Acoustic-Group-Joint-statement-16-February.pdf>, accessed 23 July 2015.

107 Senate Select Committee on Wind Turbines, *Final Report*, August 2015, p.11

108 Pacific Hydro and The Acoustic Group, 'Joint statement – Pacific Hydro & The Acoustic Group', p. 2, <http://www.pacifichydro.com.au/files/2015/02/Pacific-Hydro-The-Acoustic-Group-Joint-statement-16-February.pdf>, accessed 23 July 2015; see also Mr Andrew Richards, *Committee Hansard*, 30 March 2015, p. 13.

measured previously by others and is well below the threshold of human perception.

The Study suggests that there is a "pattern" of high severity disturbance associated with four turbine operating modes. When all data are considered, there are limitations, contradictory and limited data and the results do not support the description of a "pattern".

The Study includes a hypothesis that "sensations" felt by the participants might be related to the measured level of infrasound. The hypothesis is based on a very limited subset of the data, with any data excluded from the analysis if it did not fit the theory. When all data are considered, the evidence does not support the hypothesis.¹⁰⁹

1.186 The AAAC elaborated on this critique in its appearance before the committee:

The problem is that those occasions when people felt these sensations when the turbines were off were simply ignored in any analysis that was conducted. If you are to conduct analysis, it needs to be done on a statistical basis by a statistician who understands all of the compounding factors and has a scientific approach rather than simply ignoring things and choosing the data that suits the theory they might have.¹¹⁰

1.187 In response to Mr Cooper's claim that his study had been 'hailed around the world as finding new information and material previously not put together or understood with regard to windfarms', and that his methodology should therefore be repeated in expanded studies, the AAAC informed the committee that:

What Mr Cooper has done is nothing new. He has measured what is called the wind turbine signature, which, as Mr Turnbull has said, has been around for decades. We all know about that. In fact, if you look at the Shirley wind farm it presents the same information. So there is nothing new about that. Mr Cooper suggests that what he has done should form the basis of monitoring at all wind turbines. I do not agree with that. What we need to get to the heart of are the claims that link infrasound and health. You do not do that by following Cooper's methodology. You do that by exploring the next step of the Creighton/Tonin and hopefully NHMRC methodology, which is to expose people to exactly what some people complain of and to scientifically and medically measure the health responses and the symptoms to that exposure. That is the way forward. I would hopefully suggest that senators give support to the NHMRC funding to come on-stream later this year to do just that.¹¹¹

109 Association of Australian Acoustical Consultants, *Submission 194*, p. [1].

110 Mr Chris Turnbull, *Committee Hansard*, 10 June 2015, p. 12.

111 Dr Renzo Tonin, *Committee Hansard*, 10 June 2015, p. 11. Professor Simon Chapman has supported the AAAC analysis and noted that he is preparing a critique of the Cooper study to be 'submitted to an international peer reviewed journal as a case study illustration of how "research" with manifest problems can be used by opponents of renewable energy to advance their goals'. See Professor Simon Chapman, Answers to questions on notice arising from 29 June public hearing.

1.188 Dr Leventhall, who has significant expertise in the area of infrasound also expressed the view that the Cooper report did not establish any new connection between infrasound and health effects:

This report has received many plaudits in the media, ranging from “ground-breaking” to “pointing the way for future medical research”. Following a detailed study of the report, I do not agree that these plaudits are deserved. The report is useful in its detail, but it reveals little new and has ignored what should be its most obvious conclusions. It is clear that Mr Cooper came to the work with the firm conviction that inaudible infrasound was a problem and cared only to develop that theme. However, what the report actually shows is that those affected are responding to audible noise, and exhibiting well known stress responses to an unwanted noise, even though this noise is normally at a very low level. The report indicates that infrasound is not an issue.¹¹²

1.189 Dr Elizabeth Hanna also emphasised that the Cape Bridgewater study did not meet any of the methodological requirements needed to establish an association between exposure to wind turbines and health effects, whereas the Health Canada study did meet these requirements and found no such association:

You also have to make sure that any health reported issue is not caused by other reasons, or by the fact that a lot of people cannot sleep, a lot have tinnitus, a lot have high blood pressure and so on and so forth. You have to be able to determine the fact that there is a real and genuine increase in the standard health problems—the 150 or so that have been attributed. You have to be able to show that there is a marked and significant elevation in those health problems for those people who are living in proximity, close enough, and are actually exposed. You also have to show the time scale—the fact that they were healthy, exposure happened, and then they got sick. It is a complex, quite detailed and very expensive study that would need to be able to show that. Health Canada did a particularly good job at that, as compared to the study that has so often been reported in this committee—Cooper's study—which was not a scientific study, as he would argue.¹¹³

1.190 Labor Senators note that Mr Cooper testified in proceedings against the Stony Gap Wind Farm in the South Australian Environment, Resources and Development Court. Mr Cooper's evidence was dismissed, with the judgement stating the following in relation to Mr Cooper's work:

At present, on the basis of his evidence before us, it seems that his approach to the task includes privileging the subjective experiences of those residents who have experienced problems, and their perceptions as to the cause of these experiences, over other contradictory data. The investigations by the EPA and Mr Turnbull in relation to the same or similar material have not yielded any basis for refusing to grant development plan consent to the

112 Dr Geoff Leventhall, *Submission 379*, p. 4.

113 Dr Elizabeth Hanna, *Committee Hansard*, 19 June 2015, p. 20.

proposed development on the basis of noise generally, infrasound or low frequency noise.¹¹⁴

1.191 Labor Senators believe the evidence received by the committee supports the contention that Mr Cooper has employed a similar approach in the Cape Bridgewater study that he was criticised for by the South Australian court.

1.192 Labor Senators conclude that the Cape Bridgewater study conducted by Mr Cooper provides no scientific evidence of a connection between infrasound emitted by wind farms and health effects and that this study does not provide a foundation for changing the planning and monitoring regime governing wind farms.

Response to specific health impact claims in the majority report

1.193 The majority report makes reference to a number of sources to support the proposition that wind farms are directly linked to human health impacts. Labor Senators are not persuaded that any of the sources provided offer any credible evidence of health impacts from wind farms.

1.194 The majority report devotes significant space to the testimony of Ms Sarah Laurie to support its contention that wind farms are the direct cause of human health impacts. Ms Laurie was once a registered doctor but, after a complaint was filed with the Australian Health Practitioner Regulation Agency in 2013 that her activities constituted practice as a physician, Ms Laurie voluntarily agreed not to use the title Doctor.

1.195 Labor Senators note that Ms Laurie's evidence has been rejected in a number of court proceedings against specific wind energy developments.

1.196 Mr Laurie gave evidence against the Stony Gap Wind Farm in 2014, but it was rejected by the judge, who made the following findings:

Dr Laurie's evidence does not contain evidence (whether from her own research, or that of others) of a causal link between contemporary operating wind turbines and the kind of health problems reported by the deponents, which is consistent with any accepted scientific or legal method of proof.

...

Dr Laurie wishes to have investigated the theory that some people are "so exquisitely sensitised to certain frequencies that their perception of very, very low frequency is right off the shape of the bell curve", such that they can, for example, from Australia, perceive an earthquake in Chile.

...

Dr Laurie rejects all of the studies, including the EPA studies, which are not consistent with her theories. She admits that evidence showing a causal connection between contemporary wind farms and health effects does not

114 Environment, Resources and Development Court of South Australia, *Tru Energy Renewable Developments Pty Ltd v Regional Council of Goyder and Ors*, p.18.

exist, and she seeks to have more research done in the hope that such evidence will be generated in the future.

...

There is no basis for the refusal of development plan consent to the proposed development on the grounds of health effects.¹¹⁵

1.197 In 2013 Ms Laurie participated in a case relating to the Dufferin Wind Power Project, which went before the Environmental Review Tribunal in Ontario, Canada. In this case, the tribunal rejected claims of human and animal health impacts. It also refused permission for Ms Laurie to give opinion evidence (the equivalent of expert evidence in Australian courts). It went into extensive detail on its reasons for this decision over many pages. A small excerpt follows:

However, the Tribunal has already found that Ms. Laurie cannot be qualified to give opinion evidence based on formal medical or scientific research, or research design and methodology. The Tribunal has also found that she cannot be qualified to give opinion evidence requiring diagnostic opinions, or the application of diagnostic interpretation to formulate conclusions on the potential health impacts of exposure to operating industrial wind turbines. This raises the question whether she can be qualified to give her proposed opinion evidence on the basis of the experience she has obtained through self-study of the published research and other literature. The Tribunal accepts that the time Ms. Laurie has devoted to this aspect of her work experience is not insignificant. However, Ms. Laurie's evidence does not indicate that she has conducted a comprehensive review of all literature, nor that she has the expertise to assess the sufficiency of the research methodology in individual research studies. Consequently, the Tribunal finds that her self-study of the published literature, as described in her witness statement, even if considered in conjunction with her survey of self-identified participants, is not sufficient to meet the basic threshold of reliability necessary to assist the Tribunal in making a sound decision.

In summary, the Tribunal has found that the Appellant, Mr. Sanford has not established a basis on which Ms. Laurie can be qualified to give her proposed opinion evidence in this proceeding.¹¹⁶

1.198 In 2013, Ms Laurie was given permission to testify in a hearing for the Bull Creek Wind Project in Alberta, Canada. However, in its decision the Alberta Utilities Commission made these comments about Ms Laurie:

115 Environment, Resources and Development Court of South Australia, *Tru Energy Renewable Developments Pty Ltd v Regional Council of Goyder and Ors*, 4 November 2014, p. 29, p. 30, p. 38.

116 Judgement of the Environmental Review Tribunal in the case of Bovaird v. Director, Ministry of the Environment, pp 108–109, <http://www.dufferinwindpower.ca/Portals/23/Downloads/Final/ERT%20decision%20DWPI%20dec%2023-13.pdf>, accessed 3 August 2015.

Dr. Laurie's written evidence also included her interpretation and discussion of numerous published and unpublished epidemiological and acoustical reports and studies. In the Commission's view, Dr. Laurie lacks the necessary skills, experience and training to comment on the interpretation of epidemiologic studies or the interpretation of acoustical studies and reports. The Commission gave little weight to this aspect of Dr. Laurie's evidence.¹¹⁷

1.199 Labor Senators are persuaded that testimony from Ms Laurie regarding the health impacts of wind farms should be treated with caution.

1.200 The majority report also calls upon evidence from Ms Laurie about a number of studies 'that has identified adverse health effects on humans of low frequency sound', including work completed by Dr David Iser, Professor Alex Salt and the Inagaki study in Japan.¹¹⁸

1.201 The majority report refers to Dr David Iser as 'the first General Practitioner in Australia to report adverse health effects from wind turbines'.¹¹⁹

1.202 Dr Iser, testified to the committee that, as a local general practitioner, he was made aware that there may be adverse health impacts of wind farms. Dr Iser told the committee that, as a result, he undertook a literature review with the outcome that 'there were no significant adverse health effects of a physical nature that I could find in the literature'.¹²⁰

1.203 With this in mind, Dr Iser distributed 25 questionnaires to residents living near the Toora Wind Farm to determine if there were any health problems. Among the respondents, 12 reported no health problems, 5 reported mild problems, and 3 reported 'major health problems including sleep disturbance, stress and dizziness'.¹²¹

1.204 In response to his testimony, Dr Iser was asked a number of questions on notice about his survey, including whether he attempted to determine a direct causal link between wind farms and respondents' concerns, whether he asked any questions in an attempt to rule out other potential causes of health impacts and whether he received any substantiating medical data from the respondents. Dr Iser did not respond directly to the questions put to him on notice. Instead, he stated 'my reply is based on the fact that the survey was very much an initial survey'.¹²²

117 Alberta Utilities Commission Decision 2014-040, 20 February 2014, p. 69, <http://www.auc.ab.ca/applications/decisions/Decisions/2014/2014-040%20%28Errata%29.pdf>, accessed 3 August 2015.

118 Senate Select Committee on Wind Turbines, *Final Report*, August 2015, p. 24.

119 Senate Select Committee on Wind Turbines, *Final Report*, August 2015, p. 24.

120 Dr David Iser, *Committee Hansard*, 9 June 2015, p. 80.

121 Dr David Iser, *Committee Hansard*, 9 June 2015, pp 80–81.

122 Dr David Iser, Answers to questions on notice from arising from 9 June 2015 public hearing, p. 1.

1.205 Due to the small sample size and the lack of any attempt to determine the wider medical context of individual respondents, Labor Senators do not believe that Dr Iser's questionnaire provides evidence of a causal link between wind turbines and human health.

1.206 Labor Senators are also disappointed that the majority members of the committee chose to highlight this unscientific study while failing to recognise the extensive and scientifically-grounded processes of the NHMRC's work on wind turbines.

1.207 Another researcher mentioned in the majority report is Professor Alec Salt, who is described as 'the leading expert in inner ear fluid physiology, detailing the effects of low frequency sound on the ear and how wind turbines can be hazardous to human health.'¹²³

1.208 This assertion does not concur with the findings of the majority of medical and acoustical experts and bodies outlined earlier in this chapter. Professor Salt's claim was specifically criticised by Bolin et al in a peer-reviewed article on infrasound and low frequency noise from wind turbines:

Salt and Hullar (2010) hypothesized from previous research that the outer hair cells are particularly sensitive to infrasound even at levels below the threshold of perception. In their article, the last paragraph mentions that wind turbines generate high levels of infrasound, with reference to three articles, two of which are not relevant to exposure in residential environments (Jung and Cheung 2008, and Sugimoto *et al* 2008). No references were made to published compilations of knowledge that indicates that the infrasound to which humans are exposed to by wind turbines is moderate and not higher than what many people are exposed to daily, in the subway and buses or at the workplace (e.g. Leventhall 2007, Jakobsen 2005). It is therefore hard to see that Salt and Hullars' results are relevant for risk assessment of wind turbine noise in particular¹²⁴.

1.209 In the same article, Bolin et al concluded that:

The dominant source of wind turbine low frequency noise, LFN (20–200 Hz), is incoming turbulence interaction with the blade. Infrasound (1–20 Hz) from wind turbines is not audible at close range and even less so at distances where residents are living. There is no evidence that infrasound at these levels contributes to perceived annoyance or other health effects. LFN from modern wind turbines are audible at typical levels in residential settings, but the levels do not exceed levels from other common noise sources, such as road traffic noise. Although new and large wind turbines

123 Senate Select Committee on Wind Turbines, *Final Report*, August 2015, p. 24.

124 Bolin, K., Bluhm, G, Eriksson, G, and Nilssen, ME, 'Infrasound and low frequency noise from wind turbines: exposure and health effects', *Environmental Research Letters*, Vol 6, No.3 2011, p.4.

may generate more LFN than old and small turbines, the expected increase in LFN is small.¹²⁵

1.210 In response to a question about the Inagaki study, which the majority report claims 'found physiological effects from aerodynamic sound from wind turbines'¹²⁶, the AAAC wrote:

With regards to infrasound, the Inagaki study played a synthesised level of infrasound to subjects at a level of 92 dB(G) and a frequency of 20 Hz. The level of 92 dB(G) is significantly higher than that produced by modern wind turbines even very close by, and furthermore is at or near the mean hearing threshold for infrasound. It is therefore not surprising that some subjects may have perceived the sound at these artificially high levels. Additionally, 20 Hz is not a common infrasonic frequency associated with wind turbines, with blade pass frequencies occurring at frequencies lower than 10 Hz.¹²⁷

1.211 The majority report also calls upon the work of Nina Pierpont, who is credited with coining the term 'Wind Term Syndrome' in her self-published book of the same name. Labor Senators note that this work has been heavily criticised as having no scientific value.

1.212 Specifically, Dr Pierpont's work has been criticised for having a tiny, self-selected sample group, acceptance on hearsay on additional people as direct evidence, no control group and no medical examinations or medical data was taken.

1.213 Professor Chapman has outlined a number of flaws in Dr Pierpont's work:

Her reputation as an authority on "wind turbine syndrome" is a 2009 self-published book containing descriptions of the health problems of just 10 families (38 people, 21 adults) in five different countries who once lived near wind turbines and who are convinced the turbines made them ill. With approximately 100,000 turbines worldwide and uncounted 1,000s living around them, her sample borders on homeopathic strength representativeness.¹²⁸

1.214 Labor Senators also note that the symptoms reported by Dr Pierpont as being attributable to 'Wind Turbine Syndrome' are actually very common. Ms Fiona Crichton, who has done work on the prevalence of symptoms in the general population said on this matter:

125 Bolin, K., Bluhm, G, Eriksson, G, and Nilssen, ME, 'Infrasound and low frequency noise from wind turbines: exposure and health effects', *Environmental Research Letters*, Vol 6, No.3 2011 p.5.

126 Senate Select Committee on Wind Turbines, *Final Report*, August 2015, p. 24.

127 Association of Australian Acoustical Consultants, Answers to questions on notice from arising from 10 June 2015 public hearing, p.7.

128 Professor Simon Chapman, 'Wind turbine sickness prevented by money drug', 29 March 2011, www.abc.net.au/news/2011-03-29/windturbinesicknesspreventedbythedrugs2809cmoneye28/45730, accessed 2 August 2015.

Further, the experience of symptoms is very common. In fact, a recent population survey we conducted in New Zealand found that almost 90 per cent of respondents experienced at least one symptom over the past week, the median number of symptoms experienced was five and 23 per cent of the population reported 10 or more symptoms. Therefore, it is very simple for individuals to misattribute their common experience of symptoms to an innocuous environmental agent if they have health concerns about exposure to that agent¹²⁹.

1.215 The majority report also notes the Shirley Wind Project in the United States has found that the Shirley Wind Farm was 'a human health hazard'.¹³⁰

1.216 In relation to this Project, the AAAC wrote:

The Shirley Wind Farm report did not prove a link between infrasound from wind farms and health impacts.

It concluded:

“The four investigating firms are of the opinion that enough evidence and hypotheses have been given herein to classify LFN and infrasound as a serious issue, possibly affecting the future of the industry. It should be addressed beyond the present practice of showing that wind turbine levels are magnitudes below the threshold of hearing at low frequencies.”

The conclusion is that infrasound is a “serious issue” which could “possibly” affect the industry but that there should be further investigation.

That is not the same as saying there is a proven link.¹³¹

1.217 Labor Senators also note a news report from 3 March 2015 that the Brown County Health Board met and were unable to agree on the next step to be taken regarding the Shirley Wind Farm.¹³²

1.218 Reference was also made in the majority report to Professor McMurtry’s ‘peer reviewed papers on the criteria for diagnosis of illness from wind turbines.’ Regarding Dr McMurtry’s work, Labor Senators note these criteria were published in the *Bulletin of Science, Technology and Society*.

1.219 The *Bulletin of Science, Technology and Society* is notable in that it has published the great bulk of the literature purporting to support a link between wind turbines and human health. For example, in one listing of ‘21 Peer Reviewed Articles

129 Ms Fiona Crichton, *Committee Hansard*, 19 June 2015, p. 1.

130 Senate Select Committee on Wind Turbines, Final Report, August 2015, p.16

131 Association of Australian Acoustical Consultants, Response to questions on notice arising from 10 June public hearing, pp 8–9.

132 *Green Bay Press Gazette*, 'No action on wind farm', 3 March 2015, <http://www.greenbaypressgazette.com/story/news/local/2015/03/03/action-wind-farm-county-health-board/24351511/>, accessed 2 August 2015.

on the Adverse Health Effects of Wind Turbine Noise' posted on a prominent wind opposition website, every single article comes from this publication.¹³³

1.220 Professor Chapman provided evidence to the committee that this publication was de-indexed 20 years ago:

But after 1995 it was dropped from the list of journals being indexed, generally a sign that indexing services regard a journal as having fallen below an acceptable scientific standard.¹³⁴

1.221 In the same response to questions on notice, Professor Chapman also pointed out that Dr McMurtry's claim that the publication is indexed in Index Medicus is incorrect, as Index Medicus itself ceased publication in 2004.

1.222 Dr McMurtry's case definition was also dismissed as evidence in the Ostrander Point tribunal, *Alliance to Protect Prince Edward County v. Director, Ministry of the Environment* in 2013. On this case study, the decision read:

With respect to the proposed Case Definition of AHE/IWTs, the Tribunal finds that it is a work in progress. It is preliminary attempt to explain symptoms that appear to be suffered by people with whom Dr. McMurtry is familiar, who live in the environs of wind turbines. Dr. McMurtry's case definition has admittedly not been validated; thus there is currently no grouping of symptoms recognized by the medical profession as caused by wind turbines.¹³⁵

1.223 It should also be noted that Dr McMurtry is the founder of the wind opponent group 'Society for Wind Vigilance' and owns a property 1½ kilometres from a proposed wind farm, which Dr McMurtry testified is currently before the courts.¹³⁶

1.224 Speaking more broadly of witnesses who appeared before the committee, Labor Senators note that, of those who called on their professional expertise to argue that wind farms cause human health problems, many have a personal history of opposing wind farm developments near their own residences. Labor Senators note that this background raises questions regarding the impartiality of their evidence.

1.225 The majority report also refers to 'ground breaking work' from Dr Kelley at NASA in the 1980s in support of its claim that infrasound is leading to human health impacts.¹³⁷

133 Stop these Things, '21 Peer Reviewed Articles on the Adverse Health Effects of Wind Turbine Noise' stopthesethings.com/2014/12/17/21-peer-reviewed-articles-on-the-adverse-health-effects-of-wind-turbine-noise/, accessed 2 August 2015

134 Professor Simon Chapman, Response to questions on Notice from Senator Urquhart arising from 29 June 2015 public hearing.

135 Ontario Environmental Review Tribunal Decision on *Alliance to Protect Prince Edward County v. Director, Ministry of the Environment*, p. 30.

136 Dr Robert McMurtry, *Committee Hansard*, 29 June 2015, p. 9.

137 Senate Select Committee on Wind Turbines, *Final Report*, August 2015, p. 23.

1.226 In response to a question on notice regarding Dr Kelley's work, the AAAC noted that:

The NASA research referred to is the 1985 investigation of a downwind turbine known as the MOD-14. Downwind turbines are no longer used as they are known to generate significant levels of infrasound because of the impact of the tower wake on the turbine blades. Modern wind turbines are constructed with the blades forward of the tower and generate much less infrasound. There were no conclusions regarding noise and health other than that the noise caused annoyance.¹³⁸

1.227 Dr Leventhall explained that Kelley had gone on to do work on the MOD2 wind turbine design, which followed the MOD1:

The type of downwind wind turbine which Kelley investigated (MOD1) no longer exists. But following the MOD1 work a new design, the MOD2, was developed. This is superficially similar to modern turbines. Kelley's conclusions on the MOD2 were "We determined from our analysis of both the high- and low-frequency-range acoustic data that annoyance to the community from the 1983 configuration of the MOD-2 turbine can be considered very unlikely at distances greater than 1 km (0.6 mile) from the rotor plane."

Over the 30+ years since the MOD2 was designed there have been further developments in reducing wind turbine noise and the 1km estimate will have shrunk.

I do not believe that Kelley showed "sleep disturbance and annoyance symptoms which were scientifically established to be directly caused by infrasound and low frequency noise at levels well below the thresholds of human hearing" as stated in your question.¹³⁹

Comparative health impacts of different forms of energy generation

1.228 Finally Labor Senators note that the lack of scientific evidence linking wind farms to human health effects stands in stark contrast with the well-established evidence of health harms arising from other forms of energy generation. As with other terms of reference in this inquiry, Labor Senators believe that a proper evaluation of wind power can only be reached if it is examined in comparison to other generation types.

1.229 The PHAA supported this position:

...we submit that any potential health impacts of wind turbines need to be assessed within the broader context of the health impacts on individuals and society from all energy choices and that the broad health and energy needs

138 Association of Australian Acoustical Consultants, Answers to questions on notice arising from 10 June 2015 public hearing, p. 2.

139 Dr Geoff Leventhall, Answers to questions on notice from Senator Madigan arising from 23 June 2015 public hearing, p.2.

of the 21st century economy and society, faced with the prospect of runaway global warming if we do not rapidly reduce greenhouse gas emissions, is as much as—we are in strife if we do not reduce our emissions as much as technologically feasible, starting as soon as possible.

In this context we argue that wind turbines can make an important contribution to human health and wellbeing, which offsets the noise disturbance effects on a minority of people. The balance of evidence currently suggests that although wind turbines are not completely free of all harm to neighbouring populations, in comparison with non-renewable energy sources, particularly fossils fuels and nuclear energy, they are likely to be considerably less harmful in both the short and long term, at a population level, than these alternatives.¹⁴⁰

1.230 The Climate and Health Alliance's *Health and Energy Choices: Background Briefing Paper* provides a summary of the evidence concerning the health impacts of different forms of energy generation. It documents the following impacts of fossil fuel based energy production in Australia:

Communities across Australia are being affected by coal mining, transportation and combustion, and unconventional gas exploration and production. Communities living near proposed coal mines, coal mine expansions, coal seam and shale gas extraction potentially face displacement, water insecurity, air and noise pollution, risks to water quality, loss of amenity and social capital, and serious physiological and psychological health risks. Those being exposed to coal transport face unacceptable levels of noise and air pollution that regularly breach air quality standards. Those living in proximity to coal fired power stations face risks of respiratory, cardiovascular, neurological disease and developmental effects. Air pollution from transport kills more people each year than the road toll.¹⁴¹

1.231 A World Health Organization background document for the Fourth Ministerial Conference on Environment and Health outlined the comparative health impacts of different energy sources.

140 Dr Peter Tait, *Committee Hansard*, 19 May 2015, p. 43.

141 Climate and Health Alliance, *Health and Energy Choices: Background Briefing Paper*, November 2014, p. 1, <http://caha.org.au/wp-content/uploads/2014/11/Health-Energy-Choices-Bkgd-Briefing-Paper-201411081.pdf>, accessed 24 July 2015.

Figure 1—Years of life lost from acute and chronic air pollution effects per TWh (Source CIEWAT 1998)

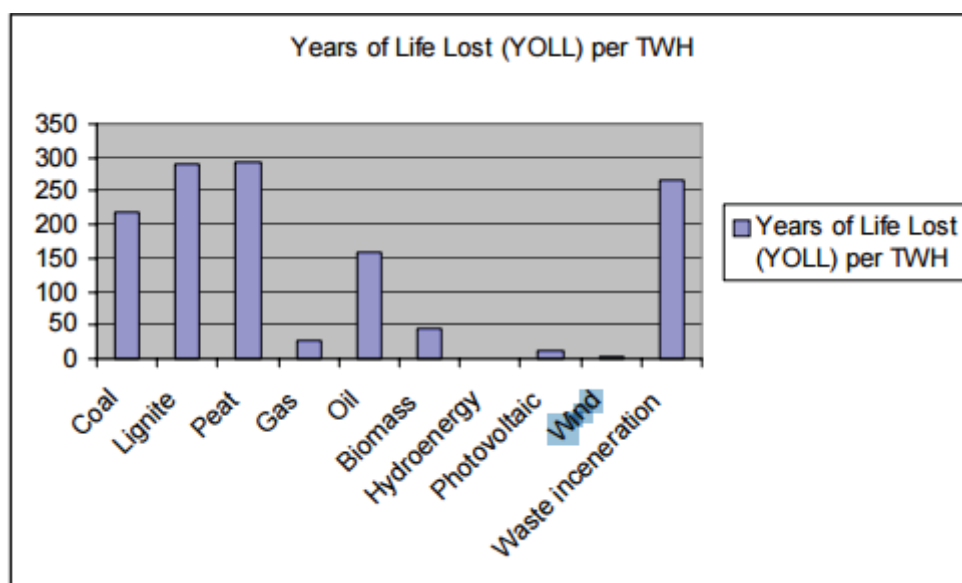
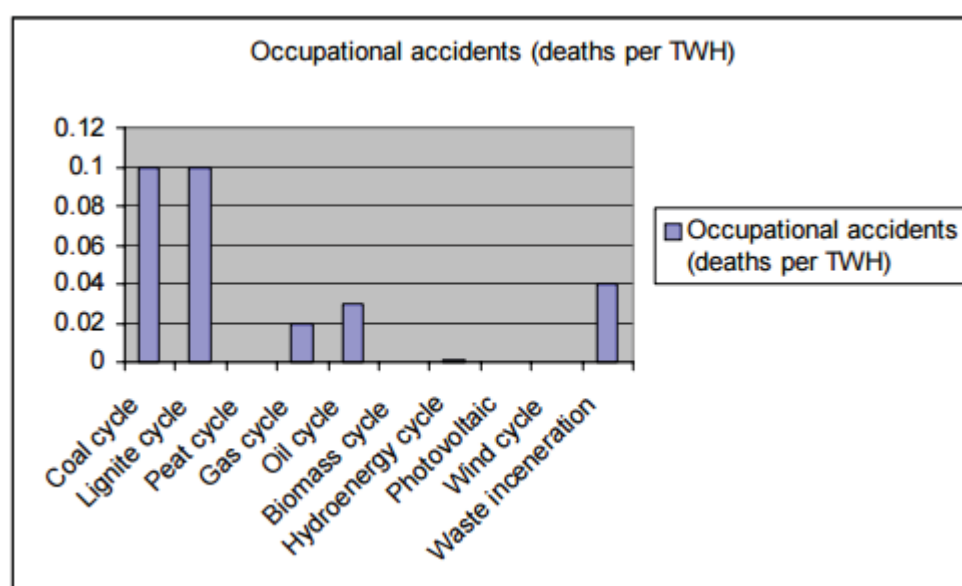


Figure 2—Occupational accidents (deaths per TWh) (CIEWAT 1998)



SOURCE: World Health Organization (2004): Energy, sustainable development and health. Background document for the Fourth Ministerial Conference on Environment and Health, 23–25 June 2004, Geneva. P.45

1.232 Labor Senators emphasise that, in light of the evidence put before the committee, the impacts of wind power on the health of the Australian community must be considered very minor in comparison to the impacts attributable to established fossil fuel generation methods. Any reasonable examination of the public health impacts of wind power must take into account this context.

(d) the implementation of planning processes in relation to wind farms, including the level of information available to prospective wind farm hosts

1.233 Labor Senators note that the Intergovernmental Panel on Climate Change (IPCC) has cited 'cumbersome and slow planning, siting and permitting procedures' as a significant challenge facing wind energy generation and noted that many countries with sizable wind resources have not deployed significant amounts of wind energy partly as a result of this factor.¹⁴²

1.234 Labor Senators believe that recommendations contained in the committee's interim report would significantly increase the regulatory and cost burdens faced by wind farm proponents and operators in Australia by unnecessarily duplicating planning regulations concerning sound emissions. These duplication proposals extend to the establishment of both a distinct scientific advisory body to deliver exactly the service currently provided by the NHMRC and a 'national wind farm ombudsman' to provide a 'referral service' to the currently existing planning complaint regimes and ombudsmen at state and territory level. These proposals will needlessly increase the complexity of the current planning regime and impose an unjustifiable penalty on the wind industry via a proposed levy.¹⁴³

1.235 Labor Senators emphasise that planning processes governing wind farms in Australia are primarily the responsibility of state and territory governments and should remain so. These processes fall within the broader category of land use planning and the Commonwealth Government has not generally intervened in this area of governance.

1.236 As detailed below, Labor Senators believe that the planning processes operating in state and territory jurisdictions are effective and that no evidence has been presented during this inquiry that would justify Commonwealth intervention. Furthermore, no coherent arguments have been presented which would justify Commonwealth intervention in the specific case of wind farm developments but not in the case of other energy generation developments with well-established health and environment impacts, such as coal seam gas extraction or coal mining and combustion.

1.237 Dr James Prest, Australian Centre for Environmental Law, emphasised that, whereas the states and territories and the Federal Parliament have continued to enact environment protection legislation, land use planning law has been undertaken by the states and territories. The only exceptions to this division of responsibilities have occurred where the Federal Parliament has made land use planning laws for parts of Canberra and the ACT and for external territories.¹⁴⁴

142 International Panel on Climate Change, *Renewable Energy Sources and Climate Change Mitigation*, 2011, pp. 559–560, http://srren.ipcc-wg3.de/report/IPCC_SRREN_Ch07.pdf, accessed 27 July 2015.

143 Senate Select Committee on Wind Turbines, Interim Report, June 2015, pp. 1–3.

144 Australian Centre for Environmental Law, *Submission 462*, p. 4.

1.238 It has been the generally accepted position that state and territory governments are responsible for land use planning and the planning law statutes in the eight mainland state and territory jurisdictions have been established on this basis.¹⁴⁵ There are also statutes governing noise limits in each of these jurisdictions.¹⁴⁶

1.239 Dr Prest also emphasised that any attempt by the Commonwealth to intervene in this area would be contrary to the terms of the 1992 *Intergovernmental Agreement on the Environment*, which explicitly states that, with regard to resource assessment, land use decisions and approval processes 'The development and administration of the policy and legislative framework will remain the responsibility of the States and Local Government.'¹⁴⁷

1.240 As was further argued by Dr Prest, such intervention would also be contrary to the principles of the National Review of Environmental Regulation, agreed to by Environment Ministers in 2014, in so far as such new Federal legislative provisions are 'inconsistent with or in contradiction to State laws on wind farms or indeed in conflict with the intent of existing Federal laws'.¹⁴⁸

1.241 With regard to the current operation of the state and territory based planning regimes, the committee received evidence that wind farms are subject to some of the strictest regulations in the world. For example, the Clean Energy Council stated:

Wind farms in Australia currently face among the toughest guidelines in the world in relation to their siting, operation and permissible noise levels.¹⁴⁹

1.242 In its 2010 *Wind Farms Technical Paper: Environmental Noise*, consulting firm Sonus reported on the regulation of noise from wind farms in Australia:

Australian jurisdictions presently assess the noise from wind farms under a range of Standards and Guidelines applicable to each individual State or Territory.

The Standards and Guidelines used in Australia and New Zealand are stringent in comparison to other International approaches. They are also the most contemporary in the World, with recent updates and releases of the main assessment approaches occurring in both late 2009 and early 2010.¹⁵⁰

145 For a list of these statutes see footnote 13 Australian Centre for Environmental Law, *Submission 462*, p. 4.

146 Australian Centre for Environmental Law, *Submission 462*, p. 8.

147 *Intergovernmental Agreement on the Environment*, 1992, schedule 2, point 4, <http://www.environment.gov.au/about-us/esd/publications/intergovernmental-agreement>, accessed 27 July 2015.

148 Australian Centre for Environmental Law, *Submission 462*, p. 6.

149 Clean Energy Council, *Submission 450*, p. 8.

150 Sonus, *Wind Farms Technical Paper: Environmental Noise*, November 2010, p. 4, http://www.epuron.com.au/wp-content/uploads/2011/12/dt_intfc4ef928e173cce_4ef948ee6b1b1.pdf?Noise%20-%20Sonus%20-%20Wind%20Farms%20Technical%20Paper%20-%20Nov%202010.pdf, accessed 27 July 2015.

1.243 This report also contains a summary of noise standards that are applied to wind farms in international jurisdictions and lists the common elements that applied in Australian jurisdictions at the time of publication:

- Objective standards that provide a base noise limit and a background noise related limit, with the exception of the EPHC draft Guidelines and the Australian Standard;
- A background noise and wind speed measurement procedure to determine the applicable background noise related limits at each dwelling;
- A noise level prediction methodology to enable a comparison of the predicted noise level from the wind farm against the noise limits at each dwelling;
- The required adjustments to the predicted noise levels to account for any special audible characteristics of the wind farm noise;
- A compliance checking procedure to confirm the operational wind farm achieves the predicted noise levels at each dwelling.¹⁵¹

1.244 Vestas also noted that, with reference to the 2010 Sonus report, 'it is fair to say many Australian wind farm planning regulations have become more restrictive since then. In late 2011 the NSW government released what the Planning Minister at that time called "some of the toughest windfarm guidelines in the country, possibly the world".'¹⁵²

1.245 With regard to the regulation of sound levels from wind farms, including infrasound, state and territory planning and environment protection bodies informed the committee that they rely on the advice of the respected scientific and health advisory bodies such as the NHMRC and World Health Organisation.¹⁵³

1.246 Labor Senators note that state and territory governments and planning bodies, as well as wind farm developers, are well aware of the need to ensure effective consultation occurs with the community in the vicinity of wind farm proposals. For example, the South Australian Government informed the committee:

Wind farm developers recognise the need for good community consultation and spend considerable hours with their prospective communities explaining their development and fielding questions. An example of good practice in South Australia is the Trust Power Palmer Wind Farm

151 Sonus, *Wind Farms Technical Paper: Environmental Noise*, November 2010, pp. 17–18, http://www.epuron.com.au/wp-content/uploads/2011/12/dt_intfc4ef928e173cce_4ef948ee6b1b1.pdf?Noise%20-%20Sonus%20-%20Wind%20Farms%20Technical%20Paper%20-%20Nov%202010.pdf, accessed 27 July 2015.

152 Vestas, Answers to questions on notice arising from 9 June public hearing, p. [3].

153 For example, see Mr Greg Chemello, *Committee Hansard*, 18 May 2015, p. 21; Mr John Ginivan, *Committee Hansard*, 9 June 2015, pp 8–9; Mr Peter Dolan, *Committee Hansard*, 29 June 2015, p. 12.

development. The company sends regular newsletters to stakeholders, has undertaken community meetings and employed a community liaison person who lives in the local area to assist with information dissemination. They have developed the concept of neighbourhood agreements whereby non-host residents who live nearby a wind farm, but who are not hosts, can benefit financially from the development.¹⁵⁴

1.247 The ACT Government emphasised that it views engagement with the local community as pivotal to 'delivering best wind farm outcomes.' To ensure this occurs for wind farms projects it supports, the ACT Government has:

...committed to the implementation of good community engagement practices by renewable energy industries. A major part of this commitment has been a significant community engagement evaluation criterion that was incorporated into the assessment of proposals submitted to the ACT's 2014/2015 wind auction.¹⁵⁵

1.248 The Clean Energy Council stated that wind proponents in Australia:

...engage a range of stakeholders at early stages of feasibility to determine environmental, cultural or amenity impacts in addition to those identified in the formal environmental assessment process that need to be understood and managed as part of the development.

These stakeholders include landowners; the local community; experts in noise, landscape and visual impacts, aviation, electromagnetic interference and heritage; the Civil Aviation Safety Authority (CASA); Network Service Providers; electricity retailers; indigenous groups and other specific interest groups including groups advocating in relation to local fauna or flora.¹⁵⁶

1.249 The Clean Energy Council also highlighted several outstanding examples of ongoing community engagement at Windlab's Coonooer Bridge wind farm and Infigen's Flyers Creek wind farm. They noted:

The wind industry is not complacent about the strong political and community support it receives and therefore continues to reflect and innovate on the ways it interacts, engages and supports local communities. A wind farm is part of a community for 20 years or more. History shows that projects inject substantial direct and indirect economic benefits to these communities both during the construction and ongoing operational phase of the wind farm. The wind sector is continuing to explore and implement different models for sharing the benefits these projects bring.¹⁵⁷

1.250 Infigen Energy reported on its engagement with local communities and stated that it financially supports landowners to seek legal advice from a practitioner of their own choosing before entering into agreements with the company:

154 South Australian Government, *Submission 59*, p. 7.

155 ACT Government, *Submission 12*, p. [2].

156 Clean Energy Council, *Submission 450*, p. 8.

157 Clean Energy Council, Answers to questions on notice arising from 9 June 2015 public hearing, p. 2.

Infigen Energy provides prospective landowners in their development projects with extensive information on all aspects of wind farms, answers any questions the landowners may have, offers tours of existing wind farms, and encourages landowners to seek their own legal advice before signing lease agreements. If the landowners desire it, Infigen Energy pays the full cost of these legal services.

We are an industry leader that aims to fully inform communities about operational and proposed wind farm sites. We contend that empowering and informing the communities near our wind farms is one of the more important issues facing the wind industry today. This applies equally to neighbours to the project as well as the landowners hosting wind turbines.¹⁵⁸

1.251 With regard to the Flyers Creek wind farm development mentioned above, Infigen Energy stated that it had initiated a community renewable energy cooperative, which offers the local community the opportunity 'to invest in, and profit from, the Flyers Creek wind farm after it is constructed.'¹⁵⁹

1.252 AGL outlined its approach to community engagement, including the establishment of community consultative committees and the operation of community funds, as follows:

AGL establishes Community Consultative Committees (CCCs) early in the wind farm development process, which continue throughout the development and construction phases. Once projects are operational, ongoing community engagement takes various forms depending on the project, such as continued CCC's or the establishment of local renewable energy information centres (as AGL has done at Burra, near the Hallett wind farms in South Australia). AGL participates in regular CCC meetings in each of the communities in which its wind farms are located or proposed.

The CCC brings together key representatives of the local community to provide an opportunity to raise questions, voice concerns, build relationships and to provide a forum for AGL to communicate with communities about its operations. Local Council participation is essential in instilling community confidence in wind energy and the planning process, and for all projects AGL seeks to collaborate closely with local Councils which form a key part of CCC deliberations. To balance community welfare and investor confidence, AGL considers that robust Council and community engagement, such as a CCC, should be a requirement of all wind energy project developments.

AGL also contributes to the communities neighbouring its wind farm projects on an ongoing basis, and will do so for the life of the projects. AGL is proud to contribute to the infrastructure and wellbeing of these communities. For example, in the 12 months to June 2014:

158 Infigen Energy, *Submission 425*, p. 11.

159 Infigen Energy, *Submission 425*, p. 11.

- The Macarthur Wind Farm Community Fund donated \$50,000 to a range of community organisations, including for sporting facilities, health equipment and venue upgrades. An additional \$40,000 was provided as a sponsorship for local firefighting vehicles, and \$12,500 in sponsorship was provided to local students for educational travel.
- The AGL Wattle Point Wind Farm Community Fund donated \$15,000 to local community, sporting and business groups.
- The Hallett Wind Farm Community Fund donated \$33,000 for local health and conservation campaigns, and for the upgrade of community facilities and sporting grounds.

AGL's experience is that community contributions work well if they are negotiated with local Councils or community groups to reflect their specific needs.¹⁶⁰

1.253 RATCH-Australia reported a similar commitment to extensive community engagement, including ensuring prospective turbine hosts are fully informed before making any decisions:

As a developer of new wind farms, RAC has had dealings with numerous private landholders who are prospective wind farm hosts. RAC is very keen to ensure that any prospective hosts are able to make a fully informed decision about hosting wind turbines, and has undertaken a range of teaching/explaining activities for the prospective hosts, including:

- Taking prospective hosts on tours of existing wind farms and introducing them to other hosts and prospective hosts
- Facilitating information sharing between prospective co-hosts, making sure they are all talking to each other and sharing their thoughts and concerns with the project group
- Funding independent legal advice for prospective hosts on land leases
- Funding independent expert reviews of studies we have undertaken¹⁶¹

1.254 The Australian Wind Alliance reported:

Local matters around individual projects are routinely and expertly handled by existing state and local planning processes.¹⁶²

1.255 The Australian Wind Alliance was, however, concerned that planning processes, specifically public planning hearings, have been the subject of disruption by anti-wind groups. It highlighted the case of a recent hearing undertaken on the Crookwell 3 project in New South Wales, at which one of its representatives had

160 AGL, *Submission 83*, p. 4.

161 RATCH-Australia Corporation, *Submission 116*, p. [2].

162 Australian Wind Alliance, *Submission 443*, p. [5].

attempted to address the meeting but was 'verbally and then physically intimidated by those in attendance', many of whom were not in fact local residents.¹⁶³

1.256 The committee also received evidence that state and territory governments have been very active in updating their planning frameworks and in developing tools to improve planning processes for both local communities and proponents.

1.257 Labor Senators note that the Clean Energy Council has also published the *Community Engagement Guidelines for the Australian Wind Industry*. This document was developed by the Australian Centre for Corporate Social Responsibility and was sponsored by AGL, Acciona, Goldwind, Hydro Tasmania, Infigen, Pacific Hydro, Vestas, RATCH-Australia and REpower.¹⁶⁴

1.258 The guidelines note that the full potential of wind farms to assist Australia to meet its emissions reductions targets as well as to bring economic benefits to local communities can only be realised with effective community engagement. In order to encourage such engagement, the guidelines are:

...designed to be a blueprint for the Australian wind industry to engage with those communities. It sets out the recommended steps to delivering a wind farm project while maintaining the support and respect of the community.¹⁶⁵

1.259 Labor Senators encourage all wind farm proponents and operators to implement these guidelines and also encourage state and territory jurisdictions to consider codifying them in their respective planning regimes.

1.260 Labor Senators note that information presented to the committee on the number of complaints made regarding wind farms indicates that very few people have been motivated to take this course of action when compared to the size of the populations that live in the vicinity of these developments.

1.261 As discussed under term of reference (c), Professor Simon Chapman has undertaken research on the pattern of complaints about Australian wind farms on the basis of noise or health effects and has demonstrated that 64.7 per cent of all wind farms have never been the subject of any complaints, even though there are an estimated 21,633 people living within five kilometres of these facilities. This research also concluded that a total of only 129 individuals had ever made a complaint, with 73

163 Australian Wind Alliance, *Submission 443*, pp [5–6].

164 Clean Energy Council, 'Community Engagement Guidelines for the Australian Wind Industry', <http://www.cleanenergycouncil.org.au/technologies/wind-energy/community-engagement-guidelines.html>, accessed 27 July 2015.

165 Clean Energy Council, 'Community Engagement Guidelines for the Australian Wind Industry', foreword, <http://www.cleanenergycouncil.org.au/technologies/wind-energy/community-engagement-guidelines.html>, accessed 27 July 2015.

per cent of these complainants being residents near six wind farms 'targeted by anti wind farm groups.'¹⁶⁶

1.262 The relatively small number of complaints, and their uneven distribution, was recognised by the Victorian Department of Environment, Land, Water and Planning which informed the committee that

Indications are that complaints about potential health impacts appear to be related to a limited number of project sites¹⁶⁷..

1.263 That wind farms generate very few complaints from a very small minority of residents was further confirmed by information provided by the Glenelg Shire Council. The committee was informed that, of the approximately 11,000–12,000 residents living within a five kilometre radius of a wind farm in the Shire of Glenelg:

Council is aware of six people (from three families) who have made written complaints about existing built wind farms. Further complaints from two people were received about Stage 4 of the Portland Wind Farm prior to its construction.¹⁶⁸

1.264 Finally, Labor Senators note that the committee received some evidence of dissatisfaction with the distribution of responsibilities between state and local governments regarding the assessment of development applications and the monitoring of planning conditions after a project is approved.¹⁶⁹

1.265 Labor Senators note that the difficulty in such cases appears to be that local governments feel they lack the expertise and resources required to properly assess wind proposals against the detailed technical requirements of the planning regimes governing wind farms in each jurisdiction.

1.266 While noting that the delegation of planning responsibility to local governments is a matter for each state jurisdiction, Labor Senators encourage state governments to provide government bodies involved in their respective planning regimes with sufficient resources to carry out their tasks, whether they be at the state or local level, and to locate approval and monitoring tasks with bodies best equipped to carry them out.

1.267 Labor Senators note that the Victorian Government has recently moved to relieve local councils of the responsibility for determining planning permit

166 Simon Chapman, Alexis St George, Karen Waller, Vince Cakic, 'The Pattern of Complaints about Australian Wind Farms Does Not Match the Establishment and Distribution of Turbines: Support for the Psychogenic, 'Communicated Disease' Hypothesis', *PLOS ONE*, 16 October 2013, <http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0076584>

167 Victorian Department of Environment, Land, Water and Planning, Answers to questions on notice arising from the 9 June public hearing, p.3.

168 Glenelg Shire Council, Answers to questions taken on notice during 30 March public hearing, p. 1.

169 For examples of this position see evidence provided by representatives of the Glenelg Shire Council, Ararat Rural City Council and Pyrenees Shire Council, *Committee Hansard*, 30 March 2015, pp 32–39.

applications for wind farms and to make the Minister for Planning the decision maker for all new permit applications.¹⁷⁰

1.268 The Queensland Government also submitted that it intends to change the way wind farm developments are assessed. It noted that local governments are currently the assessing authorities for wind farm developments against their local planning schemes, however:

...the majority of planning schemes do not include specific provisions for wind farms and many councils do not have the capacity or resources to effectively assess these highly technical applications.

Future applications for wind farm development are to be assessed by the State Assessment and Referral Agency...¹⁷¹

1.269 In conclusion, Labor Senators believe evidence provided to the committee demonstrates that wind farm developments in Australia are currently subject to very strict regulation, both when compared to other industries and when compared to wind farm regulation in other countries. These regulations are shaped, as they should be, by scientific and medical advice from the NHMRC. Labor Senators emphasise that wind farms have generated a very low rate of complaints to date and believe that the strict regulations in place have contributed to this outcome.

1.270 Labor Senators also note that both state governments and wind farm proponents are very aware of the important role community consultation plays in the successful establishment of wind farms. Evidence before the committee suggests that consultation is already extensive and that both proponents and governments are working to improve processes wherever possible. Labor Senators support this process of ongoing improvement and highlight the best practice examples discussed above.

1.271 Labor Senators do not believe any case has been made for a wind farm-specific intervention in the land use planning regimes of the states and territories by the Federal Government. The current arrangements are long-standing and successful and the states and territories have demonstrated they are responding where necessary to address pressures that arise from the technical nature of wind farm planning assessments.

170 Department of Economic Development, Jobs, Transport and Resources, *Submission 112*, p. 4.

171 Queensland Government, *Submission 413*, p. 2.

(e) the adequacy of monitoring and compliance governance of wind farms

1.272 The 2012 report of the Senate Environment and Communications Legislation Committee on the Renewable Energy (Electricity) Amendment (Excessive Noise from Wind Farms) Bill 2012, found with regard to noise regulation of wind farms:

The committee has seen evidence of adequate compliance mechanisms and audit processes in place, and acknowledges the work of state governments in strengthening aspects of these processes over the last three years.¹⁷²

1.273 Labor Senators do not believe any significant areas of concern have arisen since this time. Evidence presented to this inquiry suggests monitoring and compliance mechanisms with regard to noise and other aspects of wind farms are being effectively managed by state and territory bodies.

1.274 The Department of the Environment noted that primary responsibility of monitoring and compliance of wind farms falls to the states and territories, but that the Commonwealth has a limited role in monitoring projects that have been approved under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). These activities are determined by the department's Annual Monitoring and Compliance Plan, and cover only those activities relevant to the EPBC Act.¹⁷³

1.275 As detailed in discussion under term of reference (b), the CER monitors compliance of wind farms with Commonwealth, state and territory regulations, but does not itself make determinations about compliance.¹⁷⁴

1.276 The Clean Energy Council summarised the monitoring and compliance requirements currently affecting wind farm developers and operators as follows:

Wind farm projects adhere to specific technical compliance regulations. In order to apply for a development permit the wind farm developer must undertake various technical measurement, analysis and modeling and submit it for approval. Once approved, wind farm owners are required to supply further information to the regulator (usually the state government) which has experts who undertake the compliance analysis.¹⁷⁵

1.277 The South Australian Government submitted that it believes the wind farm industry is well regulated and that it has only found one case of marginal non-compliance in the 12-year history of the industry, a matter which was rectified promptly by the operator:

In South Australia, a wind farm developer needs to abide with specific compliance hurdles in order to be operational, and these requirements have led to a well regulated industry. Compliance is required for a change in land use, connection to the grid, generation, and noise.

172 Senate Environment and Communications Legislation Committee, *Renewable Energy (Electricity) Amendment (Excessive Noise from Wind Farms) Bill 2012*, November 2012, p. 42.

173 Department of the Environment, *Submission 358*, p. 9.

174 Department of the Environment, *Submission 358*, p. 9.

175 Clean Energy Council, *Submission 450*, p. 8.

Planning approval is required for a change in land use, which includes compliance with the EPA noise guidelines. Before developing the site, the proponent is typically required to monitor background noise. Once commissioned, further monitoring is required to ensure the wind farm operates within the noise guidelines.

This system is proven to be sufficiently robust. During 12 years of wind industry history in South Australia, there was only one case of marginal non-compliance linked to the temporary presence of tones in wind farm noise. This issue was rectified by the wind farm owner in an efficient and timely manner.¹⁷⁶

1.278 The Victorian Department of Economic Development, Jobs, Transport and Resources noted that the compliance of wind farms with noise standards attracted the most interest. In Victoria planning approvals require new wind farms to meet New Zealand Standard 6808:2010, Acoustics – Wind Farm Noise, and older wind farms to meet the 1998 version of this standard. The department provided the following details about compliance processes:

Planning permit conditions require operators to undertake monitoring and demonstrate compliance with the New Zealand Standard following completion of construction. The specific conditions of each permit vary in their wording but generally a final compliance report must be submitted after a 12 month testing period following the commencement of full operation of a facility. These reports can be peer reviewed by the responsible authority. Following this review, if the facility is deemed to be operating in accordance with the permit requirements regarding noise, the responsible authority will advise the proponent.

All wind farm permits require the proponent to develop a noise complaints evaluation procedure to address complaints or possible noise compliance issues. When the model permit conditions from DELWP's guidelines are used, they include provisions where the responsible authority can require the initiation of additional noise testing at the cost of the wind farm operator.

The Victorian Government has been refining the wind farm guidelines and the model wind farm permit conditions since their introduction. Some older permits for wind farms do not have the ability to compel operators to undertake further testing. In these instances further acoustic testing could be undertaken by the council if warranted to address specific issues or concerns.¹⁷⁷

1.279 The draft *NSW Planning Guidelines: Wind Farms* indicate that similar requirements are placed on wind farms developers in that state:

A number of requirements will be applied regarding auditing and compliance particularly in relation to noise including:

176 South Australian Government, *Submission 59*, p. 8.

177 Department of Economic Development, Jobs, Transport and Resources, *Submission 112*, p. 5.

- Conditions of consent will require the applicant to prepare and submit a Noise Compliance Report within 12 months of the commencement of operation of the wind farm
- Noise monitoring must be undertaken during 'worst case' periods (which would include during any temperature inversions).
- Special audible characteristics such as excessive amplitude modulation (including the van den Berg effect) together with cumulative impacts must also be considered.
- The proponent must make the noise compliance report publicly available.
- Neighbour can write to the Director General of the Department of Planning and Infrastructure to request independent noise monitoring at their house.¹⁷⁸

1.280 In response to complaints from residents about noise and other issues the New South Wales Government has conducted a compliance audit of wind farms. This audit was completed in 2013 and included the Cullerin Range, Capital and Woodlawn wind farms. This audit included an independent acoustic expert taking measurements at nearby residential properties. The audit concluded that 'all three wind farms were compliant with their noise-related approval conditions.' The audit did identify breaches of a number of other conditions which have since been rectified by operators.¹⁷⁹

1.281 The South Australian Environment Protection Authority has also conducted additional studies to address concerns of residents regarding sound emissions from wind farms, despite such farms demonstrating compliance with their development approval conditions via the standard post-construction noise monitoring.

1.282 Mr Peter Dolan of the South Australian Environment Protection Authority described the work his organisation undertook to investigate the sound emissions of the Waterloo wind farm in response to repeated complaints:

We did an extensive study at Waterloo over two months in six houses from zero to 20,000 hertz. We investigated this in detail because a group of concerned citizens came to us and convinced me that we needed to do more work to understand this. We were able to arrange for six shutdowns of the complete station whilst our equipment was still running during periods of generation—so what we would consider peak times for noise generation. We did however select the sites that we monitored based on complaints—there were folk who had complained previously about the wind farm—and that was based on the assumption that if that is truly concerning them we

178 NSW Department of Planning and Infrastructure, *NSW Planning Guidelines: Wind Farms (draft for consultation)*, December 2011, p. 7, http://www.planning.nsw.gov.au/Portals/0/PolicyAndLegislation/NSW_Wind_Farm_Guidelines_Web_Dec2011.pdf, accessed 28 July 2015.

179 NSW Government, 'Wind farms meet noise limits, breach other conditions', Media Release, 6 December 2013, <http://www.planning.nsw.gov.au/wind-farms-audit>, accessed 28 July 2015.

should be able to find something. We did not. In fact, I was quite surprised at how certain the results were. At several of the sites the wind farm was not detectable at all.

At several sites residents who had filled out a diary for us recorded concerns about the wind farm when the wind farm was most definitely off. We continuously monitored throughout the period of the shutdown, before and after, and we made sure that we only used data where we had had operating machines going for at least two hours prior to and two hours after to see what contribution the wind farm made to entire spectrum, including infrasound. They clearly contribute but at no time did they exceed the South Australian guidelines during that period. In some sites you could not notice the difference in noise or sound whether the wind farm was operating or not. So, based on that study, we do not believe there is a need to change our guidelines, other than some tidy up.¹⁸⁰

1.283 Pacific Hydro provided the following summary of compliance measures wind farm developers must meet:

Approval of a wind farm requires that a wind farm developer prepare in-depth technical measurements, analysis and modelling which must be approved by the relevant regulator(s). Following the granting of an approval, the wind farm operator must ensure compliance with the various conditions of the approval, which includes the ongoing provision of technical measurements and analysis to regulators, who undertake compliance analysis.¹⁸¹

1.284 Labor Senators note that some wind farm operators have undertaken studies beyond those required under planning regulations in order to address community concerns. A prominent example of such work is the study conducted by Mr Steven Cooper at Pacific Hydro's Cape Bridgewater wind farm. This study was commissioned by Pacific Hydro in order to investigate disturbances reported by residents in three households.

1.285 As discussed under term of reference (c), the author of this report agreed with the operator that the report did not justify any change to the regulatory regime. Labor Senators also note that the Cape Bridgewater facility has already been found to comply with its permit conditions and applaud Pacific Hydro for its efforts in investigating this matter further.¹⁸²

180 Mr Peter Dolan, *Committee Hansard*, 29 June 2015, p. 15; see also South Australian Environment Protection Authority, 'Waterloo Wind Farm Environmental Noise Study', http://www.epa.sa.gov.au/environmental_info/noise/types_of_noise/wind_farms/waterloo_wind_farm_environmental_noise_study, accessed 28 July 2015.

181 Pacific Hydro, *Submission 419*, p. 18.

182 Pacific Hydro and The Acoustic Group, 'Joint Statement', 16 February 2015, <http://www.pacifichydro.com.au/files/2015/02/Pacific-Hydro-The-Acoustic-Group-Joint-statement-16-February.pdf>, accessed 29 July 2015.

1.286 The inquiry also received evidence of wind farm operators carrying out ongoing bird and bat monitoring at their wind farms. For example, Trustpower provided the following information on its Snowtown wind farm:

Trustpower has a contractual requirement with our services providers that manages the respective Stage 1 and Stage 2 of our Snowtown Wind Farm to look for and report any bird strikes. We also had a specific annual Wedge Tail Eagle nesting monitoring plan for both stages of the wind farm, which has now been completed. The monitoring programme has identified successful annual wedge tail eagle breeding on site during the construction and operating of the wind farms and a total of 2 wedge tail eagle mortalities since commencement of operation in 2008.¹⁸³

1.287 AGL also stated that it undertakes regular monitoring of bat and bird mortality at its wind farms, and provided the following information regarding the Macarthur wind farm:

Where required by planning permits, AGL undertakes monitoring programs to estimate the frequency of bird and bat deaths as a result of collision with wind turbines. In the first 12 months of monitoring at the Macarthur Wind Farm, an estimated mortality rate of 1.3 birds per turbine per year was observed, as well as 0.1 bats per turbine per year. Importantly, the effects on threatened species were found to be negligible, and no collisions with the primary avian species of concern at the site (brolga) were observed.¹⁸⁴

1.288 Labor Senators believe that evidence presented to the committee indicates that state and territory governments have implemented effective regimes for undertaking monitoring and enforcing compliance.

1.289 With regard to the issue of compliance with noise limits imposed by planning regimes, it appears state bodies have been very active in responding to community concerns. In addition to the post construction noise monitoring that takes place at each wind farm development, state bodies such as the NSW Department of Planning and Infrastructure and the South Australian Environment Protection Authority have undertaken further investigations where repeated complaints have been received. In these cases, the wind farms have again been found to be compliant.

1.290 Labor Senators do not believe any case has been made that the compliance and monitoring regimes of the states and territories are systemically flawed.

1.291 As discussed under term of reference (d) the distribution of responsibilities and resources between state and local governments may be a point of weakness in current arrangements. The Australian Wind Alliance noted a number of matters with regard to compliance monitoring that could be addressed in future reforms:

Compliance of wind farms with applicable regulations is in many cases devolved to the local council level, who are often under resourced and lack the appropriate skill base to execute this work properly.

183 Trustpower, Answers to questions on notice arising from 10 June public hearing, p. [2].

184 AGL, *Submission 83*, p. 6.

Postconstruction noise monitoring is generally done by acoustic consultants retained by the developer. Submission 111 to this Inquiry from Glenelg Shire Council has suggested that postconstruction and ongoing monitoring work be done at arms' length from developers.

AWA sees merit in this idea and would welcome it as a way to increase the community's trust in the process.¹⁸⁵

1.292 Labor Senators recognise the very significant resource pressures facing local councils and the additional cost burden imposed when they are forced to retain outside expertise to inform decision making and to conduct monitoring and compliance work. Labor Senators encourage state governments to work with councils to determine the best way to reduce these pressures. The committee heard evidence from the Municipal Association of Victoria that it is currently negotiating to gain access to the acoustic expertise of the EPA.¹⁸⁶ Labor Senators applaud this work and encourage further collaboration of this nature.

1.293 Labor Senators do not question the professionalism, nor the quality, of advice that has been provided by acoustic consulting firms that have worked on post-construction and ongoing compliance work to date. The weight of evidence provided to the committee is that there has been no impact on the independence of the work completed or the advice provided. However, Labor Senators recognise that the perception of independence within the community is also important and note that change in this area may serve to ease concerns that some individuals may have and instil broader community confidence in the system.

185 Australian Wind Alliance, *Submission 443*, p. 6.

186 Municipal Association of Victoria, *Committee Hansard*, 9 June 2015, p. 54.

(f) the application and integrity of national wind farm guidelines

1.294 Labor Senators note that, as there are currently no national wind farm guidelines in place, it is not possible to comment on their application or integrity. A document entitled *National Wind Farm Development Guidelines—draft* does exist, but it has never progressed beyond the draft stage. The history of this draft document is outlined below.

1.295 Dr Prest of the Centre for Environmental Law submitted that Commonwealth regulation of wind farm projects was first suggested in 2006 by former Environment Minister, Senator Ian Campbell, in the form of a 'code of practice for wind projects', as a means of justifying 'intervention in local planning matters in the proposals for wind farms at Denmark (WA) and Bald Hills (Vic).'¹⁸⁷

1.296 The code of practice was replaced by the idea of a set of guidelines, following a change of government at the federal level. These guidelines were developed by the Environment Protection and Heritage Council (EPHC), a body established by COAG to address national policy issues regarding environmental protection. As noted by Dr Prest, a 2008 report by the EPHC, *Impediments to Environmentally and Socially Responsible Wind Farm Development*, included the following rationale for national guidelines:

The Working Group agreed that the assessment and approval systems in jurisdictions are generally robust and working well, and that many issues identified in this report are being adequately dealt with through existing processes.

...

However, the Working Group concluded that there is merit in developing government-endorsed National Wind Farm Development Guidelines to deliver a higher degree of consistency and transparency in the planning, assessment, approval and environmental monitoring of wind farms. These Guidelines would assist in building community acceptance and support for wind energy developments.¹⁸⁸

1.297 This report also noted that the best practice model embodied by the guidelines 'is preferred because it can provide greater national consistency in how the matters it covers are addressed and can be readily incorporated into jurisdictions' existing regulatory practice without the need for amendments to statutory schemes.' The previous code proposal was considered the 'less preferred approach because it would be viewed as having its own legal basis and the working group does not believe there

187 Dr James Prest, *Submission 462*, p. 11.

188 Environment Protection and Heritage Council, *Report on Impediments to Environmentally and Socially Responsible Wind Farm Development*, November 2008, p. 5, <http://www.scew.gov.au/system/files/resources/afb015f4-8b55-6904-716c-d26bcf317c86/files/ephc-wind-farm-dev-report.pdf>, accessed 28 July 2015.

is a compelling rationale for a mandatory approach, ie, the existing regulatory arrangements are effective.'¹⁸⁹

1.298 In 2009 the EPHC directed officials to develop such national wind farm development guidelines, a draft version of which was released for public consultation in July 2010. The Department of the Environment described the content and intended use of these guidelines:

The draft Guidelines outlined best-practice for industry and planning authorities, promoting a higher degree of consistency and transparency in the planning, assessment, approval and monitoring of wind farms across jurisdictions. The draft Guidelines included key principles for consideration, addressing a range of issues which are unique or significant to wind farm development and operation: community and stakeholder consultation; wind turbine noise; visual and landscape impacts; impact on birds and bats; shadow flicker; and electromagnetic interference. The draft Guidelines were not mandatory, nor did they seek to change existing jurisdictional statutory processes.¹⁹⁰

1.299 The EPHC ceased further development of the draft guidelines because jurisdictions did not consider them necessary and stakeholders believed that they 'added complexity and involved the Commonwealth in an area for which it was not the responsible authority.'¹⁹¹

1.300 The 2011 Senate Community Affairs References Committee inquiry into the social and economic impact of rural wind farms recommended that the draft guidelines be updated.¹⁹² The then federal government did not act on this recommendation, having decided that the draft guidelines remained unnecessary.¹⁹³ No further work has taken place on these draft guidelines since 2011.

1.301 The Clean Energy Council stated in its submission that national guidelines are not needed as each jurisdiction has guidelines adapted to their unique circumstances:

Every Australian state government has planning guidelines that are best suited to the unique requirements of its community, industry, and land use configurations. Planning rules for wind farms (and for any other major project) must simultaneously consider various technical issues and social

189 Environment Protection and Heritage Council, *Report on Impediments to Environmentally and Socially Responsible Wind Farm Development*, November 2008, p. 6, <http://www.scew.gov.au/system/files/resources/afb015f4-8b55-6904-716c-d26bcf317c86/files/ephc-wind-farm-dev-report.pdf>, accessed 28 July 2015.

190 Department of the Environment, *Submission 358*, p. 10.

191 Department of the Environment, *Submission 358*, p. 10. A more detailed account of criticisms of the draft guidelines can be found at Senate Community Affairs References Committee, *The Social and Economic Impact of Rural Wind Farms*, June 2011, pp 46–49.

192 Senate Community Affairs References Committee, *The Social and Economic Impact of Rural Wind Farms*, June 2011, p. 49.

193 Department of the Environment, *Submission 358*, p. 10.

issues. State governments should be left to design wind farm planning requirements as a part of a broader planning regime.¹⁹⁴

1.302 The South Australian Government expressed a similar view and commented on the last iteration of the draft guidelines:

The South Australian Government is not supportive of national wind farm guidelines due to the particular nature of each state, and the individual differences in planning system regimes. The latest version of the Draft National Wind Farm Guidelines included controversial recommendations which South Australia did not support and further work on the Guidelines was stalled due to a change of priorities at the Federal level.¹⁹⁵

1.303 The Victorian Department of Economic Development, Jobs, Transport and Resources expressed a more positive view on the draft guidelines and noted some areas where further refinements might be made, but also emphasised their status as a useful resource rather than a mandatory requirement:

The draft national wind farm guidelines are a useful resource for developers, decision makers and communities. The guidelines acknowledge that each state has its own planning controls and regulation. They provide detailed information on the matters considered when determining permit applications. The guidelines are referenced in the Victorian wind farm guidelines.

The Victorian Government considers the national guidelines to be an appropriate tool having regard to Victorian legislation. Further refinements may be considered with regard to the 1 km consent zone around turbines, EPA auditors, and enforcement.¹⁹⁶

1.304 Labor Senators note that the project to develop national guidelines was undertaken on the explicit basis that they were not intended to have a legal status in their own right and that they were not intended to require amendments to statutory schemes. These guidelines have remained in draft form and, although some jurisdictions have found them useful, others disagree with their content and do not support their further development.

1.305 Labor Senators note that the proposal put forward in recommendation 3 of the committee's interim report effectively calls for a return to the mandatory 'code of practice' approach first raised in 2006. By supporting this approach, the committee majority has in effect called for a Commonwealth takeover of planning and environment regulation governing wind farms. This recommendation states that revived national wind farm guidelines should be codified by the Commonwealth and that state and territory jurisdictions should alter their planning and environment statutes to conform with them.¹⁹⁷

194 Clean Energy Council, *Submission 450*, p. 9.

195 South Australian Government, *Submission 59*, p. 9.

196 Department of Economic Development, Jobs, Transport and Resources, *Submission 112*, p. 6.

197 Senate Select Committee on Wind Turbines, *Interim Report*, June 2015.

1.306 No case has been made that state and territory planning regimes are not adequately addressing the development and operation of wind farms. In fact, the opposite appears to be true, with evidence suggesting that a very small proportion of the population living in proximity to wind farms have ever registered complaints and that state jurisdictions have been actively updating planning arrangements and producing best-practice guidelines in the period since the national wind farm guidelines project was abandoned. As argued under term of reference (d), Labor Senators strongly oppose this attempt to impose additional levels of federal regulation on a specific industry.

1.307 While Labor Senators note that the committee has listed in its interim report a number of matters on which the proposed new national guidelines must set minimum standards, it has made no comment on how these standards will be formulated, nor any specific comment on how current regulation of these areas is failing. It is therefore unclear how these guidelines are expected to differ from those currently in place in each jurisdiction and, if they are to differ, on the basis of what evidence and advice this will be determined.

1.308 Finally, Labor Senators note that media reports indicate that, despite this committee not yet delivering its final report, the federal government has already made an attempt to introduce a national wind farm sound measure in the *Environment Protection and Heritage Council Act 1994*, and to implement new national wind farm guidelines that include minimum standards.

1.309 These proposals were reportedly put to a meeting of Commonwealth, state and territory environment ministers on 14 July 2015, but were rejected by state ministers. It was reported that:

...the states rejected the measures. State ministers asked Hunt four times if he planned to impose the same guidelines for coal, but he said no each time.

One of the states also attempted to have the details of the rejection of the wind farm sound measures included in the communique, but the federal government kiboshed the attempt.

A spokesperson for Hunt did not respond to *Crikey's* questions by deadline.

A spokesperson for Victorian Environment Minister Lisa Neville told *Crikey* in a statement that the push was rejected by the states because the concerns raised by the Senate inquiry had been "widely rejected by scientific and medical opinion".

"The opened proposal wanted minimum standards dealing with compliance obligations, turbine noise, and more regulations regarding consultation. Victoria opposed these changes," the spokesperson said.¹⁹⁸

1.310 Labor Senators are also firmly of the view that there is no compelling case for Commonwealth intervention in this area. Criticism of current arrangements stems

198 Josh Taylor, 'Gone with the wind farms: govt moves to fetter renewables, states say no', *Crikey Insider*, 21 July 2015.

overwhelmingly from those who accept claims of negative health and environmental impacts that have been repeatedly demonstrated to have no scientific foundation.

(g) the effect that wind towers have on fauna and aerial operations around turbines, including firefighting and crop management

1.311 Labor Senators note that any development activity will have some impact on fauna. Wind farms are no exception to this general rule. However, evidence presented to the committee demonstrates that the impact of wind farms on birds and other animals is extremely small when compared to that of other human activities and that any impacts are generally the subject of considerable scrutiny and mitigation activity, both prior to and after construction.

1.312 The regulation of environmental impacts for wind farm developments is primarily managed at the state level. However, the federal government also plays a regulatory role in cases where a development will have or is likely to have an impact on a matter of national environmental significance. In such cases, the approval of the Minister for the Environment is required under the EPBC Act.¹⁹⁹

1.313 The Clean Energy Council provided the following summary of how wind farm developers and operators address the environmental impacts of their projects:

Before a wind farm is constructed, project proponents conduct extensive surveys over a number of years to assess the potential impact a particular wind farm could have on surrounding flora, vegetation, soil and fauna, including birds and bats. Many wind farm operators are required to implement a monitoring program during key times such as migration or breeding to oversee potential issues.

If threatened or endangered birds and bat species live around or migrate through a wind farm, very stringent regulation applies to ensure that any impacts are minimal. During wind farm design, detailed mitigation and monitoring measures are utilised to minimise the impact on fauna species surrounding the site.

Bird and bat monitoring after construction is becoming routine practise both in Australia and overseas. There are no consistent standards in Australia for undertaking monitoring and most plans are developed with consultants and local regulators as part of the bat and avifauna management (BAM) plan for the wind farm.²⁰⁰

1.314 The committee was presented with evidence to the effect that bird deaths attributable to wind farms form an extremely small proportion of overall bird deaths resulting from human activity. Several submissions cited published estimates that wind turbines account for fewer than 1 in 10,000 bird deaths from anthropogenic causes, with buildings, power lines, cats, vehicles and pesticides posing far greater risks.²⁰¹

199 Department of the Environment, *Submission 358*, p. 7.

200 Clean Energy Council, *Submission 450*, p. 9.

201 Clean Energy Council, *Submission 450*, p. 10; Infigen, *Submission 425*, pp 13–14; Ms Emma Bennett, *Submission 267*, p. [1]; Wallace Erickson, Gregory Johnson and David Young Jr, 'A summary and comparison of bird mortality from anthropogenic causes with an emphasis on collisions', tabled by Ms Emma Bennett at 9 June 2015 public hearing.

1.315 Environment Victoria highlighted two further sources of information from North America. The 2014 State of the Birds report attributed 250,000 bird deaths per year to wind turbines in comparison to 2.6 billion attributed to cats and 620 million attributed to collisions with buildings. A further comparison of deaths caused by wind turbines and deaths caused by other electricity generation sources found 'coal-fired power stations are responsible for 35 times more bird deaths than wind turbines. Coal is responsible for 42% of US electricity generation, with all renewables at 12%, so the discrepancy in mortality is not a function of how much more coal power there is.'²⁰²

1.316 The South Australian Government confirmed that wind farm proponents must conduct surveys to ascertain any possible impacts on flora and fauna prior to gaining planning approval and that the proposal must be modified to ensure there are no significant impacts on any identified threatened species under the EPBC Act. It also provided the following figures on bird mortality per gigawatt hour for various forms of electricity generation:

There are incidences of bird strike at wind farms, although some wind farms do not incur bird kills and modern wind turbines operate in low rotation speed modes thereby mitigating bird strike. This information, however, needs to be put in context and compared with other forms of electricity generation. A 2013 study estimated the number of birds killed per gigawatt hour (GWh) of generated wind electricity, fossil fuel and nuclear power systems. The study estimates that wind farms and nuclear power stations are responsible each for between 0.3 and 0.4 fatalities per GWh of electricity, while fossil fuelled power stations are responsible for about 5.2 fatalities per GWh.²⁰³

1.317 Labor Senators note that bird mortality rates at wind farms are established with greater accuracy than for other industries due to the greater levels of investigation undertaken by wind farm operators. As Ms Bennett, an independent consultant specialising in wind farm bird and bat mortality surveys, explained:

Wind turbines are not unique in their impact on birds. Powerlines, roads, buildings, aeroplanes, cats, foxes, radio towers, pesticides, land use change, climate change and many other things are all negative pressures facing bird survival, and if we want to understand the impact our society has on birds then we need to understand each of these components and how they interact together to threaten species survival. Wind farm operators are doing their bit to understand their impact, but without a holistic approach by all industries the actual impact to the population is difficult to estimate.²⁰⁴

1.318 Concerns over the impact of wind farm developments on the brolga, which is listed as a threatened species in Victoria but not in other Australian states nor under the

202 Environment Victoria, *Submission 304*, p. [2].

203 South Australian Government, *Submission 59*, p. 9.

204 Ms Emma Bennett, *Committee Hansard*, 9 June 2015, p. 33.

EPBC Act, were raised with the committee by the Brolga Recovery Group.²⁰⁵ The group suggested that established and proposed wind farm developments across south west Victoria are having and will have a damaging impact on brolga populations. In particular the group argued that a recent bird utilisation study conducted at AGL's Macarthur wind farm demonstrated that 'Brolga are absent when turbines are operating at greater than 30% of capacity.'²⁰⁶

1.319 However, Labor Senators note Ms Bennett's statement that, in her 10 years of experience undertaking bird mortality surveys, 'the only time I found a dead brolga was in my capacity as a Landcare facilitator, where one of my volunteers phoned me up because they had found a dead brolga next to a wildlife reserve under powerlines.'²⁰⁷ Mrs Susan Dennis, President of the Brolga Recovery Group, was not able to produce any concrete evidence of any recorded brolga deaths due to wind farms, but had also witnessed brolgas hitting power lines.²⁰⁸

1.320 Evidence provided by AGL on brolga monitoring at the Macarthur wind farm contradicts the Brolga Recovery Group's claims:

Where required by planning permits, AGL undertakes monitoring programs to estimate the frequency of bird and bat deaths as a result of collision with wind turbines. In the first 12 months of monitoring at the Macarthur Wind Farm, an estimated mortality rate of 1.3 birds per turbine per year was observed, as well as 0.1 bats per turbine per year. Importantly, the effects on threatened species were found to be negligible, and no collisions with the primary avian species of concern at the site (brolga) were observed.²⁰⁹

1.321 Ms Bennett, who has conducted or supervised over 8,000 bird and bat mortality surveys at eight separate wind facilities, stated that such facilities have only a minor impact on the brolga:

...population decline has been primarily due to loss of habitat, coupled with predation of chicks by foxes. Collision with powerlines is an unknown factor but a real threat to large birds. Wind farms will add another pressure to the declining brolga populations. However, by contrast this is relatively minor in view of those factors which have led to species decline.²¹⁰

205 See Department of Sustainability and Environment, *Advisory list of threatened vertebrate fauna in Victoria*, 2013, p. 11, http://www.depi.vic.gov.au/_data/assets/pdf_file/0019/210439/Advisory-List-of-Threatened-Vertebrate-Fauna_FINAL-2013.pdf, accessed 14 July 2015. The brolga is also listed as a species of 'least concern' in the IUCN Red List of Threatened Species, see *Antigone rubicunda* entry <http://www.iucnredlist.org/details/summary/22692067/0>, accessed 14 July 2015.

206 Brolga Recovery Group, *Submission* 107, p. [3], see also *Committee Hansard*, 9 June 2015, pp 38–43.

207 Ms Emma Bennett, *Committee Hansard*, 9 June 2015, p. 35.

208 Mrs Susan Dennis, *Committee Hansard*, 9 June 2015, p. 40.

209 AGL, *Submission* 83, p. 6.

210 Ms Emma Bennett, *Committee Hansard*, 9 June 2015, pp 33–34.

1.322 With regard to the Macarthur wind farm, Ms Bennett stated:

Arguments about brolga displacement from wind farms are not supported by the evidence that has been collected. At Macarthur Wind Farm brolgas have been recorded breeding within 200 metres of a turbine and grazing within 100 metres of a turbine. At Mortons Lane Wind Farm a solitary brolga is a regular visitor to the paddock adjacent to the substation and within 200 metres of a turbine. There is also a natural flocking site that has remained undisturbed less than three kilometres away.²¹¹

1.323 Ms Bennett also commented on the ability of birds to learn to avoid wind farms, such that their impact reduces over time:

There is lots of evidence all around the world about birds' behaviour and avoidance. That is shown through data where we may find an initial impact in the first month of operation which drops off significantly straight away and throughout the life of the wind farm. We have not done extensive long-term studies here in Australia, but there is certainly a lot of evidence, particularly with small wind farms such as the Hepburn wind farm, where we found no birds during our mortality monitoring at all. Small wind farms have clear avoidance patterns; that has been demonstrated. I would suggest that birds are not stupid.²¹²

1.324 Labor Senators believe, based on evidence put before the committee, that wind farms in fact have a very limited impact on fauna, and on birds in particular, both in relative and absolute terms. While any negative impacts on wildlife are regrettable, evidence suggests that wind farm operators are better informed about, and more proactively responsive to, this side effect of their activities than are other industries.

1.325 On the particular issue of the interaction of brolgas and wind farms in south-west Victoria, Labor Senators do not believe any expert evidence was presented to the committee that recent wind farm development has had a significant impact on population levels.

1.326 With regard to aerial firefighting operations, the committee received no credible evidence that wind farms, when appropriately managed, pose greater risks than any other structures or have hampered the operations of rural firefighters. In fact the committee received evidence that wind farms have in some cases aided firefighting operations because they offer improved access for vehicles.

1.327 The New South Wales Rural Fire Service informed the committee that 'a fire moving across the area of a wind farm is generally managed in the same way as any other grass and/or bushfire.'²¹³ It further noted that, although 'aerial firefighting suppression in close proximity to wind turbines may be inhibited at times' this is because firefighting aircraft operate under the Civil Aviation Safety Authority's

211 Ms Emma Bennett, *Committee Hansard*, 9 June 2015, p. 34.

212 Ms Emma Bennett, *Committee Hansard*, 9 June 2015, p. 35.

213 NSW Rural Fire Service, *Submission 97*, p. 1.

(CASA) *Visual Flight Rules* for navigating by visual reference and are required to maintain standard distances from wind turbines, as they are with 'any other potential hazard such as power lines, transmission towers, mountains and valleys.'²¹⁴

1.328 A position statement developed by the Australasian Fire and Emergency Services Authorities Council emphasises that the risks posed by wind farms are routine and no greater than those posed by other activities:

Wind farms are an infrastructure development that must be considered in the preparation of Incident Action Plans for the suppression of bushfires in their vicinity. These considerations are routine and wind farms are not expected to present elevated risks to operations compared to other electrical infrastructure.

Aerial fire fighting operations will treat the turbine towers similar to other tall obstacles. Pilots and Air Operations Managers will assess these risks as part of routine procedures. Risks due to wake turbulence and the moving blades should also be considered. Wind turbines are not expected to pose unacceptable risks.

Wind farms are not expected to adversely affect fire behaviour in their vicinity. Local wind speeds and direction are already highly variable across landscapes affected by turbulence from ridge lines, tall trees and buildings.

Turbine towers are not expected to start fires by attracting lightning.

Turbines can malfunction and start fires within the unit. Automatic shutdown and isolation procedures are installed within the system. Although such fires may start a grass fires within the wind farm, planning for access and fire breaks can reduce the likelihood of the fire leaving the property. This risk from such fires is less than that of many other activities expected in these rural environments.²¹⁵

1.329 An example of the high level of fire safety precautions taken by wind turbine manufacturers and operators was provided by Pacific Hydro, who outlined the following measures present at their Cape Bridgewater wind farm:

- All major components within the wind turbine are fitted with temperature sensors. These sensors ensure turbines are closely monitored (24 hours a day) to ensure they remain within their designed operating range. If any of the settings are exceeded (e.g. because of fire, overheating, smoke), the turbine controller automatically shuts down the turbine and sends an alarm, via the control system, to a technician. Following a detailed inspection of the systems which caused the particular fault, the turbine will then be restarted as appropriate.
- Fire extinguishers are fitted in every turbine in the nacelle and at the entrance in order to comply with the relevant Australian Standards and regulations.

214 NSW Rural Fire Service, *Submission 97*, p. 1.

215 NSW Rural Fire Service, *Submission 97*, p. 8.

- Pacific Hydro's operating procedures, emergency evacuation/management procedures and up to date training of all personnel ensures that all operating and safety measures are adhered to.
- All vehicles entering the wind farm site must use diesel fuel and be fitted with fire extinguishers.
- Site personnel are equipped with the latest radio communication.²¹⁶

1.330 The Victorian Country Fire Authority stated that it provides advice to owners and operators of wind farms and advice on planning permit applications. It has developed the *Emergency Management Guidelines for Wind Energy Facilities*, which provide guidance to operators on such matters as engagement with the CFA, siting of turbines, access recommendations and provision of firefighting water.²¹⁷

1.331 When asked whether wind turbines are particularly problematic for firefighters, the Victorian Country Fire Authority stated:

No. We have done an investigation of fire and incident reporting data over the last 17 years—so, back to 1998—and we have had 289 incidents in areas surrounding wind farms, none of them involving the wind farm facility as such. As you say, there are a lot of other risks within the natural environment rather than the towers themselves. From my perspective, from an operational perspective, we would rate trees themselves as being one of the highest risks to firefighters for injury and death over wind farms or wind towers.²¹⁸

1.332 With regard to aerial operations in particular, the committee was informed:

Basically, the air fleet that we use operates under visual flight rules. That means that they will not operate in low light or after light, or through cloud or smoke. Wayne has indicated that there are a lot of other, higher-risk areas, like power lines and the like, over wind towers. They are quite visible and they do not cause the aircraft any concern in aviation operations for CFA.²¹⁹

1.333 The Australian Wind Alliance confirmed the advice of the Victorian Country Fire Authority that wind turbines are treated much like any other obstacle, and also noted that wind farms have a beneficial impact on firefighting efforts:

Advice to AWA confirms the position of the Victorian CFA. Furthermore we have received advice that wind farms actually improve accessibility for

216 Pacific Hydro, Answers to questions taken on notice during 30 March public hearing, pp. [5–6].

217 Mr Andrew Andreou, *Committee Hansard*, 30 March 2015, p. 40; Victorian Country Fire Authority, *Submission 14 – Attachment 1*.

218 Mr Craig Brownlie, *Committee Hansard*, 30 March 2015, p. 41.

219 Mr Craig Brownlie, *Committee Hansard*, 30 March 2015, p. 41.

fire intervention due to the proliferation of well maintained access roads and the presence of onsite staff who are alert to fire threats.²²⁰

1.334 Trustpower informed the committee that access tracks built for stage 2 of its Snowtown wind farm improved access for the local CFS and acted as a fire break during recent grassfires. They quoted the local Snowtown CFS captain's comments regarding the access roads:

They were absolutely of great benefit in helping us fight the fires. If it weren't for those roads the fires, which were going at a fair rate of knots, would have just kept going. They acted as a natural fire break, giving us an edge to work back to and enabling us to back burn if we'd needed to. These new access roads provided an unexpected bonus, but they'll help us control fires in the future.²²¹

1.335 The committee received advice from CASA that it had not identified any aviation accidents resulting from wind turbines:

The data that CASA has readily available in the timeframe is derived from Aviation Safety Incident Reports from 2008 to the present. In that period CASA has not found any aviation accidents related wind farms or wind turbines. For the same period there 1,231, aviation accidents.²²²

1.336 The committee received several submissions raising concerns about the impact of the Gullen Range Wind Farm on the operations of the Crookwell aerodrome.²²³ Labor Senators note correspondence from CASA in response to these submissions, which noted that it had been consulted on the original planning application for the wind farm and that NSW Planning had, consistent with the current National Airports Safeguarding Framework, deleted 11 proposed turbines that 'would have been within the boundary of the hypothetical obstacle limitation surfaces (OLS) for a local, daylight-only, non-instrument runway such as Crookwell.' There will now be 'no infringement of the theoretical OLS which have an extent of 3,600m from the aerodrome.'²²⁴

1.337 CASA has also examined safety issues in light of correspondence on the matter and concluded:

That the wind turbines would not be hazardous obstacles for operations at Crookwell aerodrome provided pilots are above the required minimum altitudes for day and night operations. The wind turbines present a pilot with conditions that their training equips them to deal with. In this context

220 Australian Wind Alliance, Answers to written questions on notice, 7 July 2015, p. 10.

221 Trustpower, Answers to questions taken on notice at 16 June public hearing, p. 3; Infigen Energy also commented on improved access for firefighters at the Snowtown windfarm and provided photos of the firefighting operations in its submission, see *Submission 425*, pp. 14–16.

222 Civil Aviation Safety Authority, Answers to written questions on notice, 11 June 2015, p. [1].

223 Parksbourne/Mummel Landscape Guardians Inc, *Submission 119*, p. 91; Mr Jim Hutson, *Submission 30*.

224 Civil Aviation Safety Authority, *Response to Submission 119*, p. 2.

CASA agrees with the view expressed by the NSW Rural Fire Service (Submission 97) that wind turbines are not expected to pose increased risks due to wind turbulence or rotating blades. The NSW Rural Fire Service notes pilots are required to maintain standard distances from wind turbines, just as they are from other potential hazards such as power lines, transmission towers, mountains and valleys.²²⁵

1.338 With respect to the issue of turbulence, CASA's response also noted that the '3,600m exclusion zone mandated by the NSW Government should ensure that excessive turbulence from the rotors is not experienced in the immediate vicinity of the aerodrome' and that the aerodrome is already subject to warnings regarding natural wind effects due to the Gullen Range itself.²²⁶

1.339 Finally, Labor Senators note the concern raised by the Aerial Agricultural Association of Australia (AAAA) regarding the safety threat posed by wind farm developments to low-level aviation.²²⁷ In general, as noted by the Clean Energy Council, Labor Senators agree with the Clean Energy Council that, 'Wind turbines are just another obstacle to be managed in planning and conducting low level aerial operations. It is the responsibility of the pilot to anticipate, assess and make operational judgments as to how close they fly to an obstacle.'²²⁸

1.340 As noted by Vestas, the US state of Iowa provides an example of the very productive coexistence of the cropping and wind power industries:

From the 2007 Census to the 2012 Census, Iowa's total value of agriculture production increased 51 percent. The value of crops sold also increased by 69 percent, and the value of Iowa livestock production increased by 34 percent.

Iowa is also the third-biggest producer of wind power in the USA. The wind industry has grown in Iowa to create between 6000 and 7000 direct and indirect jobs, with an installed capacity of almost 6000 MW of wind power (significantly more than all of Australia's installed wind capacity). The wind industry in Iowa has attracted around US \$10 billion of capital investment.

In Iowa the wind industry and the cropping industry have learnt to co-exist and do so in a safe and profitable manner. Accordingly we see no reason why Australia is any different.²²⁹

1.341 In the specific case of wind monitoring towers, which are often associated with wind farm developments and can be very difficult for pilots to see, Labor Senators agree that high visibility marking is essential. This matter is covered at section 39 of the National Airports Safeguarding Framework Guideline D, and Labor

225 Civil Aviation Safety Authority, *Response to Submission 119*, p. 1.

226 Civil Aviation Safety Authority, *Response to Submission 119*, p. 1.

227 Aerial Agricultural Association of Australia, *Submission 20*, p. 1.

228 Clean Energy Council, *Submission 450*, pp 10-11.

229 Vestas, Answers to questions taken on notice at 9 June public hearing, p. [4].

Senators urge wind farm operators to ensure they implement the measures suggested there.²³⁰

230 National Airports Safeguarding Framework Guideline D, p. 6, https://infrastructure.gov.au/aviation/environmental/airport_safeguarding/nasf/files/4.1.3_Guideline_D_Wind_Turbines.pdf, accessed 15 July 2015.

(h) the energy and emission input and output equations from whole-of-life operation of wind turbines

1.342 Evidence presented to the committee unequivocally demonstrates that wind turbines rapidly generate more energy than is used in their whole-of-life operation, including construction, installation, operation and decommissioning, and that wind turbines produce among the lowest emissions per unit of electrical energy of all generation types.

1.343 With regard to the greenhouse gas emissions intensity of wind farms, the Energy Supply Association of Australia referred to a recent analysis conducted by the US National Renewable Energy Laboratory, which concluded that the greenhouse emissions generated by wind farms are dwarfed by those of coal or gas fired power plants:

...the median published life cycle greenhouse gas emission estimates for onshore wind farms is 12 grams of carbon dioxide equivalent CO₂-e for each kWh of electricity generated (gCO₂-e/kWh). In contrast, coal-fired power plants emit 979 gCO₂-e/kWh on average. This varies significantly depending on the type of coal used and the type of generation technology. Gas-fired power plants emit between 450 (combined cycle) and 670 gCO₂-e/kWh (open cycle).²³¹

1.344 The IPCC has also published figures on this matter in its 2014 *Mitigation of Climate Change* report. Its findings on this topic were summarised by RATCH-Australia Corporation as follows:

- Median lifecycle emissions from a coal-fired power station are 820 grams of carbon dioxide-equivalent emissions per kilowatt hour of electricity generated (820 gCO₂eq/kWh).
- Median lifecycle emissions from a combined cycle gas power station are 490 gCO₂eq/kWh.
- Median lifecycle emissions from an onshore wind farm are 11 gCO₂eq/kWh.²³²

1.345 Siemens has recently published calculations that indicate one of its turbine models has an energy payback period of 4.5 months.²³³ Vestas informed the committee that each of its turbines generates over 25 times the energy consumed during its lifecycle.²³⁴ Further, in documentation published by the New South Wales Department of Environment, Climate Change and Water, it has been estimated that

231 Energy Supply Association of Australia, *Submission 299*, p. 3.

232 RATCH-Australia Corporation, Answers to Questions taken on notice during 18 May public hearing, p. 5.

233 Siemens, Press Release, 'Siemens publishes Environment Product Declarations for wind turbines', 26 November 2014, <http://www.siemens.com/press/pool/de/pressemitteilungen/2014/windpower-renewables/PR2014110070WPEN.pdf>, accessed 10 July 2015.

234 Vestas Australian Wind Technology, *Submission 298*, p. [6]

wind farms 'typically generate the energy used in construction within three to seven months of operation, with the operational lifetime of a turbine being at least 20 years.'²³⁵

1.346 Based on these figures, it is clear that wind farms emit a small fraction of the greenhouse gasses generated by coal and gas power stations. It is also clear that they very quickly recover the energy used in their production and installation.

1.347 The level of greenhouse gas abatement achieved depends on which type of generation wind power is displacing. This matter was explained by AGL:

Under the design of the National Electricity Market (NEM), generators bid their capacity into the market, and the market operator (AEMO) is responsible for dispatching the lowest-cost capacity to meet demand for each half hour interval of the day. Wind farms tend to have low operating costs, so generally can bid in their generation capacity at a low price, and are therefore dispatched ahead of generators with higher operating costs (such as gas or coal).

The amount of greenhouse gas emissions avoided via the operation of wind farms at any given time depends on the emissions intensity of the 'marginal' generator(s) that would otherwise have been dispatched to meet electricity demand, which may produce more or less emissions per unit of electricity generated than the market average depending on the fuel and age of the power station.²³⁶

1.348 The Department of the Environment summarised the findings of recent modelling undertaken for the Warburton Review of the RET scheme by ACIL Allen to calculate emissions abatement. Although this modelling is based on a target which has since been reduced, it remains instructive:

The modelling estimates that 50 to 60 per cent of the additional renewable electricity generated displaces black coal generation, while brown coal and baseload gas make up around 20 per cent each of the electricity generation displaced. Hydro and peaking gas generation is also slightly reduced in many years.

...

The modelling indicates this decrease in electricity generation from black coal, brown coal and gas would reduce emissions by 59 Mt CO₂-e between 2015 and 2020, and 299 Mt CO₂-e between 2015 and 2030.²³⁷

1.349 With regard to the level of abatement achieved to date under the RET, the Warburton Review itself noted:

235 Department of Environment, Climate Change and Water, *Wind Energy in NSW: Facts and Myths*, p. 27, <http://masg.org.au/wp-content/uploads/2008/06/Wind-Energy-In-NSW-Myths-and-Facts.pdf>, accessed 10 July 2015.

236 AGL, Answers to questions taken on notice during 19 May public hearing, p. 2.

237 Department of the Environment, *Submission 358*, pp 12–13.

Historical CO₂-e emissions abatement from the RET has been estimated by SKM to be around 20 Mt CO₂-e between 2001 and 2012. The modest level of abatement achieved to date primarily reflects the small targets in effect under the scheme from 2001 to 2009.²³⁸

1.350 The Warburton Review also referred to a body of modelling work on the significant increase in greenhouse emissions that would occur were the RET to be repealed:

Bloomberg New Energy Finance estimates that removing the RET would increase cumulative emissions from the power sector by 57.3 Mt CO₂-e over the period 2015 to 2020 and 259 Mt CO₂-e over the period 2015 to 2030. Modelling by ROAM Consulting for the Clean Energy Council found that cumulative emissions would be 34.7 Mt CO₂-e higher by 2019-20 if the RET is repealed and modelling by Schneider Electric suggests that removing the LRET would increase cumulative emissions in the National Electricity Market by around 50 Mt CO₂-e by 2020 and by 260 Mt CO₂-e by 2030.²³⁹

1.351 Labor Senators note that the overall emissions intensity of electricity generation in the NEM has fallen in recent years. This has occurred at the same time as the generation mix has altered, with significant reductions in energy produced by coal and increases in energy produced by wind and other renewables and by gas. Thus, the overall impact of changes in the energy generation mix in favour of renewables and gas has been to reduce the emissions intensity of electricity generation in Australia, even as absolute emission levels continue to increase.²⁴⁰

1.352 The South Australian Government provided information on the reduction in emissions brought about by the significant growth in the share of wind power in its generation mix:

In terms of overall output, wind overtook coal based generation to become the second most relied upon generation source in the State's electricity mix in 2011-12. Data from the National Greenhouse Accounts shows that emission factors for electricity production in the state has reduced as a result of wind energy. In 2010 Scope 2 emissions from purchased electricity produced 0.72 kilograms of carbon dioxide equivalent per kilowatt hour and in 2012 it had reduced to 0.61.²⁴¹

1.353 Labor Senators note that claims made by some witnesses that the interaction between wind farms and other forms of generation in the NEM lead either to no

238 Dick Warburton, Brian Fisher, Shirley In't Veld, Matt Zema, *Renewable Energy Target Scheme: report of the Expert Panel*, 15 August 2014, p. 11.

239 Dick Warburton, Brian Fisher, Shirley In't Veld, Matt Zema, *Renewable Energy Target Scheme: report of the Expert Panel*, 15 August 2014, p. 41.

240 Pitt & Sherry, 'Carbon emission index – electricity emissions update – data to 30 June 2015', <http://www.pittsh.com.au/assets/files/Cedex/CEDEX%20Electricity%20Update%20July%202015.pdf>, accessed 14 July 2015.

241 South Australian Government, *Submission 59*, p. 10.

greenhouse gas abatement or to a massive increase in the utilisation of coal-fired generation, were comprehensively refuted by material provided to the committee.

1.354 For example, Mr Hamish Cumming claimed that the addition of wind farms to the electricity grid had resulted in an additional six million tonnes of coal being burnt at AGL's Loy Yang A plant per year and that wind farms are forcing the production of more greenhouse gas emissions than would be the case if they did not exist.²⁴²

1.355 AGL's response to these assertions was as follows:

As demonstrated in AGL's supplementary submission, wind generation does not materially increase coal consumed at our thermal power stations. For example...for AGL's Loy Yang A Power Station in Victoria both the amount of coal combusted and the amount of coal used to generate each unit of electricity sold has remained reasonably consistent over the past six years - despite the significant growth of wind power in the National Electricity Market. This data is consistent with reporting to the Commonwealth Government under the National Greenhouse and Energy Reporting Act 2007.²⁴³

1.356 Some witnesses argued that the contribution of wind power to the reduction of greenhouse gas emissions is less than 100 per cent 'efficient' in that the percentage reduction in greenhouse gas emissions across the whole NEM is lower than the percentage of electricity generated by wind farms. This purported effect was attributed to two consequences of the integration of wind farms into the NEM: first, that wind farms often replace the relatively less emissions intensive gas generators; second, that when wind farms are operating coal generators operate under part load, which is less efficient.²⁴⁴

1.357 The nature of wind farm power generation may lead to some marginal loss of efficiency of other generators in the NEM. Nevertheless, even on the calculations provided by those who emphasise this effect, in absolute terms wind power still leads to significant greenhouse gas abatement calculated across the whole network.

1.358 As noted above, Dr Joseph Wheatley and others maintained that wind power imposes inefficiencies on other parts of the network such that it does not reduce emissions at the same rate as it replaces other sources of energy generation:

We looked at the calendar year 2014, and our main findings were that in 2014 wind power generation provided 4.5 per cent of all energy generated on the NEM but it reduced emissions by a lesser amount—by 3.5 per cent.

242 Mr Hamish Cumming, *Submission 31*, p. [3]; see also evidence at *Committee Hansard*, 30 March 2015, pp 45–62.

243 AGL, Answers to questions taken on notice during 19 May public hearing, p. 4.

244 Dr Joseph Wheatley, *Committee Hansard*, 19 May 2015, pp 77–79; see also Dr Joseph Wheatley, *Submission 348*.

So the effectiveness is the ratio of 3.5 to 4.5, which is about 80 per cent effective, and we would argue that is a significant loss of effectiveness.²⁴⁵

1.359 However, regarding the question of how much coal or gas power is actually displaced by wind power, taking into account any increased standby requirements on non-renewable generators, the committee received the following evidence from the Australian Wind Alliance:

The Inquiry has heard evidence that what is required to properly answer this question is to analyse actual emissions data at short time intervals from coal-fired power stations. Just such a study was conducted in 2013 by America's National Renewable Energy Laboratory (NREL) using hourly emissions data from nearly every power plant in the Western U.S. It was reviewed by 55 experts including representatives from eight utilities.

This study found that the emissions cost of cycling was 'negligible' and that a 'high wind scenario' of 25% wind and 8% solar produced a 29% - 34% decrease in CO₂ emissions. That is, 1 kWh of wind (or solar) generation displaces almost all the emissions from the coal- and gas- fired power stations that remain in the grid, even when cycling is taken into account.²⁴⁶

1.360 The Australian Wind Alliance also highlighted analysis on the situation in South Australia which suggests that 'wind energy, even at high penetration levels, does indeed displace the full emissions of the coal and/or gas fired power it replaces.'²⁴⁷ Regarding the high level of wind power in the South Australian generation mix, Windlab Systems came to the following conclusions:

Wind power generation has increased substantially in South Australia in the last eight years, from supplying 6% of the state's needs in 2005/06 to 25% in 2012/13.

This increase in wind generation has been the primary reason for a 34% reduction in CO₂-e emissions due to electricity generation. The electricity network has managed to accommodate this increase in wind power without increasing the amount of electricity required from peaking power plants.

Energy produced from these peaking plants has actually reduced during this same period, which has helped further reduce CO₂-e emissions. Wholesale prices have not risen over the period (even with LGC costs included) and we conclude the cost of abatement using wind is low.²⁴⁸

245 Dr Joseph Wheatley, *Committee Hansard*, 19 May 2015, p. 77; Dr Joseph Wheatley, *Submission 348*; see also Mr Peter Lang, *Committee Hansard*, 19 May 2015, pp. 59–62; Mr Peter Lang, *Submission 259*.

246 Australian Wind Alliance, Answers to questions on notice arising from 19 May public hearing, pp [1–2].

247 Australian Wind Alliance, Answers to questions on notice arising from 19 May public hearing, p. [2].

248 Dr David Osmond and Luke Osborne, *Peaking Capacity, CO₂-e Emissions and Pricing in the South Australian Electricity Grid with High Wind Penetration 2005-2013*, p. 4, http://www.windlab.com/sites/default/files/20110915_SouthAustralianWindPower_DO_LHO.pdf, accessed 21 July 2015.

1.361 On the basis of this evidence, it appears that the introduction of renewable energy abates very nearly all of the emissions generated by the fossil-fuel generation it replaces.

1.362 The related issue of 'spinning reserve' was also raised by some submitters and witnesses, who argued that, due to its intermittent nature, the incorporation of renewable energy generation into the electricity grid increases the requirement to have other generators on standby but not providing electricity and thereby reduces the efficiency the grid. This issue overlaps somewhat with the discussion above of the abatement efficiency of wind generation.

1.363 The CER provided the following explanation of the purpose of spinning reserve in the operation of the electricity grid:

Spinning reserve is the generation capacity that is on-line but not providing electrical energy that can respond to compensate for sudden generation or transmission outages. Spinning reserves are the first type used when dispatch shortfalls occur, which helps keep the grid operating in a stable manner. Because the level of electricity demand varies with time, enough spinning reserve in the system is required to maintain system stability.²⁴⁹

1.364 The AEMO is responsible for managing the stability of the NEM. It provided evidence that directly refuted claims that the introduction of greater levels of wind has required an increase in capacity dedicated to maintaining the stability of the grid.

1.365 The AEMO noted that it does not employ the term 'spinning reserve', which originates in North America, and that the NEM, due to its design, does not have a directly comparable feature. The AEMO does, however, operate a Frequency Control Ancillary Services (FCAS) market, which it explained as follows:

AEMO operates "Frequency Control Ancillary Services" (FCAS) markets which match supply and demand over timescales shorter than the NEM's energy dispatch cycle of five minutes. Beyond that timescale variations are balanced by energy dispatch. In some overseas markets the dispatch cycle is longer, e.g. 60 minutes, requiring balancing services beyond the scope of FCAS. Some energy markets operate on a day ahead basis rather than in real time.²⁵⁰

1.366 The AEMO further explained that it has not changed the amount of FCAS in response to the rising level of wind generation in the grid and that FCAS costs represent only about one per cent of market turnover:

AEMO recruits sufficient FCAS in order to meet the frequency standards and keep the power system secure at all times. To date AEMO has not measurably changed the amount of FCAS it recruits as a result of the growth in wind generation. It is possible that more of one form of FCAS – regulation – may be required in time due to the sub five-minute variability of wind generation. It should be noted that total NEM FCAS costs are

249 Clean Energy Regulator, *Response to Submission 31*, p. 2.

250 Australian Energy Market Operator, *Submission 469*, p. 11.

relatively small, comprising about one percent of energy market turnover.²⁵¹

1.367 The AEMO emphasised that, although renewable generation does present some technical challenges, the NEM is uniquely well placed to deal with them due to its design. It again emphasised that it has not increased ancillary services in response to increasing levels of renewable generation:

The NEM has been uniquely successful in securely integrating wind generation to date at low cost. For example, AEMO has not had to change or materially increase the quantity of ancillary services purchased to maintain system security.²⁵²

1.368 It is important to note that spinning reserves are maintained in order to meet 'sudden generation or transmission outages'. The committee received evidence that, although wind generation is certainly intermittent in that it generates electricity only when the wind is blowing, it is also generally highly predictable. Pacific Hydro referred the committee to the Australian Wind Energy Forecasting System operated by the AEMO, which enables the efficient operation the electricity dispatch system by accurately forecasting wind conditions across the country.²⁵³

1.369 It is also important to note that spinning reserves are a feature of the operation of the electricity grid regardless of the presence of wind generation and that the size of the spinning reserves, or contingency, are generally determined by the largest power station in the grid so that its sudden loss would not unbalance the system. This matter was explained by RATCH-Australia Corporation:

In terms of the size of the reserve that needs to be sitting there waiting as backup, our national electricity market, called the NEM, considers that a credible contingency event is the unexpected loss suddenly of one power station on the network. So the spinning reserve backup needs to be large enough to cover the loss of electricity generation in case any one of the currently operated power stations suddenly shuts down.

I am simplifying a little here because the details get very technical, but the critical case here is if the largest of the currently operating power stations suddenly shuts down, so the spinning reserve is sized to cover this one, the largest one. If it is going to cover the loss of the largest power station then it would cover the loss of any of the others if they were to fail as well. Up to this date in the NEM, the largest power station has been a coal fired power station. Wind farms can be quite big, they can comprise many turbines, but overall the size of a wind farm is generally a fair bit smaller than the size of

251 Australian Energy Market Operator, *Submission 469*, p. 11.

252 Australian Energy Market Operator, *Submission 469*, p. 4.

253 Mr Andrew Richards, *Committee Hansard*, 30 March 2015, pp 14–15. For a detailed explanation of the Australian Wind Energy Forecasting System, see AEMO, 'AWEFS', <http://www.aemo.com.au/Electricity/Market-Operations/Dispatch/AWEFS>, accessed 20 July 2015.

one coal fired power station. So the spinning reserve is sized to cover the loss of one coal fired power station.

So there is no extra requirement for spinning reserve due to wind turbines. If a wind turbine was to fail, if a whole wind farm were to fail, if the wind suddenly stopped blowing, which is something that does not actually happen—the wind is very predictable and forecastable, and it does not just stop blowing—but let's say for some reason a wind farm suddenly shuts down, whatever backup is there would be there, whether or not that wind farm was operating, because there is always a larger power station which it needs to be there for as well.²⁵⁴

1.370 Using the example of South Australia, Pacific Hydro also explained that, despite the very high level of wind power in that state, there had been a decrease in the capacity of coal-fired power stations:

South Australia has significantly more wind energy than any other Australian state, which makes it a good case study when it comes to integrating wind energy into the grid. According to the Australian Energy Market Operator, wind generation in South Australia was sufficient to meet the state's entire operational consumption for the first time on 27 June 2014 between 4.10 am and 4.35 am. AEMO have also found that for 90% of the time, South Australian wind generation varies by less than 2% across five-minute periods, and by around 3% across 10-minute periods. In addition to this, AEMO reports that the capacity factor of coal stations is dropping in the state, clearly demonstrating that wind farms are displacing coal fired power generation in the state.²⁵⁵

1.371 Labor Senators therefore conclude that the issue of maintaining sufficient 'spinning reserve' is one that affects the electricity network as a whole, rather than renewable generation in particular. No type of power generation is completely reliable and capacity must be maintained to cover unexpected events; this is a consequence of maintaining a reliable grid and cannot be attributed only to the presence of renewable energy generation.

1.372 Labor Senators highlight the summary of this matter provided by the CER:

As spinning reserve is required to maintain system stability, one MWh of renewable generation may indeed not displace the exact amount of fossil-fuel generation required for the same one MWh of electricity. On the other hand, it should not be assumed that fossil-fuel generators continue to burn fuel and hence generate emissions at the same rate regardless of the amount of renewable generation (mostly wind) that is dispatched. Overall, it is more likely that the extra emissions from increased spinning reserve are a small proportion of the emissions reductions from displacement of fossil-fuel generation.²⁵⁶

254 Mr Joseph Hallenstein, *Committee Hansard*, 18 March 2015, pp 7–9.

255 Pacific Hydro, Answers to questions taken on notice during 30 March public hearing, p. [4].

256 Clean Energy Regulator, *Response to Submission 31*, p. 3.

1.373 Labor Senators also emphasise that assertions made by some witnesses that renewable energy certificates are being incorrectly claimed because the actual greenhouse gas emissions achieved by the introduction of renewable generation varies depending on which form of generation is displaced at a given point in time are also baseless. Such a claim was put to the committee by representatives of the Association for Research of Renewable Energy Australia. Further criticisms of the conduct of the CER founded on this claim are also baseless.²⁵⁷

1.374 First, as noted by the CER, clean energy certificates are not granted on the basis of greenhouse gas abatement, but on the basis of electricity generated. The CER emphasised this point and explained:

The eligibility formula makes no reference to the amount or emissions intensity of fossil-fuel generated electricity that is displaced by the renewable generated electricity. Therefore, the Regulator is neither required, nor has the power, to vary the number of LGCs issued according to emissions reductions achieved.

As a matter of practicality this would be exceedingly difficult to determine on a case by case basis because of the pooled nature of the electricity market. Generators offer to supply the electricity market with specific amounts of electricity at particular prices. Dispatch prices are determined every five minutes (aggregated to a 30 minute trading interval) and it would be difficult to establish what would have been dispatched in the absence of the renewable electricity and hence what emissions were avoided at the time.²⁵⁸

1.375 Second, as presented in the discussion above of Dr Joseph Wheatley's claims, strong evidence was provided to the committee that in fact renewable generation does displace very nearly all of the emissions from fossil fuel generators.

1.376 The claims presented to the committee regarding the invalidity of renewable energy certificates is mistaken about both the legal foundation on which the certificates are issued and the factual question concerning the level of abatement achieved by renewable generation.

1.377 Based on the evidence presented to the committee on element (h) of the terms of reference, Labor Senators believe that there is a great deal of information available on the greenhouse gas emissions intensity of wind power and on its overall effect on the emissions intensity of the NEM. On both measures wind power is clearly having a positive impact and its further development should be encouraged.

257 Association for Research of Renewable Energy in Australia, *Submission 372*, pp 10–11; see also evidence at *Committee Hansard*, 29 June 2015, pp 54–58.

258 Clean Energy Regulator, *Response to Submission 31*, pp 1–2.

A handwritten signature in cursive script, reading "A. E. Urquhart".

Senator Anne Urquhart

A handwritten signature in cursive script, reading "Gavin Marshall".

Senator Gavin Marshall

APPENDIX 1

Submissions and additional information received by the Committee

Submissions

- 1** Mr Alan Scott
- 2** Mr Anton Lang
- 3** Name Withheld
- 4** Regulation Economics (plus a supplementary submission)
- 5** Mr David Archibald
- 6** Dr Judy Ryan
Response from the Clean Energy Regulator
- 7** Mr Gordon McGlashan
- 8** Mr Graham Thomas
- 9** Mr Malcolm Barlow (plus two attachments)
- 10** Ms Patricia Gabb
- 11** Mrs Jenny Holmes
- 12** ACT Government, Environment and Planning
- 13** Mr John McKerral
- 14** Victorian Country Fire Authority (plus five attachments)
- 15** Dr Paul Kay
Response from the Clean Energy Regulator
- 16** Mr William Palmer (plus nine attachments)
- 17** Mr and Mrs Bill and Sandra Rogerson (plus two attachments and a supplementary submission)
Response from AGL
- 18** Mr and Mrs John and Robin Pollard
- 19** Ms Nicole Macdonald
- 20** Aerial Agricultural Association of Australia Ltd (plus three attachments)

- 21 Waterloo and District Concerned Citizens Group
- 22 Ms Julie Quast
- 23 Confidential
- 24 Mr and Mrs David and Alida Mortimer (plus two supplementary submissions)
Response from Infigen
- 25 Ms Jenny Bruty
- 26 Ms Kathy Russell (plus two attachments)
- 27 Mr Brian Osborne
- 28 Mr George Papadopoulos
- 29 Mrs Kris McMillan (plus an attachment and a supplementary submission)
- 30 Mr Jim Hutson
- 31 Mr Hamish Cumming (plus three attachments)
Response from Victorian Government Department of Environment, Land,
Water and Planning
Response from the Clean Energy Regulator
- 32 Mr Keith Staff (plus an attachment)
- 33 Confidential
- 34 Mrs Judy Rowland-Jones (plus a supplementary submission)
- 35 Ms Janet Hetherington (plus two supplementary submissions)
- 36 Name Withheld
- 37 Ms Carmel Anderson
- 38 Mr Michael Machin
- 39 Mr and Mrs Simon and Louise Manifold
- 40 Name Withheld (plus two supplementary submissions)
Response from Moorabool Shire Council
- 41 Mr Kenneth Rees
- 42 Mr Tim Le Roy
Response from Biosis
Response from Bald Hills Wind Farm
- 43 Mr Frank Kearns

- 44 Mr Philip Davis
- 45 Tarwin Valley Coastal Guardians Inc
- 46 Dr Marjorie Curtis
- 47 Pyrenees Shire Council
- 48 Australian Charities and Not-for-profits Commission
- 49 Mr Geoffrey Clark
- 50 Emeritus Professor Colin Hansen
- 51 Mr Peter Keatley
- 52 Mrs Bev Keatley
- 53 Mr Ivan Chan
- 54 Mr Reg Shepherd
- 55 Dr Christopher Hanning
- 56 Ms Merle Clarke
- 57 Mr Bruce Mortlock
- 58 Upper Hunter Landscape Guardians
- 59 South Australian Government
- 60 Ms Amanda Vance
- 61 Mr and Mrs Chris and Katrina Knight
- 62 Mr Joe Hallenstein
- 63 Name Withheld
- 64 Dr Jay Tibbetts (plus a supplementary submission)
- 65 Dr Kim Forde
- 66 Name Withheld (plus a supplementary submission)
- 67 The Australia Institute (plus two attachments)
- 68 Mr Patrick Hockey
- 69 Mr Bruce Howlett
- 70 Mr David Stewart

- 71 Mr Peter Bowden
- 72 Name Withheld
- 73 Mr Alan Cole
- 74 Mr William Hoorweg
- 75 Dr Daniel Shepherd
- 76 Mr and Mrs Bernard and Elizabeth Hogan
- 77 Mr Paul Schomer
- 78 Tasmania Fire Service (plus an attachment)
- 79 Ms Angie Angel
- 80 Professor Emeritus Alun Evans MD
- 81 Mr Robert Griffin
- 82 Mr Paul Evans (plus an attachment)
- 83 AGL Energy Ltd
- 84 Ergon Energy
- 85 Southern and Hills Local Government Association (SA)
- 86 Institute of Public Affairs
- 87 Frontier Economics
- 88 Ms Eve Lamb
- 89 Ms Jackie Rovensky (plus twenty attachments and a supplementary submission)
- 90 Ms Carmen Krogh (plus six attachments and two supplementary submissions)
- 91 Mr Peter Bobroff (plus a supplementary submission)
- 92 Mr David Clarke
- 93 Clean Energy Regulator (plus a supplementary submission)
- 94 Mr Patrick Ryan
- 95 Name Withheld
- 96 Dr Tom Quirk

-
- 97 NSW Rural Fire Service
- 98 Miss Trinidad Diaz
- 99 Mr Grant Winberg (plus two attachments)
- 100 Mr Richard Sharp
- 101 Charlie Prell
- 102 National Health and Medical Research Council (plus an attachment)
- 103 Ms Brenda Herrick
- 104 Confidential
- 105 Mr Maxwell Srice
- 106 Ms Cheryl Small
- 107 Brolga Recovery Group
- 108 Mr and Mrs Peter and Lyn Kuhlmann (plus a supplementary submission)
- 109 Miss Cheryl White
- 110 Mr Peter Kemmis
- 111 Glenelg Shire Council
- 112 Victorian Department of Economic Development, Jobs, Transport and Resources
- 113 Mr Anthony Gardner
- 114 Cr Gilbert Wilson
- 115 Ms Sandra Hawkins
- 116 RATCH-Australia Corporation Ltd
- 117 Mrs Christine Metcalfe (plus five attachments)
- 118 Mr William Quinn
- 119 Parkesbourne/Mummel Landscape Guardians Inc (plus nineteen attachments, a supplementary submission and a piece of additional information)
Response from Clean Energy Regulator
Response from Civil Aviation Safety Authority
Response from CSIRO
Response from NGH Environmental
Response from Dr Geoff Leventhall

Response from National Health and Medical Research Council
Response from NSW Government Department of Planning and Environment
Response from Professor Wayne Smith
Response from Goldwind
Response from South Australian Environment Protection Authority
Response from Pacific Hydro and The Acoustic Group
Response from Mr Ben Bateman
Response from Dr Norm Broner
Response from Emeritus Professor Bruce Armstrong
Response from NSW Government Planning Assessment Commission

- 120 Mr David Maughan (plus seven attachments)
- 121 Mr Bryan Matthews
- 122 Mrs Karen Wilson (plus an attachment)
- 123 Mr Kurt Gunter
- 124 Mr Tim Denniss
- 125 Mr Brian Cavagnino
- 126 Mr Darryl Boylan
- 127 Mr Simon Jarrett
- 128 New South Wales Landscape Guardians Inc
- 129 Mr Noah Kelk
- 130 Mrs Lee Schwerdtfeger (plus an attachment)
- 131 Mr Colin Mowbray
- 132 Mr Volker Schwerdtfeger
- 133 Dandenong Ranges Renewable Energy Association Inc
- 134 LIVE
- 135 Confidential
- 136 Wind Industry Reform Victoria Inc
- 137 Climate Realists of Five Dock
- 138 Mr and Mrs Larry and Val McLean (plus six attachments)
- 139 Mr Bruce Keen and Ms Heather Barker (plus two attachments)
- 140 Ms Cathy Ezard (plus five attachments)

-
- 141 Mr Bruce Key
- 142 Name Withheld (plus an attachment)
- 143 Dr Andrea Bunting
- 144 Ms Jane Robson
- 145 Mr John Dooley (plus five attachments)
- 146 Mr Robert McMurtry (plus eight attachments)
- 147 Carbon Sense Coalition (plus a supplementary submission)
- 148 Ms Felicity Crombach
- 149 Ms Elisa Ginty
- 150 Kristian Rodd
- 151 Mr Bill Gresham
- 152 Mrs Christine Jelbart
- 153 Flag Australia Inc
- 154 Ms Erin O'Donnell
- 155 Dr Bob Thorne (plus three attachments and two supplementary submissions)
- 156 Mr Harry Cossar-Gilbert
- 157 Mr Rupert Russell
- 158 Tablelands Regional Council
- 159 Mr Andre Kratzer
- 160 Surf Coast Air Action Inc
- 161 Ms Rosemary Howe
- 162 Ms Janine O'Keeffe
- 163 Ms Maria Linke
- 164 Name Withheld (plus an attachment)
- 165 Mr Colin Schaefer (plus an attachment)
- 166 Ms Maureen Pearl
- 167 Wind Prospect Pty Ltd

- 168** Mr Andrew Tune
- 169** Name Withheld
- 170** Mr James Miele
- 171** Mr Robert Money
- 172** Mr Andrew Laird
- 173** Trustpower Ltd
- 174** Climate Action Monaro
- 175** Grain Producers SA
- 176** Ararat Rural City Council
- 177** Ms Barbara Fraser
- 178** Confidential
- 179** Ms Marita Keenan
- 180** Mr Bruce Watkins
- 181** Ms Beverley Prescott
- 182** Mr Alwyn Roweth
- 183** Heartland Farmers Association (plus five attachments)
Response from Senvion Australia
- 184** Ms Jill Dumsday
- 185** Ms Suzanne Berry
- 186** Ms Margo Rees
- 187** Mr John Oldfield (plus a supplementary submission)
- 188** Cr Neil Rankine
- 189** Dr Malcolm Swinbanks
- 190** Voices of the Valley
- 191** Mr David Reynolds
- 192** Ms Jessica Vorreiter
- 193** Residents against Jupiter Wind Turbines Noise Subcommittee (plus four attachments)

-
- 194** Association of Australian Acoustical Consultants (plus a supplementary submission)
- 195** Ms Bernadette Janssen
- 196** Mr Andrew Reid
- 197** Mr Donald Thomas
Response from Acciona
- 198** Mr Gunther Wilhelm
- 199** Ms Joy Mettam
- 200** Ms Beverley McIntyre
- 201** Mr John Kaye
- 202** Mr Peter Fensham
- 203** Ms Jocelyn O'Neil
- 204** Mr Brian Kermond
- 205** Mr F. S. Hespe (plus two attachments)
- 206** Ms Melissa Ware (plus two attachments)
- 207** Australian Manufacturing Workers' Union
- 208** Mr and Mrs Andrew and Ann Gardner (plus three supplementary submissions, seven attachments and a piece of additional information)
Response from AGL
Response from Pacific Hydro
- 209** Mrs Helen Darbyshire
- 210** Mr Bernard Boatman
- 211** Mrs Joanne Kermond
- 212** Mr Hamish Officer
- 213** Mr John Benjamin (plus an attachment)
- 214** Mr Tony Edney
- 215** Ms Ellie Watts
- 216** Lynsey Ward
- 217** Mr Mark Glover (plus two attachments)

- 218 Mr Peter Senior
- 219 Mr Bradley Kermond (plus an attachment)
- 220 Confidential
- 221 Mr Dale Curtis
- 222 Confidential
- 223 Mr Mark McDonald (plus two attachments)
- 224 Gasfield Free Seaspray
- 225 Mr Colin Walkden
- 226 Springmount Primary Producers Rural Fire Brigade (plus a supplementary submission)
- 227 Bodangora Wind Turbine Awareness Group (plus nine attachments)
- 228 Mr Adrian Lyon
- 229 Mr Terry Conn
- 230 Tablelands Wind Turbine Action (plus an attachment)
- 231 Confidential
- 232 Friends of Collector Inc (plus an attachment)
- 233 Mr Craig Burton
- 234 Ms Melanie Chilianis
- 235 Mr and Mrs Greg and Patricia Hallam
- 236 Mr and Mrs John and Grace Gargan
- 237 Confidential
- 238 Mr Ian Parker
- 239 Mr Dave Heathcock and Ms Mandy Bridges
- 240 Mr James Vandepeer
- 241 Mr Charley Barber
- 242 Mr Andreas Marciniak
- 243 Mr Anthony Farrell and Ms Christine Schiansky

-
- 244 Ms Krista Watkins
- 245 Ms Belinda Wehl
- 246 Mr Brad Reynolds
- 247 Ms Nicki Morgan
- 248 Mr Peter Hooke and Ms Deborah Williams
- 249 Ms Regina Gleeson
- 250 Mr Hugh Venables
- 251 Crispin Trist
- 252 Holy Transfiguration Monastery
- 253 Pat Swords (plus two attachments)
- 254 Mr Steven Cooper
- 255 Ms Joan Selby Smith
- 256 Name Withheld
- 257 Mr Luke Foster
- 258 Mr John Lamarra
- 259 Mr Peter Lang (plus an attachment)
- 260 Mr Dennis Workman (plus three attachments)
- 261 CWP Renewables
- 262 Mr and Mrs David and Maureen Coleman (plus four attachments)
- 263 Mr Shane Papps
- 264 Friends of the Earth Adelaide
- 265 Mr Christopher Johnston
- 266 Mr and Mrs Andrew and Carmel Johnston
- 267 Ms Emma Bennett
- 268 Ms Clare Due
- 269 Mr Tony Power
- 270 Mr Peter Jelbart

- 271 CLIMARTE
- 272 Confidential
- 273 The Goulburn Group Inc
- 274 Yass Earth Movers
- 275 Name Withheld
- 276 Public Health Association of Australia (plus an attachment)
- 277 Mr Ketan Joshi
- 278 Ms Vivien de Rémy de Courcelles
- 279 Ms Geraldine Bagwell
- 280 Confidential
- 281 Mr Stephen Mitchell (plus two attachments)
Response from Clean Energy Regulator
- 282 Ms Lisa Hough
- 283 Mr John Langer
- 284 Mr Jack Laing
- 285 Mr and Mrs James and June Field
Response from Epuron
Response from Trustpower
- 286 Ms Emily Gayfer
- 287 Australian Conservation Foundation
- 288 Ms Ramona Headifen
- 289 Ms Abbey Lake
- 290 Ms Jennifer Disley (plus four attachments)
- 291 Mr Paul Judd
- 292 Confidential
- 293 Mr Alan McCormack
- 294 Acciona Energy Australia Global Pty Ltd
- 295 Dr Jacinta Morahan

-
- 296** Ms Prani Harrison
- 297** Mr Keith Altmann
- 298** Vestas Australian Wind Technology
- 299** Energy Supply Association of Australia
- 300** Ms Jacinta Conlon
- 301** Mr Richard Whitebrook
- 302** Committee for Portland
- 303** Ms Johanna Conlon
- 304** Environment Victoria
- 305** Confidential
- 306** Mr Mark Smith
- 307** Ms Morgana Russell
- 308** Mr and Mrs John and Margaret Emery and Charles and Lucy Knight
Response from Newtricity
- 309** Ms Anne Carroll
- 310** Drs Alan and Colleen Watts
- 311** Ms Virginia Trescowthick
- 312** Ms Megan Williams
- 313** Ms Bridget Gilmartin
- 314** Mr John McGrath
Response from Brett Lane and Associates Pty Ltd
Response from Epuron
Response from Goldwind
- 315** Mr Frank Forster
- 316** Dr Michael Crawford (plus four attachments and a supplementary submission)
Response from EPYC
Response from National Health and Medical Research Council
- 317** Ms Maree Williams
- 318** Ms Lucia McLean

- 319 Mr Adam Gray
- 320 Mr Malcolm Scott
- 321 Mr Bernie McComb, Ground Swell Bass Coast
- 322 Central NSW Renewable Energy Cooperative
- 323 Ms Fiona Wright
- 324 Ms Tegan Abbott
- 325 Ms Laura Gilmartin
- 326 Save the Eagles International
- 327 Ms Sophie Broughton-Cunningham
- 328 Mrs Judith Gayfer
- 329 Australian Youth Climate Coalition
- 330 Mr Hero Macdonald
- 331 Climate and Health Alliance (plus two attachments)
- 332 Mr David Formby
- 333 Mr Bob Hill
- 334 Name Withheld
- 335 EPURON
- 336 Ms Jenny Holcombe
- 337 Mr Rikki Nicholson
- 338 Name Withheld (plus two attachments)
Response from RATCH Australia Corporation
- 339 Stockyardhill Community Guardians
- 340 Councillor Marjorie Pagani
Response from RATCH Australia Corporation
- 341 Mr Parke Ewing
- 342 Ms Elizabeth Wilson
- 343 Mr Colin Gimaud
- 344 Dr Ursula Walsh (plus an attachment)

-
- 345 Australian Nursing and Midwifery Federation
- 346 Dr Joseph Buttery
- 347 Ms Emily Pritchard
- 348 Dr Joseph Wheatley
- 349 Flat Earth Institute
- 350 Mr Graham Williamson
Response from the Clean Energy Regulator
- 351 Ms Jan Perry
- 352 Mrs Lisa Dwyer (plus an attachment)
- 353 Mr Val Martin
- 354 Mr Mike Kenny, MetroCount
- 355 Mr Douglas Moir
- 356 Mrs Leonie Martin
- 357 Mr Claude Brasseur (plus two attachments)
- 358 Department of the Environment
- 359 Doctors for the Environment Australia
- 360 Mr Wentworth Hill
- 361 Ms Tania Neville and Mr Peter Stoops
- 362 Wildlife Preservation Society of Queensland
- 363 Ms Helen Lyon (plus four attachments)
- 364 Confidential
- 365 Mr Roderick Dean
- 366 General Electric
- 367 Mr Richard Paltridge (plus seven attachments)
- 368 Tarcowie Phosphate
- 369 Professor Simon Chapman AO (plus three attachments)
- 370 Mr John Middleton

- 371 Mr Barry and Mrs Denise O'Neill
Response from KJA
- 372 Association for Research of Renewable Energy in Australia
- 373 Name Withheld
- 374 Mrs Theresa Grima (plus four attachments)
- 375 Moorabool Shire Council
- 376 Name Withheld
- 377 Ms Colleen Towers
- 378 Name Withheld (plus three attachments)
Response from Brett Lane and Associates
- 379 Mr Geoff Leventhall
- 380 Ms Greta Gallandy-Jakobsen
- 381 Mr Rodney Stuart
- 382 Mr Noel Dean
Response from Acciona
Response from Pyrenees Shire Council
- 383 Confidential
- 384 Ms Barbara Ashbee (plus an attachment)
- 385 Mr Mauri Johansson (plus seven attachments and a supplementary submission)
- 386 Mr and Mrs Peter and Julie Brown
- 387 Mr Peter Mitchell (plus an attachment)
- 388 Mr Andrew Gabb (plus twelve attachments)
- 389 Mr Jim Litchfield
- 390 Mr and Mrs Greg and Michelle Noel
- 391 Mr Sam McGuinness
- 392 Mr and Mrs Mark and Rayleen Williams
- 393 Mr and Mrs Narelle and Alan Goodall
- 394 Ms Pamela Hawke
- 395 Name Withheld

-
- 396** Mr Norman Allan (plus three attachments and a supplementary submission)
- 397** Mr and Mrs Glenn and Joan Dennis
- 398** Ms Dorothy Newman
- 399** Mr and Mrs Tim and Susan Kosch
- 400** Hepburn Wind
- 401** Eastern Mt Lofty Ranges Landscape Guardians
- 402** RES Australia
- 403** Ms Pieta Farrell
- 404** Senvion Australia
- 405** Yorke Peninsula Wind Farm Project Pty Ltd (plus an attachment)
- 406** Australian Psychology Society
- 407** Mr Dave Southgate
- 408** Mr Richard Mann
- 409** Atkinson & Rapley Consulting (plus an attachment and a s upplementary submission)
- 410** Mr Robert Allen
- 411** Confidential
- 412** Wollar Progress Association
- 413** Queensland Government
- 414** Name Withheld
- 415** Mr Owain Rowland-Jones (plus two attachments)
- 416** Mr Kaj Bank Olesen (plus three attachments)
- 417** Mr Marc Amelinckx (plus an attachment)
- 418** Mr Richard Way
- 419** Pacific Hydro Pty Ltd
- 420** Mr Andrew Chapman
- 421** Ms Hiedi Clarke

- 422 Ms Wanda Allott
- 423 Friends of the Earth
- 424 Hydro Tasmania
- 425 Infigen
- 426 Mr Chris Luckock
- 427 Mr and Mrs Andy and Leanne Lamont
- 428 Mr Will Lynch
- 429 World Council for Nature
- 430 Mr Peter Molan
- 431 Mr Peter Coy
- 432 Mr and Mrs Vin and Donna Gedye
- 433 Woolnorth
- 434 Ms Debbie Brooks
- 435 Mr Nigel Sharp
- 436 Ms Sara Brown
- 437 Ms Jane Touzeau
- 438 Mr Peter Royal (plus an attachment)
- 439 North American Platform Against Wind Power (plus an attachment)
- 440 Mr Aidan Stanger
- 441 Mr Tony Walker
- 442 Union Fenosa Wind Australia
- 443 Australian Wind Alliance (plus two attachments)
- 444 Mr John Formby
- 445 Ms Mourilyan F Nicholls
- 446 Mr Shane Mortimer
- 447 Australian Industrial Wind Turbine Awareness Network
- 448 Australian Environment Foundation

-
- 449 Wind Energy Queensland (plus eight attachments)
- 450 Clean Energy Council (plus nine attachments and a supplementary submission)
- 451 Flyers Creek Wind Turbine Awareness Group Inc (plus eleven attachments)
- 452 Confidential
- 453 Confidential
- 454 Mrs Tracey Hopkins
- 455 Noise Watch Australia Inc
- 456 Ms Sonia Trist (plus an attachment)
Response from Pacific Hydro
- 457 Ms Megan Briggs
- 458 Name Withheld (plus twenty one attachments)
Response from RATCH Australia Corporation
- 459 Mrs Lee Schwerdtfeger (plus sixteen attachments)
- 460 Moyne Shire Council (plus six attachments)
- 461 Confidential
- 462 Australian Centre for Environmental Law, Australian National University
College of Law
- 463 Community for the Accurate Impact Assessment of the Dalton Power Station
Response from AGL
- 464 Mrs Mary Morris (plus nineteen attachments and a supplementary submission)
Response from South Australian Environment Protection Authority
- 465 Confidential
- 466 Department of Fire and Emergency Services Western Australia
- 467 Ms Lilli-Ann Green
- 468 StarCore Nuclear
- 469 Australian Energy Market Operator
- 470 Mrs Samantha Stepnell (plus eight attachments)
Response from Acciona
Response from Pacific Hydro
- 471 Confidential

- 472 Ms Marjorie Cross
- 473 Mr Greg Wilkins
- 474 Ms Robin Gardner
- 475 Ms Angela McFeeters
- 476 Mr Igor Sekatski
- 477 Mr Carey Wakeley
- 478 Ms Chloe Franke
- 479 Mr Gordon Monsbourgh
- 480 Mr Rob Tozer
- 481 Mr John Knox
- 482 Mr Christopher Rathjen
- 483 Mr Craig Douglas
- 484 Ms Rachel Craig
- 485 Mr Jeremy Maddox
- 486 Mr Patrick Bradbery
- 487 Mr Gavin Cerini
- 488 Ms Meredith Debens
- 489 Mr David Osmond
- 490 Sam Fyfield
- 491 Confidential

Additional Information

- 1 Letter from the NSW Government Department of Planning and Environment to Mr Alwyn Roweth, received 20 March 2015
- 2 Evaluation of Secondary Windshield Designs for Outdoor Measurement of Low Frequency Noise and Infrasound, paper by Kristy Hansen, Branko

-
- Zajamsek and Colin Hansen, from Mr Steven Cooper, received 1 April 2015
- 3 Review of NACA 0012 Turbulent Trailing Edge Noise Data at Zero Angle of Attack, paper by Con Doolan and Danielle Moreau, from Mr Steven Cooper, received 1 April 2015
 - 4 Comparison of the noise levels measured in the vicinity of a wind farm for shutdown and operational conditions, paper by Kristy Hansen, Branko Zajamsek and Colin Hansen, from Mr Steven Cooper, received 1 April 2015
 - 5 Investigation of the time dependent nature of infrasound measured near a wind farm, paper by Branko Zajamsek, Kristy Hansen and Colin Hansen, from Mr Steven Cooper, received 1 April 2015
 - 6 Noise Monitoring in the Vicinity of the Waterloo Wind Farm, paper by Kristy Hansen, Branko Zajamsek and Colin Hansen, from Mr Steven Cooper, received 1 April 2015
 - 7 Letter to the Department of Health, by Colin Hansen, from Mr Steven Cooper, received 1 April 2015
 - 8 Analysis of Unweighted Low Frequency Noise and Infrasound Measured at a Residence in the Vicinity of a Wind Farm, paper by Kristy Hansen, Branko Zajamsek and Colin Hansen, from Mr Steven Cooper, received 1 April 2015
 - 9 A Primer on Noise report, from Mr Steven Cooper, received 1 April 2015
 - 10 Analysis, Modeling, and Prediction of Infrasound and Low Frequency Noise from Wind Turbine Installation, Phase 1: PEI Site Final Report, from Mr Steven Cooper, received 1 April 2015
 - 11 Analysis, Modeling, and Prediction of Infrasound and Low Frequency Noise from Wind Turbine Installation, Phase 2: Southern Ontario Site Final Report, from Mr Steven Cooper, received 1 April 2015
 - 12 A Cooperative Measurement Survey and Analysis of Low Frequency and Infrasound at the Shirley Wind Farm in Brown County Wisconsin, from Mr Steven Cooper, received 1 April 2015
 - 13 Letter from the Victorian Government Department of Environment, Land, Water and Planning, received 25 March 2015
 - 14 Information on lambing percentages, from Bill and Sandy Rogerson, received 7 April 2015
 - 15 Response to adverse comments made at Portland public hearing 30 March

- 2015, from Pacific Hydro, received 24 April 2015
- 16 Comment on AMA Position Statement, from Mr Geoff McPherson, received 18 May 2015
 - 17 The Inconsistent Acceptance of Industrial Wind Turbine Impacts, presentation, from Mr Geoff McPherson, received 18 May 2015
 - 18 Repeated elicitation of the acoustic startle reflex leads to sensitisation in subsequent avoidance behaviour and induces fear conditioning, research article, 2011, from Mr Geoff McPherson, received 18 May 2015
 - 19 Analysis of aerodynamic sound noise generated by a large-scaled wind turbine and its physiological evaluation, original paper, 2015, from Mr Geoff McPherson, received 18 May 2015
 - 20 Preliminary studies on the reaction of growing geese to the proximity of wind turbines, original article, 2013, from Mr Geoff McPherson, received 18 May 2015
 - 21 A theory to explain some physiological effects of the infrasonic emissions at some wind farm sites, article, 2015, from Mr Geoff McPherson, received 18 May 2015
 - 22 NSW Government: Renewable Energy Action Plan, from the Australian Wind Alliance, received 19 May 2015
 - 23 NSW Government Department of Planning and Infrastructure: Draft Planning Guidelines, Wind Farms, December 2011, from the Australian Wind Alliance, received 19 May 2015
 - 24 Information about the recent International Wind Turbine Noise Conference in Glasgow, from Paul Miskelly, received 6 May 2015
 - 25 The effect of wind turbine noise on sleep and quality of life: A systematic review and meta-analysis of observational studies, Environment International article, from Dr Christopher Hanning, received 19 May 2015
 - 26 Noise and Health, A Bi-monthly Inter-disciplinary International Journal, September-October 2012, from Dr Christopher Hanning, received 19 May 2015
 - 27 Not For Greens, He who sups with the devil should have a long spoon, publication, from Emeritus Professor Ian Plimer, received 3 May 2015
 - 28 Response to adverse comments made in submissions and at the Portland public hearing 30 March 2015, from AGL Energy, received 14 May 2015
 - 29 Letter regarding hearing tests, from Mr Crispin Trist, received 2 June 2015

-
- 30 National Recovery Plan for the Southern Bent-wing Bat, from Jackie Rovensky, received 4 June 2015
 - 31 Yorke Peninsula Council's submission to the Development Assessment Commission, and further correspondence, from Heartland Farmers Association, received 10 June 2015
 - 32 Property finance letter, from Mr David Mortimer, received 10 June 2015
 - 33 Submissions to the Planning Assessment Commission, from Ms Rosemary Howe, received 19 June 2015
 - 34 Report, The Perception and Effect of Wind Farm Noise at Two Victorian Wind Farms, An Objective Assessment, June 2012, from Mr Noel Dean, received 23 June 2015
 - 35 Opening statement, from Dr Michael Crawford, received 30 June 2015
 - 36 Submission to the NSW Minister for Planning, from Dr Michael Crawford, received 30 June 2015
 - 37 Information about property devaluation in the area of the proposed Flyers Creek Wind Farm, from Ms Patina Schneider, received 4 July 2015
 - 38 Graph, from Dr Malcolm Swinbanks, received 10 July 2015
 - 39 Information regarding vibration and its impact on sleep disturbance, from Ms Sarah Laurie, received 13 July 2015

Answers to Questions on Notice

- 1 Answers to Questions taken on Notice during 30 March public hearing, received from Victorian Country Fire Authority, 30 March 2015
- 2 Answers to Questions taken on Notice during 30 March public hearing, received from Victorian Country Fire Authority, 1 April 2015
- 3 Answers to Questions taken on Notice during 30 March public hearing, received from Pyrenees Shire Council, 7 April 2015
- 4 Answers to Questions taken on Notice during 30 March public hearing, received from Glenelg Shire Council, 16 April 2015
- 5 Answers to Questions taken on Notice during 30 March public hearing, received from Keith Staff, 22 April 2015

- 6 Answers to Questions taken on Notice during 30 March public hearing, received from Glenelg Shire Council, 12 June 2015
- 7 Answers to Questions taken on Notice during 30 March public hearing, received from Victorian Country Fire Authority, 22 June 2015
- 8 Answers to Questions taken on Notice during 30 March public hearing, received from Keppel Prince Engineering, 26 June 2015
- 9 Answers to Questions taken on Notice during 30 March public hearing, received from Pyrenees Shire Council, 30 June 2015
- 10 Answers to Questions taken on Notice during 30 March public hearing, received from Pacific Hydro, 30 June 2015
- 11 Answers to Questions taken on Notice during 30 March public hearing, received from Steven Cooper, 1 July 2015
- 12 Response to adverse comments in Steven Cooper's answers to questions on notice, received from Association of Australian Acoustical Consultants, 2 August 2015
- 13 Answers to Questions taken on Notice during 18 May public hearing, received from Carbon Sense Coalition, 23 May 2015
- 14 Answers to Questions taken on Notice during 18 May public hearing, received from Robert Thorne, 12 June 2015
- 15 Answers to Questions taken on Notice during 18 May public hearing, received from RATCH-Australia Corporation, 16 June 2015
- 16 Answers to Questions taken on Notice during 18 May public hearing, received from Robert Thorne, 20 June 2015
- 17 Answers to Questions taken on Notice during 18 May public hearing, received from Queensland Government Department of Infrastructure, Local Government and Planning, 25 June 2015
- 18 Answers to Questions taken on Notice during 19 May public hearing, received from Infigen, 28 May 2015
- 19 Answers to Questions taken on Notice during 19 May public hearing, received from Public Health Association of Australia, 31 May 2015
- 20 Answers to Questions taken on Notice during 19 May public hearing, received from CSIRO, 1 June 2015
- 21 Answers to Questions taken on Notice during 19 May public hearing, received from Australian Wind Alliance, 2 June 2015

-
- 22 Answers to Questions taken on Notice during 19 May public hearing, received from Regulation Economics, 9 June 2015
 - 23 Answers to Questions taken on Notice during 19 May public hearing, received from Kim Forde, 10 June 2015
 - 24 Answers to Questions taken on Notice during 19 May public hearing, received from Clean Energy Regulator, 10 June 2015
 - 25 Answers to Questions taken on Notice during 19 May public hearing, received from Civil Aviation Safety Authority, 12 June 2015
 - 26 Answers to Questions taken on Notice during 19 May public hearing, received from Clean Energy Regulator, 12 June 2015
 - 27 Answers to Questions taken on Notice during 19 May public hearing, received from Andrew Bell, 14 June 2015
 - 28 Answers to Questions taken on Notice during 19 May public hearing, received from Christopher Hanning, 15 June 2015
 - 29 Answers to Questions taken on Notice during 19 May public hearing, received from Peter Lang, 15 June 2015
 - 30 Answers to Questions taken on Notice during 19 May public hearing, received from Clean Energy Regulator, 15 June 2015
 - 31 Answers to Questions taken on Notice during 19 May public hearing, received from Public Health Association of Australia, 15 June 2015
 - 32 Answers to Questions taken on Notice during 19 May public hearing, received from CSIRO, 16 June 2015
 - 33 Answers to Questions taken on Notice during 19 May public hearing, received from AGL Energy, 19 June 2015
 - 34 Answers to Questions taken on Notice during 19 May public hearing, received from Australian Wind Alliance, 7 July 2015
 - 35 Answers to Questions taken on Notice during 9 June public hearing, received from Brolga Recovery Group, 14 June 2015
 - 36 Answers to Questions taken on Notice during 9 June public hearing, received from Brolga Recovery Group, 14 June 2015
 - 37 Answers to Questions taken on Notice during 9 June public hearing, received from Municipal Association of Victoria, 23 June 2015
 - 38 Answers to Questions taken on Notice during 9 June public hearing, received from Moyne Shire Council, 3 July 2015

- 39 Answers to Questions taken on Notice during 9 June public hearing, received from Les Huson, 6 July 2015
- 40 Answers to Questions taken on Notice during 9 June public hearing, received from Moyne Shire Council, 8 July 2015
- 41 Answers to Questions taken on Notice during 9 June public hearing, received from Samantha Stepnell, 9 July 2015
- 42 Answers to Questions taken on Notice during 9 June public hearing, received from Tarwin Valley Coastal Guardians Inc, 10 July 2015
- 43 Answers to Questions taken on Notice during 9 June public hearing, received from Wind Industry Reform Victoria Inc, 11 July 2015
- 44 Answers to Questions taken on Notice during 9 June public hearing, received from Vestas Australian Wind Technology, 13 July 2015
- 45 Answers to Questions taken on Notice during 9 June public hearing, received from Hepburn Wind, 14 July 2015
- 46 Answers to Questions taken on Notice during 9 June public hearing, received from Emma Bennett, 16 July 2015
- 47 Answers to Questions taken on Notice during 9 June public hearing, received from David Iser, 16 July 2015
- 48 Answers to Questions taken on Notice during 9 June public hearing, received from Victorian Department of Environment, Land, Water and Planning, 17 July 2015
- 49 Answers to Questions taken on Notice during 9 June public hearing, received from Les Huson, 17 July 2015
- 50 Answers to Questions taken on Notice during 9 June public hearing, received from Moyne Shire Council, 20 July 2015
- 51 Answers to Questions taken on Notice during 9 June public hearing, received from Clean Energy Council, 24 July 2015
- 52 Answers to Questions taken on Notice during 9 June public hearing, received from Victorian Department of Environment, Land, Water and Planning, 28 July 2015
- 53 Answers to Questions taken on Notice during 10 June public hearing, received from Paddy Phillips, 16 June 2015
- 54 Answers to Questions taken on Notice during 10 June public hearing, received from Waterloo and District Concerned Citizens Group, 23 June 2015

-
- 55 Answers to Questions taken on Notice during 10 June public hearing, received from Waterloo and District Concerned Citizens Group, 27 June 2015
- 56 Answers to Questions taken on Notice during 10 June public hearing, received from Trustpower, 2 July 2015
- 57 Answers to Questions taken on Notice during 10 June public hearing, received from Noise Watch Australia, 3 July 2015
- 58 Answers to Questions taken on Notice during 10 June public hearing, received from Trustpower, 22 July 2015
- 59 Answers to Questions taken on Notice during 10 June public hearing, received from Grain Producers SA, 27 July 2015
- 60 Answers to Questions taken on Notice during 10 June public hearing, received from Australian Association of Acoustical Consultants, 28 July 2015
- 61 Answers to Questions taken on Notice during 19 June public hearing, received from National Health and Medical Research Council, 10 July 2015
- 62 Answers to Questions taken on Notice during 19 June public hearing, received from Fiona Crichton, 28 July 2015
- 63 Answers to Questions taken on Notice during 23 June public hearing, received from Geoff Leventhall, 27 July 2015
- 64 Answers to Questions taken on Notice during 29 June public hearing, received from Frontier Economics, 13 July 2015
- 65 Answers to Questions taken on Notice during 29 June public hearing, received from Senvion Australia, 15 July 2015
- 66 Answers to Questions taken on Notice during 29 June public hearing, received from Simon Chapman, 28 July 2015
- 67 Answers to Questions taken on Notice during 29 June public hearing, received from Senvion Australia, 28 July 2015
- 68 Answers to Questions taken on Notice during 29 June public hearing, received from Norm Broner, 7 July 2015
- 69 Answers to Questions taken on Notice during 19 May public hearing, received from Department of the Environment, 30 July 2015
- 70 Answers to Questions taken on Notice during 19 June public hearing, received from National Health and Medical Research Council, 30 July 2015

- 71 Answers to Questions taken on Notice during 19 June public hearing, received from Bruce Rapley, 31 July 2015
- 72 Answers to Questions taken on Notice during 23 June public hearing, received from Geoff Leventhall, 27 July 2015
- 73 Response to adverse comments in Geoff Leventhall's answers to questions on notice, received from Sarah Laurie, Waubra Foundation, 31 July 2015
- 74 Answers to Questions taken on Notice during 23 June public hearing, received from Malcolm Swinbanks, 29 July 2015
- 75 Answers to Questions taken on Notice during 29 June public hearing, received from Simon Chapman, 27 July 2015
- 76 Response to adverse comments in Simon Chapman's answers to questions on notice, received from Ann Gardner, 30 July 2015
- 77 Answers to Questions taken on Notice during 29 June public hearing, received from South Australian Environment Protection Authority, 31 July 2015
- 78 Answers to Questions taken on Notice during 29 June public hearing, received from South Australian Environment Protection Authority, 31 July 2015
- 79 Answers to Questions taken on Notice during 29 June public hearing, received from Bob McMurtry, 1 August 2015
- 80 Answers to written Questions on Notice, received from Vestas Australian Wind Technology, 26 June 2015
- 81 Answers to written Questions on Notice, received from Australian Medical Association, 16 July 2015
- 82 Answers to Questions taken on Notice during 30 March public hearing, received from Steven Cooper, 20 April 2015

Tabled Documents

- 1 Opening statement, tabled by Bill Rogerson, at Portland public hearing 30 March 2015
- 2 Opening statement, tabled by Robin Pollard, at Portland public hearing 30

March 2015

- 3 Opening statement, tabled by Ann Gardner, at Portland public hearing 30 March 2015
- 4 Email to Ann Gardner from AGL Energy, tabled by Ann Gardner, at Portland public hearing 30 March 2015
- 5 Opening statement, tabled by Jan Hetherington, at Portland public hearing 30 March 2015
- 6 Opening statement, tabled by Hamish Cumming, at Portland public hearing 30 March 2015
- 7 Letter to the Editor from AGL, tabled by Senator Urquhart, at Portland public hearing 30 March 2015
- 8 Photos of Rangeview site, tabled by Senator Canavan, at Cairns public hearing 18 May 2015
- 9 Correspondence relating to Windy Hill, tabled by Tablelands Regional Council, at Cairns public hearing 18 May 2015
- 10 Opening Statement, tabled by Dr Andrew Bell, at Canberra public hearing 19 May 2015
- 11 Victorian Department of Planning and Community Development: Advice to Minister for Planning – Waubra Wind Farm Noise Compliance, 6 December 2010, tabled by Senator Madigan, at Canberra public hearing 19 May 2015
- 12 Correspondence from Victorian Minister for Planning to Mr Brett Wickham, Director – Generation, Pyrenees Wind Farm Development Pty Ltd, dated 10 December 2010, tabled by Senator Madigan, at Canberra public hearing 19 May 2015
- 13 Victorian Department of Planning and Community Development: Advice to Minister for Planning – Waubra Wind Farm, Permit Compliance, 22 August 2011, tabled by Senator Madigan, at Canberra public hearing 19 May 2015
- 14 Correspondence from Victorian Minister for Planning to Mr Brett Wickham, Pyrenees Wind Farm Development Pty Ltd, Waubra Wind Farm Development, Permit Compliance, dated 15 September 2011, tabled by Senator Madigan, at Canberra public hearing 19 May 2015
- 15 Extracts from Australian Government, Office of the Renewable Energy Regulator, Annual Electricity Generation Returns: 2010, 2011 and 2012, tabled by Senator Madigan, at Canberra public hearing 19 May 2015
- 16 Australian Securities and Investments Commission, Current Company

- Extract, Mount Emerald Wind Farm Pty Ltd, 18 May 2015, AEST 09:36:41 AM, tabled by Senator Canavan, at Canberra public hearing 19 May 2015
- 17 Opening Statement, tabled by Australian Wind Alliance, at Canberra public hearing 19 May 2015
 - 18 NSW Farmers, Wind Farm Guide for host landholders, tabled by Australian Wind Alliance, at Canberra public hearing 19 May 2015
 - 19 Community Engagement Guidelines for the Australian Wind Industry, tabled by Clean Energy Council, at Melbourne public hearing 9 June 2015
 - 20 Wind Farms A Guide for Communities, tabled by Clean Energy Council, at Melbourne public hearing 9 June 2015
 - 21 Victoria's planning regulations, tabled by Victorian Department of Environment, Land, Water and Planning, at Melbourne public hearing 9 June 2015
 - 22 A Summary and Comparison of Bird Mortality from Anthropogenic Causes with an Emphasis on Collisions, article by Wallace Erickson, Gregory Johnson and David Young Jr., tabled by Emma Bennett, at Melbourne public hearing 9 June 2015
 - 23 Preliminary Methodology to Assess the National and Regional Impact of U.S. Wind Energy Development on Birds and Bats, USGS Scientific Investigations Report 2015-5066, tabled by Emma Bennett, at Melbourne public hearing 9 June 2015
 - 24 Information on brolga breeding site buffers, tabled by Brolga Recovery Group, at Melbourne public hearing 9 June 2015
 - 25 Brolga information sheet and maps, tabled by Brolga Recovery Group, at Melbourne public hearing 9 June 2015
 - 26 Email correspondence between Les Huson and the CTBTO in Vienna, tabled by Les Huson, at Melbourne public hearing 9 June 2015
 - 27 Email correspondence between Les Huson and Hepburn Wind, tabled by Les Huson, at Melbourne public hearing 9 June 2015
 - 28 Opening Statement, tabled by Rikki Nicholson, at Melbourne public hearing 9 June 2015
 - 29 Correspondence relating to Cherry Tree Wind Farm Inc, tabled by Tim Brew, at Melbourne public hearing 9 June 2015
 - 30 Opening Statement, tabled by Tim Brew, at Melbourne public hearing 9 June 2015

-
- 31 Speaking notes, tabled by Grain Producers SA, at Adelaide public hearing 10 June 2015
 - 32 SA EPA South East Site Graphs Waterloo Study 2013, tabled by Mary Morris, at Adelaide public hearing 10 June 2015
 - 33 Lease agreement letter, tabled by Clive and Trina Gare, at Adelaide public hearing 10 June 2015
 - 34 Memorandum of lease, tabled by Clive and Trina Gare, at Adelaide public hearing 10 June 2015
 - 35 Information and graph relating to wind energy production during 30 September 2014, tabled by Jacqueline Rovensky, at Adelaide public hearing 10 June 2015
 - 36 Wind performance on Eastern Grid at approximate South Australian time indicated, tabled by Jacqueline Rovensky, at Adelaide public hearing 10 June 2015
 - 37 List of proposed Australian wind energy projects, as of December 2005, tabled by Jacqueline Rovensky, at Adelaide public hearing 10 June 2015
 - 38 Graph showing the National grid wind energy production during 7 June 2015, tabled by Jacqueline Rovensky, at Adelaide public hearing 10 June 2015
 - 39 Graph showing the South Australian wind energy production during 7 June 2015, tabled by Jacqueline Rovensky, at Adelaide public hearing 10 June 2015
 - 40 Opening Statement, tabled by Fiona Crichton, at Canberra public hearing 19 June 2015
 - 41 Opening Statement, tabled by Bruce Rapley, at Canberra public hearing 19 June 2015
 - 42 Presentation, tabled by Charley Barber and Rosemary Howe, at Canberra public hearing 19 June 2015
 - 43 Letter from NSW EPA to Mr and Mrs Grima relating to infrasound/low frequency noise, tabled by Theresa Grima, at Sydney public hearing 29 June 2015
 - 44 Speaking notes, CV and information, tabled by Peter Rae AO, at Sydney public hearing 29 June 2015
 - 45 Renewables 2015 Global Status Report, Key Findings, tabled by Peter Rae AO, at Sydney public hearing 29 June 2015

- 46** Renewables 2015 Global Status Report, tabled by Peter Rae AO, at Sydney public hearing 29 June 2015

Correspondence

- 1** Correspondence clarifying evidence given at Portland public hearing on 30 March, from Ararat Rural City Council, received 16 April 2015
- 2** Correspondence clarifying evidence given at Portland public hearing on 30 March, from Ann Gardner, received 27 April 2015
- 3** Letter regarding comments made by a RATCH employee at the committee's public hearing in Cairns, from RATCH Australia Corporation, received 19 May 2015
- 4** Correspondence clarifying evidence given at Canberra public hearing on 19 May, from Peter Lang, received 26 May 2015
- 5** Correspondence to correct a misquote/misunderstanding of evidence given at Canberra public hearing on 19 May, from Peter Lang, received 26 May 2015
- 6** Correspondence providing supplementary evidence to that given at Sydney public hearing on 29 June, from Association for Research of Renewable Energy in Australia, received 7 July 2015
- 7** Correspondence providing supplementary evidence to that given at Sydney public hearing on 29 June, from Peter Rae, received 17 July 2015
- 8** Correspondence clarifying evidence given at Sydney public hearing on 29 June, from Parkesbourne/Mummel Landscape Guardians Inc, received 28 July 2015
- 9** Correspondence clarifying evidence given at Melbourne public hearing on 9 June, from Tarwin Valley Coastal Guardians Inc, received 29 July 2015

APPENDIX 2

Public hearings

Monday, 30 March 2015

South West Institute of TAFE, Portland

Witnesses

The Acoustic Group Pty Ltd

COOPER, Mr Steven, Principal Engineer

Pacific Hydro Pty Ltd

RICHARDS, Mr Andrew, Executive Manager, External Affairs

Keppel Prince Engineering

McKINNA, Mr Daniel, Assistant General Manager

WILSON, Councillor Gilbert, Private capacity

DIAZ, Miss Trinidad (Trini), Private capacity

MILLS, Mr David, Private capacity

Australian Manufacturing Workers Union

KELLY, Mr Craig, Assistant State Secretary

Glenelg Shire Council

BURGOYNE, Mr Greg, Chief Executive Officer

BERRY, Mr Matthew, Planning Manager

KERRIGAN, Mr Stephen, Group Manager, Planning and Economic Development

Ararat Rural City Council

HOOPER, Councillor Paul, Mayor

Pyrenees Shire Council

NOLAN, Mr James, Chief Executive Officer

HALL, Mr Christopher, Senior Town Planner

Country Fire Authority

ANDREOU, Mr Andrew, Executive Manager, Community Infrastructure

BROWNLIE, Mr Craig, Operations Officer, Specialist Response

ROGERSON, Mr Bill, Private capacity

ROGERSON, Mrs Sandy, Private capacity

POLLARD, Mr John, Private capacity

POLLARD, Mrs Robin, Private capacity

STAFF, Mr Keith, President, Southern Grampians Landscape Guardians

HETHERINGTON, Mrs Janet, Private capacity

CUMMING, Mr Hamish, Private capacity

EZARD, Ms Catherine, Private capacity

GARDNER, Mrs Ann, Private capacity

DARBYSHIRE, Mrs Helen, Private capacity

BARRETT, Mr Wayne, Private capacity

MACONACHIE, Mr Graeme, Private capacity

OFFICER, Mr Hamish, Private capacity

BOATMAN, Mr Bernard, Private capacity

ALLGOOD, Ms Gwenda, Private capacity

DENNIS, Ms Susan, Private capacity

GABB, Mr Andrew, Past President, Stockyard Hill Community Guardians

JELBART, Mr Peter, Private capacity

JELBART, Mr Ron, Private capacity

LYON, Mr Adrian, Private capacity

MARKULEV, Ms Christine, Private capacity

McMAHON, Mr John, President, Wind Industry Reform Victoria

MORTIMER, Mr David, Private capacity

NICHOLSON, Mr Rikkie, Private capacity

SAUNDERS, Mr Steven, Traditional Owner (Cape Bridgewater)

Monday, 18 May 2015

Rydges Esplanade Resort, Cairns

Witnesses

RATCH-Australia Corporation Ltd

GREENACRE, Mr Simon Espie, General Counsel and Company Secretary

NANGIA, Mr Anil, General Manager, Business

HALLENSTEIN, Mr Joseph, Project Development Manager

JOHANNESSEN, Mr Terry James, Project Development Manager

FINNEY, Mr David Hubert, Technical Director, RPS Group

DALTON, Mr Owen Leslie, Principal, Planning, RPS Australia Asia-Pacific

Ergon Energy

ALLEN, Ms Sophie, Pre-Contracts Manager

EDMUNDS, Mr David, EGM Network Optimisation

Queensland Department of Infrastructure, Local Government and Planning

CHEMELLO, Mr Gregory John, Deputy Director-General, Planning Group and

General Manager, Economic Development Queensland

Tablelands Regional Council

PAGANI, Ms Marjorie Elizabeth, Division 6 Councillor

PATTISON, Mr Peter, Senior Planner

McPHERSON, Mr Geoff, Private capacity

THORNE, Dr Robert, Private capacity

Carbon Sense Coalition

FORBES, Mr Vivian Richard, Chairman

WALKDEN, Mr Colin, Private capacity

WATKINS, Ms Krista, Private Capacity

LYONS, Mr Michael, Wind Energy Queensland

HEWITT-STUBBS, Ms Susan, Private Capacity

McAULIFFE, Mr Jeremiah, Private Capacity

LYONS, Mr Bryan, Wind Energy Queensland

MARTIN, Mr Stephen, Private Capacity

REYNOLDS, Mr David, Private Capacity

GARGAN, Mr John, Private Capacity

SCHWERDTFEGER, Mrs Lee, Private Capacity

ALLWOOD, Mr Trevor, Private Capacity

McGUIRE, Dr Geraldine, Private Capacity

Tuesday, 19 May 2015

Parliament House, Canberra

Witnesses

Clean Energy Regulator

MUNRO, Ms Chloe, Chair; Chief Executive Officer

PURVIS-SMITH, Mr Geoff, General Counsel

RATHORE, Mr Amar Singh, General Manager, Renewables and Carbon Farming
Division

WILLIAMSON, Mr Mark, Acting Executive General Manager, Renewables and
Carbon Farming Division

Department of the Environment

ARCHER, Mr Brad, First Assistant Secretary, Climate Change and Renewable Energy Division

KNUDSON, Mr Dean, First Assistant Secretary, Policy, Environment Assessment and Compliance Division

TREGURTHA, Mr James, Assistant Secretary, Policy and Reform Branch, Environment Assessment and Compliance Division

BELL, Dr James Andrew, Private capacity**Regulation Economics**

MORAN, Dr Alan John, Chief Executive Officer

The Australia Institute

CAMPBELL, Mr Roderick Edward Stuart, Research Director

Civil Aviation Safety Authority

CROMARTY, Mr Peter, Executive Manager Airspace and Aerodrome Regulation

FARQUHARSON, Mr Terry, Deputy Director, Aviation Safety

HUTSON, Mr James Henry, Private capacity**Public Health Association of Australia**

TAIT, Dr Peter William, Convenor, Ecology and Environment Special Interest Group

WALKER, Ms Melanie Jayne, Acting Chief Executive Officer

Commonwealth Scientific and Industrial Research Organisation

HALL, Dr Nina, Senior Social Scientist, Land and Water

SMITHAM, Dr Jim, Deputy Director, Energy

Australian Wind Alliance

BRAY, Mr Andrew Phillip, National Coordinator

PRELL, Mr Charlie, New South Wales Regional Coordinator

de GROOTE, Mr John, Engineering Manager, Divall's Earthmoving and Bulk Haulage

LANG, Mr Peter, Private capacity**AGL Energy Ltd**

JACKSON, Mr Doug, Executive General Manager, Group Operations

SPREE, Mr David, Manager, Government Affairs

TROMPF, Mr Jeff, Head of Renewables

Infigen Energy

UPSON, Mr Jonathon, Senior Development and Government Affairs Manager

MORTIMER, Mr Shane John, Elder, Guumaal-Ngambri People

WHEATLEY, Dr Joseph, Private capacity

FORDE, Mrs Kim Anne, Private capacity

HANNING, Dr Christopher Douglas, Private capacity

Tuesday, 9 June 2015

Monash Conference Centre, Melbourne

Witnesses**Clean Energy Council**

THORNTON, Mr Kane, Chief Executive

WEBB, Ms Alicia, Senior Policy Adviser

Victorian Department of Environment, Land, Water and Planning

GINIVAN, Mr John, Executive Director, Planning and Building Systems

Victorian Environment Protection Authority

WILKINSON, Dr Cathy Wilkinson, Executive Director, Knowledge Standards and Assessments

DEAN, Mr Noel Lindsay, Private capacity

THOMAS, Mr Donald Robert, Private capacity

STEPNELL, Mr Carl Peter, Private capacity

STEPNELL, Mrs Samantha Leah, Private capacity

MITCHELL, Mr Peter Richard, Private capacity

GODFREY, Ms Trish, Private capacity

Hepburn Wind

PERRY, Dr David, Chair

Vestas Australian Wind Technology

McALPINE, Mr Ken Andrew, Special Advisor, Public Affairs

NIELSEN, Mr Danny Gath, Managing Director

BENNETT, Ms Emma Michelle, Private capacity**Brolga Recovery Group**

DENNIS, Mrs Susan Jane, President

Moyne Shire Council

ASKEW-THORNTON, Ms Vicki, Major Projects Liaison and Economic Development Officer

GRAINGER, Mrs Michelle, Manager Planning

Municipal Association of Victoria

DUNN, Ms Claire, Environment Manager

HATELY, Mr Gareth, Manager of Planning

HUSON, Mr William Leslie, Private capacity**Wind Industry Reform Victoria Inc.**

McMAHON, Mr John, President

Tarwin Valley Coastal Guardians Inc.

FAIRBROTHER, Mr Don, Member

JELBART, Mr Donald, President

WRAGG, Ms Cheryl, Advocate and Researcher

BREW, Mr Tim, Private capacity**DEAN, Mrs Suzanne, Private capacity****ISER, Dr David James, Private capacity****KEARNS, Mr Francis X, private capacity****KEARNS, Mrs Angela, Private capacity****MITCHELL, Mr Stephen, Private capacity**

NICHOLSON, Mr Rikki, Private capacity

ROBERTS, Mr Richard, Private capacity

STARK, Dr Elizabeth, Private capacity

Wednesday, 10 June 2015

Stamford Plaza Hotel, Adelaide

Witnesses

Association of Australian Acoustical Consultants

COOPER, Mr Jonathan, Associate Director, Resonate Acoustics, member firm of the Association of Australian Acoustical Consultants; and representative of the Wind Farm Subcommittee

DELAIRE, Mr Christophe, Representative, Marshall Day Acoustics, member firm of the Association of Australian Acoustical Consultants; and representative of the Wind Farm Subcommittee

TONIN, Dr Renzo, Representative of the Wind Farm Subcommittee of the Association of Australian Acoustical Consultants

TURNBULL, Mr Christopher, Director, Sonus; and Chair, Wind Farm Subcommittee of the Association of Australian Acoustical Consultants

Trustpower Limited

DELMARTER, Mr Clayton Douglas, Engineering Manager

VAN ZYL, Mr Rontheo, Wind Generation Development Manager

Regional Council of Goyder

MATTEY, Councillor Peter, Mayor

Noise Watch Australia Inc

GOLAND, Mr Gary, Public Officer

PHILLIPS, Professor Paddy, Chief Medical Officer and Acting Chief Public Health Officer, SA Health

Grain Producers SA

ARNEY, Mr Darren Grant, Chief Executive Officer

HUCZKO, Mrs Trudy, Policy Officer

HANSEN, Emeritus Professor Colin Henry

Waterloo and District Concerned Citizens Group

FAINT, Mr John, Chair

QUAST, Mrs Julie Ann, Secretary

MORRIS, Mrs Mary Louise, Private capacity

SCHAEFER, Mr Colin Russell, Private capacity

GARE, Mr Clive Donald, Private capacity

GARE, Mrs Petrina Mary, Private capacity

HOPKINS, Dr Gary Douglas, Private capacity

NELSON, Ms Tracey, Private capacity

ROVENSKY, Mrs Jacqueline, Private capacity

VOUMARD, Mr John Francis, Private capacity

WEBSTER, Ms Natalie, Private capacity

Friday, 19 June 2015

Parliament House, Canberra

Witnesses

CRICHTON, Ms Fiona Louise, Private capacity

Atkinson & Rapley Consulting Ltd

RAPLEY, Dr Bruce Ian, Principal Consultant, Acoustics and Human Health

National Health and Medical Research Council

McCALLUM, Professor John, Former Director, Research Translation

ROBERTSON, Ms Samantha, Executive Director, Evidence, Advice and Governance Branch

HANNA, Dr Elizabeth, Private capacity

Australian Psychological Society

BURKE, Dr Susie, Senior Psychologist, Public Interest, Environmental and Disaster Response

GRIFFIN, Mr Robert John, Private capacity

ROWETH, Mr Alwyn, Private capacity

BARBER, Mr Charles E, Private capacity

HOWE, Ms Rosemary, Private capacity

ANU College of Law, Australian National University

PREST, Dr James David Maurice, Lecturer, Australian Centre for Environmental Law

Tuesday, 23 June 2015

Parliament House, Canberra

Witnesses

SWINBANKS, Dr Malcolm Alexander, Private capacity

LEVENTHALL, Dr Geoff, Private capacity

Monday, 29 June 2015

NSW Parliament, Sydney

Witnesses

GREEN, Ms Lilli-Anne, Private capacity

McMURTRY, Dr Robert, private capacity

Science Assessment and Planning, Environment Protection Authority (South Australia)

DOLAN, Mr Peter, Operations Director

Frontier Economics

HARRIS, Mr Matt, Head of Climate Change and Renewables Policy

Schneider Electric

McGINLEY, Ms Lauren, Marketing Communication Manager

MORRIS, Mr Brian, Vice-President, Energy & Sustainability Services

CHAPMAN, Professor Simon, AO, Professor of Public Health, School of Public Health, University of Sydney

Senvion Australia

BEER, Mr Jason, Head of Projects and Service

KLADOUHOS, Mr George, Chief Financial Officer

SGARDELIS, Mr Peter, Development and Strategy Manager

WHEATLEY, Ms Megan, Manager, Communications and External Affairs

Waubra Foundation

LAURIE, Ms Sarah, Chief Executive Officer

Residents against Jupiter Wind Turbines Noise Committee

TOMLINSON, Mr Mark, Member

CRAWFORD, Dr Michael Arthur, Private capacity

Bodangora Wind Turbine Awareness Group

LYONS, Mr Michael David, Coordinator

Parkesbourne/Mummel Landscape Guardians Inc.

BROOKS, Mr David, Chairman

Association for Research of Renewable Energy in Australia Ltd

BUCKNELL, Mr Lionel Douglas Wentworth (Douglas), Member

GLOVER, Mr Mark Berry, Member

McGUINNESS, Mr Sam, Member

GRIMA, Mr Ricky Lee, Private capacity

GRIMA, Mrs Theresa Ann, Private capacity

ALLAN, Mr Norman David, Private capacity

BROWN, Mr Peter, Private capacity

StarCore Nuclear

DABNEY, Mr August, Business Analyst

CARLILE, Associate Professor Simon, Private capacity

RAE, Mr Peter, Private capacity

BRONER, Dr Norm, Managing Director, Broner Consulting Pty Ltd

APPENDIX 3

Environment Protection and Biodiversity Conservation Act 1999

Division 2B—

Establishment and functions of the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development

505C Establishment

- (1) The Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development is established.
- (2) The Committee is to consist of at least 5, but not more than 8, members.
- (3) A member of the Committee is to be appointed by the Minister by written instrument, on a part-time basis.
- (4) The Minister must appoint one member of the Committee to be the Chair.
- (5) When appointing members of the Committee, the Minister must ensure that:
 - (a) each member (other than the Chair) possesses appropriate scientific qualifications or expertise that the Minister considers relevant to the performance of the Committee's functions; and
 - (b) each member's appointment is not being made to represent any particular body, group or community.
- (6) The Minister must also ensure that a majority of the members possess scientific qualifications and expertise in one or more of the following areas:
 - (a) geology;
 - (b) hydrology;
 - (c) hydrogeology;
 - (d) ecology.

Note: Other provisions relating to members are set out in Division 3.

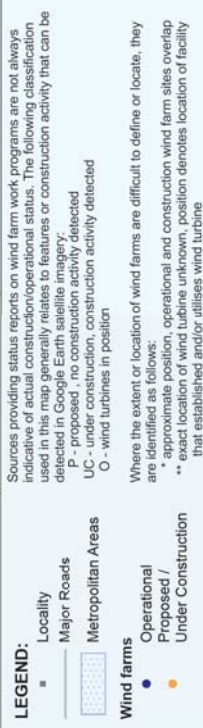
505D Functions of the Committee

- (1) The Committee has the following functions:
 - (a) within 2 months of a request by the Minister (the *Environment Minister*)—to provide scientific advice to the Environment Minister in relation to proposed coal seam gas developments or large coal mining developments that are likely to have a significant impact on water resources, including any impacts of associated salt production and/or salinity;
 - (b) within 2 months of a request by an appropriate Minister of a declared State or Territory—to provide scientific advice to the Minister in relation to proposed coal seam gas developments or large coal mining developments in the relevant State or Territory that are likely to have a significant impact on water resources, including any impacts of associated salt production and/or salinity;
 - (c) at the request of the Environment Minister—to provide advice to the Environment Minister about:
 - how bioregional assessments should be conducted in areas where coal seam gas development or large coal mining development is being carried out or is proposed; and
 - priority areas in which bioregional assessments should be undertaken; and
 - bioregional assessments commissioned by the Minister;
 - (d) at the request of the Environment Minister—to provide advice to the Environment Minister about:
 - priorities for research projects to improve scientific understanding of the impacts of coal seam gas developments and large coal mining developments on water resources, including any impacts of associated salt production and/or salinity; and
 - research projects commissioned by the Minister in relation to the impacts of coal seam gas developments and large coal mining developments on water resources, including any impacts of associated salt production and/or salinity;
 - (e) to publish information about improving the consistency and comparability of research in relation to the impacts of coal seam gas developments and large coal mining developments on water resources, including any impacts of associated salt production and/or salinity;
 - (f) to publish information relating to the development of standards for protecting water resources from the impacts of coal seam

-
- gas development and large coal mining development, including from any impacts of associated salt production and/or salinity;
 - (g) to collect, analyse, interpret and disseminate scientific information in relation to the impacts of coal seam gas development and large coal mining development on water resources, including any impacts of associated salt production and/or salinity;
 - (h) any other functions prescribed by the regulations;
 - (i) to do anything incidental to, or conducive to, the performance of the above functions.
- (2) The Committee also has the following functions:
- (a) at the request of the Environment Minister—to provide scientific advice to the Environment Minister in relation to a matter that is protected by a provision of Part 3;
 - (b) at the request of the appropriate Minister of a declared State or Territory and with the written agreement of the Environment Minister—to provide scientific advice to the Minister of the State or Territory in relation to the matters specified in the request, if the Committee has sufficient scientific expertise.

APPENDIX 4

Wind Farms in Australia (Operational, Proposed and Under Construction): Document prepared by the Parliamentary Library

[illegible]

New South Wales: Wind Farms (Operational, Proposed and Under Construction)

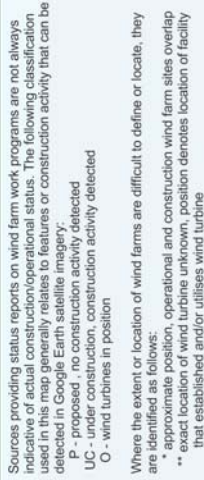


© Commonwealth of Australia



Creative Commons
With the exception of the Commonwealth Coat of Arms, and to the extent that copyright subsists in a third party, this publication, its logo and front page design are licensed under a Creative Commons Attribution-NonCommercial-NoDerivs 3.0 Australia licence.
In essence, you are free to copy and communicate this work in its current form for all non-commercial purposes, as long as you attribute the work to the author and abide by the other licence terms. The work cannot be adapted or modified in any way. Content from this publication should be attributed in the following way: Author(s), Title of publication, Series Name and No, Publisher, Date. To the extent that copyright subsists in third party quotes it remains with the original owner and permission may be required to reuse the material. Inquiries regarding the licence and any use of the publication are welcome to webmanager@aph.gov.au.

Except as required by law, the Commonwealth will not be liable for any loss, damage, expense or cost (including any incidental or consequential loss or damage) incurred by any person or organisation arising out of use of, or reliance on, this map. Material used 'as supplied'. Sources: Geoscience Australia; Australian Bureau of Statistics; Australian Electoral Commission; StreetPro © 2012 Pitney Bowes Software Pty Ltd. All Rights Reserved. Derivative material: Based on material supplied by: Geoscience Australia; Australian Bureau of Statistics; Australian Electoral Commission.
RT56792 LS20150609

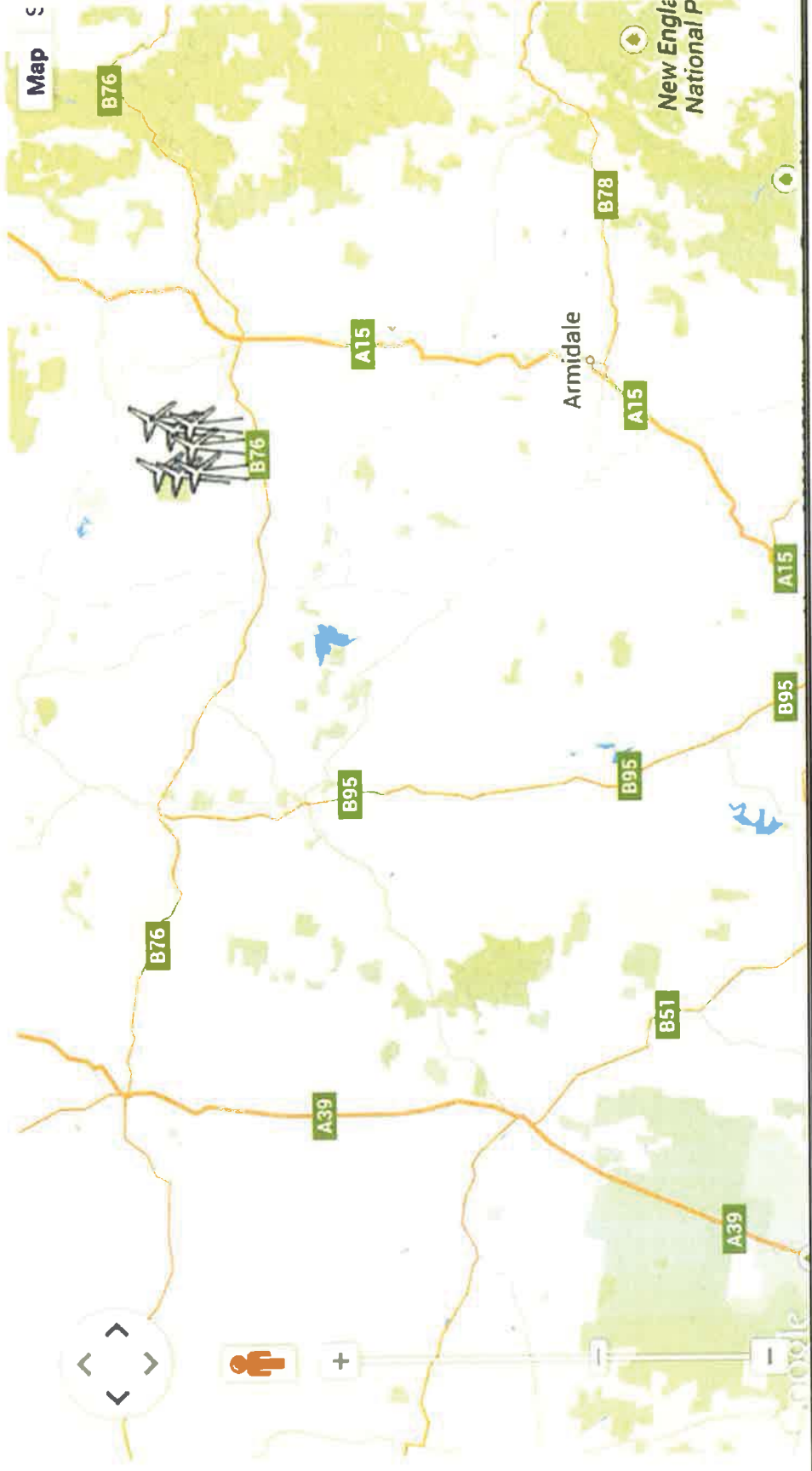


APPENDIX 5

**Picture of Sapphire Wind Farm provided by CWP Renewables
(supplied by Mr Robert Allen, Submission 410)**

The Wind Farm

The proposed Sapphire Wind Farm is located 18km west of Glen Innes, and 28km east of Inverell, in northern NSW. The wind turbines depicted on this map represent the approximate extent of the current wind farm layout.



nd Farm

3 figures

ere?

ted views

sed benefits

happening?

unity

ccess

us

nergy

gallery

t us

site

GO»



COMMONWEALTH OF AUSTRALIA

Proof Committee Hansard

SENATE

SENATE SELECT COMMITTEE ON WIND TURBINES

(Public)

WEDNESDAY, 10 JUNE 2015

ADELAIDE

CONDITIONS OF DISTRIBUTION

This is an uncorrected proof of evidence taken before the committee.
It is made available under the condition that it is recognised as such.

BY AUTHORITY OF THE SENATE

[PROOF COPY]

INTERNET

Hansard transcripts of public hearings are made available on the internet when authorised by the committee.

To search the parliamentary database, go to:

<http://parlinfo.aph.gov.au>

SENATE

SENATE SELECT COMMITTEE ON WIND TURBINES

Wednesday, 10 June 2015

Members in attendance: Senators Back, Canavan, Day, Leyonhjelm, Madigan, Urquhart, Xenophon.

Terms of Reference for the Inquiry:

To inquire into and report on:

The application of regulatory governance and economic impact of wind turbines, with particular reference to:

- a. the effect on household power prices, particularly households which receive no benefit from rooftop solar panels, and the merits of consumer subsidies for operators;
- b. how effective the Clean Energy Regulator is in performing its legislative responsibilities and whether there is a need to broaden those responsibilities;
- c. the role and capacity of the National Health and Medical Research Council in providing guidance to state and territory authorities;
- d. the implementation of planning processes in relation to wind farms, including the level of information available to prospective wind farm hosts;
- e. the adequacy of monitoring and compliance governance of wind farms;
- f. the application and integrity of national wind farm guidelines;
- g. the effect that wind towers have on fauna and aerial operations around turbines, including firefighting and crop management;
- h. the energy and emission input and output equations from whole-of-life operation of wind turbines; and
- i. any related matter.

I have written quite a lot in my submission about what I think is wrong with the EPA study. It is great that they did it, but I think they have come to some really illogical conclusions.

CHAIR: Thank you.

Mr Gare: Thank you for inviting me to present my submission today. My submission deals with the impact on my health and lifestyle living in close proximity to a wind farm. Let me say from the outset that we were excited about the prospect of being part of the renewable electricity industry. I am a host to wind towers on my property, the nearest being about 800 metres away with three towers within approximately one to 1.5 kilometres away.

We were not made aware of the impacts of noise on our health or lifestyle. Fortunately, we had heard from others that they were quite noisy. Luckily, in our contracts we inserted clauses about the need for noise mitigation. I do wonder why though the wind tower operators inserted the following clause in all the hosts' contracts section 77C, which is on the memorandum of lease which I will table: 'The landlord acknowledges and agrees that it is adequately compensated for any noise or inconvenience caused as a result of the permitted use of the site or the land and that it will not seek any further compensation from the tenant in relation to such matters.' If the wind tower operators were confident of their impact studies, that clause would not be necessary.

After a short period of living with an operating wind farm, we had these products installed. I find that, because I work and reside in close proximity to the wind farm, I suffer sleep interruption, mild headaches, agitation and a general feeling of unease; however, this occurs only when the towers are turning, depending on the wind direction and wind strength. My occupation requires that I work amongst the wind towers during the day which means I suffer the full impacts of noise for days at a time without relief. The impacts are that we are not able to open our windows because of the noise at night and we are not able to entertain outside because of the noise.

In conclusion, if we did not have soundproof batts in Vlam Hush windows, our house would not be habitable. In my opinion, towers should not be within five kilometres of residences, and I would personally not buy a house within 20 kilometres of a wind farm. Thank you.

Mrs Gare: Good afternoon Senators, and ladies and gentlemen. Thank you for letting me speak to the committee today. I would like to open my statement with the following: developers and construction. In the beginning, I was excited about the wind farm and of course the financial security for our property and family. The process began with high-pressure consultations, negotiations for weeks on end, numerous phone calls and face-to-face meetings with the developers. We seemed to be under constant pressure to agree to their wishes and, if we wanted any changes, it took a lot of negotiation.

We had to try and foresee any problems that may impact on our lifestyle for the next 25 years plus. With little or no previous information to go on, this was a very taxing time. Having gone through this, I would like to see that a person or persons—probably with a legal background and well-schooled in wind turbine information—be contactable for future wind farm hosts for advice and even to help with negotiations with the development companies.

Construction was also a very stressful and challenging time. The landowners are up against not only the power company but also all the big contractors and civil works companies. Any meetings with the above parties had to be attended by both of us with me taking notes so that we had some kind of record of what was said and what matters needed to be addressed at the time.

We had a lot of erosion problems from the pads and roadways, which we had to chase up with the power company to get them to address. During construction there were lots of problems with gates left open, boxing up mobs of cattle which then took a full day of redrafting and settling back into their paddocks. We also had gates opening onto public roadways. We have a main bitumen road that goes past our property. This caused great angst as far as public liability is concerned, if our stock got out into the roads. We also had lots of rubbish scattered around the property. We witnessed one of our cattle eating a one metre by one metre piece of plastic sheeting.

Living with wind turbines. Our house is solid sandstone, built for the late Charles Hawker in the 1920s, with concrete internal walls and a steel roof. The house is surrounded by a lot of vegetation and trees. I have brought some photos to show the Senate. In the months after the towers started in October 2010, the noise was unbearable, especially when two towers became in sync. A loud thumping would radiate throughout the house. Even watching TV in the furthestmost room from the towers, you could hear them. Sleeping was most difficult. I use, and still do, an earpiece radio every night, which helps block out the noise to a certain degree. If they are really going I have to up the volume.

After some time, due to a very slow installer, the house was finally insulated: sonobatts in the ceiling cavity; all our outside air vents blocked; a special American glass called Vlam Hush, which is two sheets of glass with a

special gel between, were installed in every door and window of the house. This has improved the situation for me considerably, but at times the noise still penetrates into the house.

Ongoing issues. Due to the house being sealed we have refrigerated air conditioning, because we cannot open windows because of the noise. A separate meter was installed on the wind farm operator's advice, so that they could pay the cost of the air conditioning usage. That went in over 12 months ago and we are still chasing payment. Another issue is the increase in our emergency services levy. The value of our property has increased by double, which has had a major increase in the levy. The power company pay council rates on the land that they lease, and we pay rates on the rest. We brought up the issue of the increased ESL with the power company, but they have not addressed it. We feel they should be responsible due to the increase in our land value. I have the value difference here: I think it is about \$1.6 million increase. I quote from the contract, 6.1, rates and taxes, section B:

However, during each year of this lease the tenant must pay any increase in rates and taxes above the rates and taxes that were payable immediately before the start of the agreement to lease, if the increase is directly attributable to the works or the use of the site for the permitted use.

We also have ongoing problems with the cables which run across our property and connect into the individual towers to transport the power to a substation. There seem to be constant cable breakages, which have to be dug up and fixed. This, of course, happens all over the property. Having 19 towers, it has quite a big impact. Quite a large area is disturbed and then has to be recovered with sand or soil. We have asked for compensation concerning this, as we have numerous cable breaks on the property with disturbance to our pastures, which interferes with our stock grazing. This was discussed at a meeting back in August 2014. We are still waiting for compensation, which is agreed by the wind operators. As you can see, they are not fast movers.

The land owners need to know their rights in regard to their property and how it is treated during and after construction of towers. Land owners with residences close to towers need to be made aware of the noise impact and there should be discussion of how close towers should be permitted to their premises. In my opinion, towers should not be any closer than five kilometres to a dwelling. If we had to buy another property, it would not be within a 20-kilometre distance to a wind farm. I think that says it all.

We have a son who will come home in a couple of years, and I have concerns for him and a family that he might have in the future, with regard to any health problems that may arise. Having lived with towers now for five years, in my opinion future hosts should glean as much information as they can and find out their rights so they can fully understand what they are taking on.

Senator XENOPHON: I would just like to ask some questions to Mr and Mrs Gare. I think the fact that you are hosts of wind turbines and you are giving evidence is significant. How many turbines are there on your property?

Mr Gare: Nineteen.

Senator XENOPHON: How long have you had them there?

Mr Gare: Five years.

Senator XENOPHON: And when did you start complaining about the turbines in terms of the adverse impacts?

Mr Gare: Straightaway.

Senator XENOPHON: Is it AGL that you are dealing with?

Mr Gare: Yes.

Senator XENOPHON: You may want to provide us with any documents in respect of this. How did they deal with the process? Once you raised the issue, what happened?

Mr Gare: We had it in our contract that if we found there was a problem they would put in noise mitigation products. We said: 'You will have to do it. We cannot bear it.' Because it was in the contract they went along with it, but I am sure, Nick, that they would not have if they did not have to.

Senator XENOPHON: It is a contractual relationship so it is under the terms of the contract. Are you able to say—and you may not want to—what level of payment have you been getting? If you do not feel comfortable saying how much you are being paid for the 19 turbines on an annual basis, you do not have to.

Mr Gare: All up, in total, about \$200,000, so there is not a lot of advantage for us in coming here today.

Senator XENOPHON: When you experienced the noise, could you stay in the property or did you have to move out?

Mr Gare: If we did not have the noise mitigation products put in, we would have moved out.

Senator XENOPHON: Prior to the noise mitigation products being put in, how did it affect your sleep? Did you spend more time away from home?

Mr Gare: Fortunately, we have eastern rangeland country where I could go to get away from it. As I said in my submission, I am there 24 hours a day in amongst it. I had to go away to wind down. What was your question, sorry?

Senator XENOPHON: What period of time was it from the time the noise affected you until the time you had the noise mitigation—several weeks or several months? How long was it?

Mrs Gare: I reckon it took about 15 months or more. We had a very slow installer of the batts and things.

Senator XENOPHON: You are protected by parliamentary privilege when speaking out here today. Did AGL say to you: 'Sometimes this happens. It is just one of those things'? Did they give an explanation as to the level of disruption? Did they say, 'This has not happened before'?

Mr Gare: No. It was all glossed over right from the start. We were given no information. One of their little tricks is to take people right up to the towers and say, 'This is how noisy they are.' But that is not so. The further you get away from the tower the noisier they are. That is a funny thing, to a point I guess. When you are right underneath them and they are 80 metres up in the air there is very little noise. There is just a bit of wind noise. As you go away one or two kilometres it actually gets worse.

Senator XENOPHON: Before the noise attenuation or noise suppression in your home what was your quality of life like?

Mr Gare: Crap, to put it honestly.

Senator XENOPHON: You got a bit of sleep each night, didn't you?

Mr Gare: With earplugs, yes. I wore earplugs constantly—only while they are turning, mind you, and providing they are in the right direction and have the right wind strength. Frosty nights are the worst because the sound tends to travel so much clearer and further on a frosty night. But earplugs.

Senator XENOPHON: Anything else, Mrs Gare?

Mrs Gare: No. Pretty much what Clive has said.

Senator XENOPHON: Do you sleep okay now?

Mrs Gare: No, they were waking me up on the weekend. You wake up to the thumping. This is with all the soundproofing in the house. As I said, I sleep with the radio on every night. If they are really cranked up I have to turn the volume up, so I will probably just go slowly deaf.

Senator DAY: I just want to clarify something. Frosty nights are normally not very windy.

Mr Gare: That is a funny thing. Our country is very hilly, and they put wind farms on top of hills. It can be blowing an absolute gale on the top of the hills and you can have frost in the valley.

Senator DAY: It is just that we have heard evidence that, even when the blades are not turning, they do have a similar infrasound impact on people because of the effect of the wind across the blades, across the aerofoil.

Mr Gare: Yes, but if there is that much wind the blades are turning, aren't they?

Senator DAY: That is right.

Senator LEYONHJELM: If you had your time over again, would you host a wind farm?

Mr Gare: No, absolutely not. If I were a rich man, I would not have a wind farm on my property.

Senator LEYONHJELM: And you said it was \$200,000 over five years approximately?

Mr Gare: No, 12 months.

Senator LEYONHJELM: Per year.

Mr Gare: Yes.

Senator LEYONHJELM: That is a fairly healthy income.

Mr Gare: Absolutely.

Senator LEYONHJELM: In spite of that, you would say that you would not have them.

Mr Gare: Absolutely, if I were a rich man, but unfortunately I am a farmer and there are not many rich farmers around.

Senator LEYONHJELM: What sort of farming?

Mr Gare: We are grazing, we can be cropping but we—

Senator LEYONHJELM: Sheep or cattle?

Mr Gare: Mostly cattle.

Senator LEYONHJELM: Has there been any effect on your cattle from the wind farms?

Mr Gare: No.

Senator LEYONHJELM: Okay, thank you.

Mr Faint: Thank you for this opportunity. I am speaking on behalf and as the chair of the Waterloo and District Concerned Citizens Group, so I will speak broadly. I also have personal issues and I want to inform the committee that I have left the area. I now sleep and live in Kapunda but I still come up to the farm and work during the day. Like other people, I was having lots of sleep issues so we decided to move from Waterloo.

Obviously you have our submissions in front you, but I will add a couple of later things that we have done since we submitted them. We who live in the shadow of these enormous industries clearly have been impacted, and the consequences have been devastating. These include the splitting of the community, noise and health issues, and in four cases already families have been forced to leave the area. There is numerous environmental damage. It was mentioned before about the fox cull—in fact I conducted that fox cull—and we were alarmed at the loss of native birds and animals in the Waterloo wind farm area. There has also been a significant drop in property value.

The most serious thing now is the link between turbines and frost severity. Turbines cool the air and in our situation at Waterloo it is now causing a huge loss in food production and the viability of farms up to 10 kilometres and further away. We have been lobbying for a long time to have a setback of at least 10 kilometres from towns, farmhouses, frost-prone areas, cropping and vineyard land. Clearly changes have to be made and future locations carefully assessed. What is more important to Australia—the protection of our food bowl or the construction of costly and inefficient wind farms? I think the answer is obvious.

Senator DAY: That is first time that we have heard the cooling of the air effect resulting in a decrease in crop production. Do you have any estimates of the percentage of crop production or productivity declines as a result?

Mr Faint: Yes. We did a survey together with Mary. Of at least nine farmers within a five-kilometre radius of Waterloo, collectively there was a 70 per cent loss in our average cropping. This has happened for three consecutive years in the Waterloo area, and this is since the commissioning of the wind farm. We are in a frost-prone area, that is acknowledged, but we have never had such severe frosting. Normally, we would expect an area probably 100 or 200 metres from a creek bed but we have had our whole paddocks wiped out. After two years of frost damage we contacted the University of Adelaide to do a test. They were good enough to build a model wind farm and there they proved that turbines cool the air. They also established that the turbines at Waterloo were too close together—they are only 250 metres apart and they were in a continuous line—so this is causing a huge mass of cold air to form in the valley.

Senator DAY: If you could provide us with any documentation or any of your results, both from the university and from your own local studies, that would be very helpful to the committee.

Mr Faint: We have related that.

Mrs Quast: I will keep mine very brief. We are very concerned about the health issues of people living in the vicinity of wind farms. Having experienced them first hand, we do not wish anybody else to suffer as we are. We feel that the guidelines set by NHMRC need to be addressed. I was fortunate enough to attend a forum there a few years ago and they were not really very interested so I am happy to see that they are at least taking some notice now. The EPA has done lots of testing in the Waterloo area—we acknowledge that, as Mary did—but the results were certainly circumspect and I think they need to be addressed and investigated properly. As I stated in my submission, they put turbines in the most stupid places—under trees and other things.

The health issues could all stem from sleep deprivation from the noise and from the infrasound. Also, I have two dogs who have both been affected by the turbines. I take them for walks and they will stop and they will look at the turbines because they are making so much noise. They also bark at night because they think it is thunder. It is very loud, my house is not insulated and over the TV you can hear it. It is like a jet engine coming but that never gets there. Unlike traffic and planes, it does not stop. It is continuous 24-hours a day. I have kept a health diary from day 1 of the operation of the wind farms, and I have stated in there that I felt the effects immediately, and it gets worse. It is now quite a few years on and I am a lot worse than I was when I first noticed them operating. We have property we cannot build on because we would be 1,200 metres from the nearest turbines in a

Submission to the Select Committee on Wind Turbines

Wind's effectiveness and CO₂ avoidance cost

By Peter Lang¹,
CPEng (retired), MIEAust

23 March 2015

This submission responds to the [Terms of Reference](#) items a, b, h and i:

- a. the effect on household power prices, particularly households which receive no benefit from rooftop solar panels, and the merits of consumer subsidies for operators
- b. how effective the Clean Energy Regulator is in performing its legislative responsibilities and whether there is a need to broaden those responsibilities
- h. the energy and emission input and output equations from whole-of-life operation of wind turbines; and
- i. any related matter.

¹ Peter Lang is a retired geologist and engineer with 40 years' experience on a wide range of energy projects throughout the world, including managing energy RD&D programs and providing policy advice to Government. Energy projects included: hydro, geothermal, nuclear, coal, oil and gas and a wide range of energy end-use management projects.

Executive Summary

The [*Renewable Energy \(Electricity\) Act 2000*](#) states:

“The objects of this Act are:

- (a) to encourage the additional generation of electricity from renewable sources; and
- (b) to reduce emissions of greenhouse gases in the electricity sector; and
- (c) to ensure that renewable energy sources are ecologically sustainable.”

Object (b) is, arguably, the principal objective because if it is not justifiable, on the basis of objective evidence, (a) and (c) are not justifiable either. This submission presents evidence that wind turbines are less effective at meeting objective (b) than is commonly assumed. Therefore, the CO₂² abatement cost estimated from economic analyses is frequently understated.

This submission focuses on the **effectiveness** of wind turbines at reducing CO₂ emissions from electricity generation in Australia and the impact of the **effectiveness** on the estimates of abatement cost (\$/tonne CO₂ avoided) by wind energy.

It is often assumed that effectiveness of wind energy is 100%, i.e., 1 MWh of wind energy displaces the emissions from 1 MWh of the conventional energy displaced. But it is usually much less, and values as low as 53% have been reported. To be clear, 53% effective means wind turbines avoided 53% of the emissions that, in the absence of wind, would have been produced by the generators that were displaced by wind generation.

Empirical analyses of the emissions avoided in electricity grids in the U.S. and Europe indicate that (1) wind turbines are significantly less effective at avoiding emissions than is commonly assumed and (2) effectiveness decreases as the proportion of electricity generated by wind turbines increases.

Unfortunately, neither the Clean Energy Regulator (CER) nor the Australian Energy Market Operator (AEMO) collect the CO₂ emissions information needed for an accurate empirical estimate of effectiveness. Without good data for the emissions from power stations at time intervals of 30 minutes or less, estimates of emissions avoided by wind are biased high and have large uncertainty, i.e., we don't know what emissions reductions are actually being achieved by wind generation.

Under the Renewable Energy Target (RET), the proportion of wind generation is increasing so it is projected to supply about 15% of electricity by 2020 (interpreted from

² Throughout this document, CO₂ means ‘carbon dioxide equivalent’. ‘Equivalent’ means it includes CO₂, CH₄ and N₂O with CH₄ and N₂O converted to their CO₂ equivalent as defined by the UNFCCC.

the 2014 [RET Review Report, Figures 11 and 13](#)). In this case, effectiveness might approach as low as 53% by 2020.

When effectiveness is properly factored into calculations, wind energy has a high abatement cost; I provide a simple analysis using Levelised Cost of Electricity (LCOE) which estimates abatement cost of wind power at \$168/t CO₂ by 2020.

In comparison, the RET Review summarised estimates of the abatement cost of the Large Scale Renewable Energy Target (LRET)³ at [\\$32-\\$70/t CO₂](#). These estimates, however, are likely underestimated as the analyses do not appear to take effectiveness into account, or at least not fully. If the economic analyses do not take effectiveness into account, and if effectiveness decreases to 53% by 2020, the estimates of abatement cost would nearly double to \$60-\$136/t CO₂ with effectiveness included.

To put these abatement costs in context, the 'carbon' tax was \$24.15/t CO₂ when it was rejected by the voters at the 2013 Federal election. The current price of EU ETS carbon credits and the international carbon credit futures are:

- European Union Allowance (EUA) market price (10/3/2015) = [€6.83/tCO₂](#) (A\$9.50)
- Certified Emissions Reduction (CER) futures to 2020 (9/3/2015) = [€0.40/tCO₂](#) (A\$0.56)

Therefore, the LRET in 2020 could be 2 to 5 times the carbon tax, which was rejected by the voters in 2013; 6 to 14 times the current price of the EUA; and more than 100 times the price of CER futures out to 2020.

Clearly, the RET is a very high cost way to avoid greenhouse gas (GHG) emissions. The rational policy decision is to close the RET to future investments. Or, as an interim measure, wind the target back to a real 20% of electricity generation.

I urge the Select Committee to consider: has the RET passed its use-by date? Why not allow Direct Action to do what it is designed to do, to achieve emissions reductions at the lowest cost?

Recommendations:

In consideration of the issues outlined in this submission, I recommend that:

1. The Government task an appropriately qualified agency, such as the Productivity Commission and/or Bureau of Resources and Energy Economics (BREE) with estimating the full economic cost of wind energy (\$/MWh) as well as the CO₂ abatement cost (\$/t CO₂ avoided).

³ The current legislation requires the RET to generate 45,000 GWh in 2020, of which the LRET is to generate 41,000 GWh and the SRET 4,000 GWh. Therefore, the LRET will supply 91% of the RET. Wind power is projected to supply 83% of the LRET in 2020.

2. To get an early indication of the abatement cost of wind energy, contract an appropriately qualified consultant to:
 - a. assemble the best estimates it can of the 'high quality' data required for a sophisticated analysis (this may include seeking information from generators with appropriate 'commercial in confidence' agreements), and
 - b. estimate the CO₂ abatement cost with wind power (including all the hidden costs and the effects of higher electricity costs on the Australian economy).
3. Either, repeal the RET legislation which will:
 - a. avoid what will become an escalating compliance cost of emissions monitoring if it remains in place, and
 - b. allow Direct Action to operate without the RET being a major market distortion.
4. Or, if repeal of RET is not politically acceptable, close the RET to new entrants and incorporate the existing and committed RET installations into Direct Action.
5. Change the name of Direct Action to 'CO₂e Emissions Reduction Scheme' (CO₂e ERS). This should be technologically neutral with the primary selection criteria being objectively justifiable CO₂e avoidance cost (i.e. \$/t CO₂e avoided).

Contents

Executive Summary	2
1 Introduction.....	7
2 Issue 1 - Effectiveness	8
2.1 Definition & Relevance	8
2.2 Estimates of effectiveness of wind in other grids.....	8
2.3 Data quality.....	9
2.4 Data availability.....	10
2.5 Data needed	11
3 Issue 2 - Uncertainty and biases	11
3.1 Uncertainties	11
3.2 Causes of uncertainty.....	12
3.3 Biases	12
3.4 Implications	13
4 Issue 3 - Abatement cost (\$/t CO ₂ avoided).....	13
4.1 Background.....	13
4.2 Additional costs	14
4.3 CO ₂ abatement cost vs effectiveness - an illustrative calculation:.....	15
5 Issue 4 – Renewable Energy Target (RET)	18
6 Recommendations.....	18
7 Responses to the Terms of Reference items	19
7.1 a. Household power prices.....	19
7.2 b. Clean Energy Regulator.....	20
7.3 h. Energy & emission I/O equations.....	20
7.4 i. Related matters	21
8 References.....	21
Appendix 1: ‘Quantifying CO ₂ savings from wind power’	23
1 Outline	23
4 Conclusion	25
Appendix 2 – Ramp rates and heat rate curves.....	26
Ramp Rates	26
Heat rate curves	26
Appendix 3 – Simple calculation of CO ₂ abatement cost (\$/t CO ₂ avoided).....	29
Other estimates of CO ₂ abatement cost with the RET	30
References:	33
Appendix 4: – Compliance costs of GHG emissions monitoring – a NSW paint factory’s experience	34

1 Introduction

The [*Renewable Energy \(Electricity\) Act 2000*](#) states:

“The objects of this Act are:

- (a) to encourage the additional generation of electricity from renewable sources; and
- (b) to reduce emissions of greenhouse gases in the electricity sector; and
- (c) to ensure that renewable energy sources are ecologically sustainable.”

Object (b) is clearly the principal objective because if it is not justifiable, on the basis of objective evidence, (a) and (c) are not justifiable either. Consequently, the principal justification for favouring wind turbines (and other renewables) with legislation, regulation, direct subsidies and hidden cross-subsidies is to reduce CO₂⁴ emissions. But how much CO₂ does wind generation avoid and at what cost?

There is a cost to such government interventions in the market. It is a cost to the Australian economy. Ultimately it is sheeted home to all Australians in the form of higher cost of living, fewer jobs, lower remuneration, less government income leading to poorer government services compared with what would have been if not for these government interventions. There are also the more visible cost increases like electricity prices. No one likes high electricity prices, not households who struggle with their household budget, not industry where energy costs can destroy their competitiveness, not politicians who wear the opprobrium. Clearly, emission reductions should be done at least cost and at no higher cost than is justifiable based on rational analysis of objective information.

As will be shown, wind turbines are a high cost measure with considerable uncertainty about the true costs and reductions actually achieved. This has implications for policy, particularly the utility of the Renewable Energy Target ([*Renewable Energy \(Electricity\) Act 2000*](#)). There are four main issues here: (1) the effectiveness of wind turbines in abating emissions, (2) the high cost of abatement, (3) the lack of data and (4) the usefulness of the Renewable Energy Target (RET). Each will be discussed in turn.

⁴ Throughout this document, CO₂ means ‘carbon dioxide equivalent’. ‘Equivalent’ means it includes CO₂, CH₄ and N₂O with CH₄ and N₂O converted to their CO₂ equivalent as defined by the UNFCCC.

2 Issue 1 - Effectiveness

2.1 Definition & Relevance

The term “**effectiveness**” is used throughout this paper to refer to the ability of wind generation to reduce CO₂ emissions relative to emissions in the absence of wind generation. 100% effective means the electricity generated by wind avoids all the CO₂ that would have been emitted without the wind generation. Put another way, effectiveness is % reduction in CO₂ emissions divided by % electricity supplied by wind.

Wind energy substitutes for energy from other generators, but not all the emissions of the other generators are avoided. There are several reasons for this. First, wind energy usually substitutes for the energy from the generators with the highest marginal cost; so wind tends to displace more gas than the proportion of gas in the grid mix at the time of substitution. Consequently, the average emissions intensity of the displaced energy is less than the average emissions intensity of the grid ([Wheatley, 2013](#), gives an example on pp95-96). Second, some generators are kept on standby ready to take the load when the wind drops, still burning fuel and emitting CO₂ but not generating electricity. Third, some generators shut down and then restart later. Starts and stops take considerable time (many hours for coal generators) and consume fuel. Fourth, when the wind blows, some generators are ‘throttled back’ to produce less power. However, they are less efficient when operating below their optimum output. Also, ramping power up and down consumes more fuel than operating constantly at optimum power, so they produce more emissions per MWh of electricity sent out.

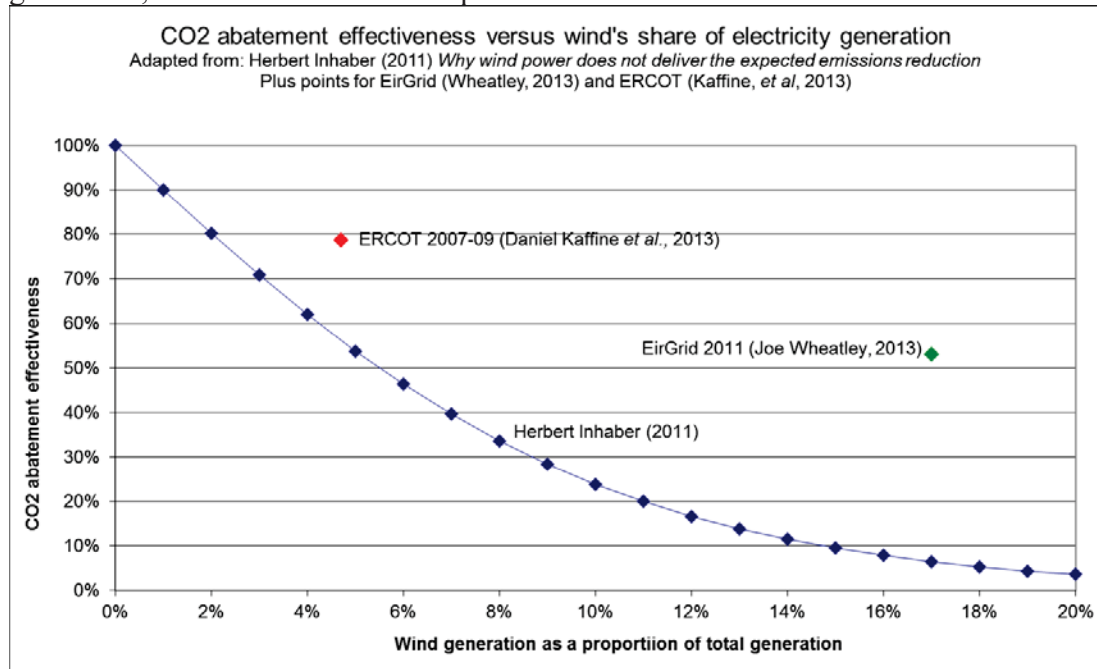
The **effectiveness** of wind turbines at abating CO₂ emissions is an important input to correctly estimating the cost of emissions reduction. As **effectiveness** decreases the cost per tonne increases (all else equal). For example, if wind turbines are 50% **effective**, then the cost per tonne CO₂ avoided is double that of estimates that do not take effectiveness into account. The key point here is that most estimates of the CO₂ abatement cost of wind do not take **effectiveness** into account, but abatement costs increase as effectiveness decreases (see Issue 2) and means lower emissions reductions than planned.

2.2 Estimates of effectiveness of wind in other grids

Many studies have estimated the effectiveness of wind generation. Two recent, comprehensive studies using empirical data were of ERCOT (Texas) by [Kaffine et al. \(2013\)](#) and EirGrid (Ireland) by [Wheatley \(2013\)](#).

Figure 1 shows CO₂ abatement effectiveness versus wind generation as a proportion of total generation for ERCOT (Texas) and EirGrid (Ireland) together with the [Herbert Inhaber \(2011\)](#) analysis of many published studies. All are from published analyses of empirical data. Critiques of the Inhaber paper revealed there were some misunderstandings and misinterpretations leading to the curve being too low, but the important point for this submission is the shape of the curve.

Figure 1: CO2 abatement effectiveness versus wind generation as a proportion of total generation, from three studies of empirical data.



The data in Figure 1 reveal two important issues. First, wind effectiveness is commonly less than 100%. Second, effectiveness declines as wind penetration increases.

A further issue, data quality, is discussed below.

2.3 Data quality

Wheatley did a preliminary estimate of emissions avoided using the electricity demand and emissions data published by EirGrid (this is similar to AEMO's data for electricity generated but EirGrid has better CO2 emissions intensity information). His preliminary analysis implied an effectiveness of 59%. A more sophisticated analysis using higher quality data (e.g. [Wheatley, 2013](#), Tables 3 and 4) implied an effectiveness of 53%. (Appendix 1 is an excerpt from [Wheatley, 2012](#), which provides a clear explanation of these concepts as well as an example). In this case, the high quality data reduces estimated effectiveness by 10% with a commensurate 11% increase in abatement cost. This highlights the need for high quality data. The [SEAI, 2014, modelling study](#) estimated effectiveness at 65% for all of Ireland and for a different year. The result is questioned [here](#).

Many other countries collect the high quality data that allows effectiveness to be estimated, e.g. Ireland and other EU countries. Unfortunately, as will be shown in the next section, Australia does not.

2.4 Data availability

I have investigated the availability of high quality data for Australia but have been advised by AEMO that the data has not been collected. Details of my request and the AEMO response are in Box 1.

Box 1:

My request dated 21 January 2015, AEMO Information and Support Hub Call: 195322

*"What I most want at the moment is (for **each individual generator unit, or station average**):*

- 1. CO2-e emissions intensity (CO2-e/MWh) curves (for both as-generated and sent-out),*
- 2. Thermal efficiency curves*
- 3. Period when unit is consuming fuel but not generating*
- 4. CO2-e emissions rate while consuming fuel but not generating, OR*
- 5. No Load Fuel Consumption (% of Full Load Fuel Consumption)*

Since AEMO doesn't have this data, can you please tell me who does have it and how I can go about getting it?"

AEMO Response 21 January 2015, AEMO Information and Support Hub Call : 195322

"Peter Lang,

I am sorry but I don't have good news. We estimate the weekly GHG for power stations using the factors given in the spreadsheet [here](#). The SCADA data can be found on our website www.nemweb.com.au then go to reports and archive then Dispatch_SCADA then select a day which opens a zip file with all the times of that day. The file has the SCADA data and DUID.

This is what standard carbon contracts are settled off and equates to our CDEI data. Having said that, this will not add up to the total GHG as it only includes generators actually feeding into the market and it uses a general assumption on CO2-e/MWh.

I am not aware of any way you can say for certain what the five minute emission is. The assumptions used by AEMO is aiming at getting the weekly emissions roughly right and we can only benchmark against the one year of CER data which has been released.

I am not aware of thermal efficiency curves being made publicly available and AEMO doesn't have these. Having been previously involved with NGERs data for a large energy corporation, I am not sure that anyone has that level of information."

AEMO Response dated 22 January 2015, AEMO Information and Support Hub Call: 195322:

"Regarding your earlier comments about AEMO needing to make the data available. We can bring it up with industry and COAG to see if they believe that there is sufficient market benefit to warrant a rules change. The issue AEMO has at the moment is that the information is not shared with us and in some cases may not already exist. We welcome feedback and suggestions for improvements however we will not be able to collect this data in the short term. "

However, the lack of AEMO data need not preclude the development of estimates for effectiveness in Australia. I expect a company such as ACIL-Allen, which has done considerable research on emissions from the power sector including providing the

emissions intensity and related data for AEMO, may be able to develop reasonable estimates of the needed data.

2.5 Data needed

Previous studies have established the quality of data needed to estimate effectiveness. Such data should include measured emissions data, ideally at 5 minute intervals but not greater than 30 minute intervals. If measured emission data are not available, emissions can be estimated from the following variables for each individual generator unit (ref. [Wheatley, 2013, Tables 3 and 4](#)). Required data include the following or equivalent:

- Emissions when consuming fuel but not generating electricity.
- Emissions factor (kg CO₂/GJ) for the fuel consumed
- Thermal efficiency (or heat rate) *curves* for each individual generator unit (or points and slopes as per Wheatley, 2013, Table 4)

The mean and 95% confidence intervals for each of the above are also needed.

US EPA requires [emission be measured in the exhaust stack at 15 minute intervals](#). The EU requires emissions are estimated using the data listed above.

These data are not collected by CER or AEMO. In fact, AEMO doubts that anyone has the needed data (see Box 1).

3 Issue 2 - Uncertainty and biases

3.1 Uncertainties

When a statistical analysis is conducted the results are given as, for example, 45% +/- 3 percentage points at 95% confidence level (or 19 times out of 20). Estimates of the effectiveness of wind turbines and of the cost per tonne avoided vary greatly. Clearly these estimates have high uncertainty (large margin of error). It is important to quantify the uncertainty for these analyses.

Uncertainty is defined by the confidence interval. For example, we might estimate the effectiveness as 50% +/- 20 percentage points at 95% confidence. Similarly, we might estimate the CO₂ abatement cost at \$100/t +/- \$20/t at 95% confidence.

[NGER, Chapter 8 Assessment of Uncertainty](#) defines the requirements for reporting uncertainty in emissions estimates and the methods to be used for estimating uncertainty. However, the information available is not applicable at the short time intervals required for estimating the emissions avoided by wind generation.

3.2 Causes of uncertainty

Three main causes of uncertainty relevant to estimating effectiveness and CO2 avoidance cost are:

1. Statistical uncertainty
2. Lack of data
3. Lack of calibration, lack of checks from alternative estimating or measurement method. Lack of validation.

3.3 Biases

Estimates of the CO2 emissions caused by power plant ramping and cycling may be biased for a number of reasons:

1. Thermal efficiency of power plants reported by CER and used by AEMO are linear through the range of power output from minimum to maximum power. In reality, this is a curved function (see examples in Appendix 2). Using the linear approximation understates the emissions when generators are running at less than optimum power so they underestimate CO2 emissions when wind power is high and overestimate it when it is low. This makes wind energy seem more effective than it actually is at reducing emissions.
2. Fuel is consumed when no electricity is being generated, e.g. during warm and hot stand-by, spinning reserve, start-up and shut-down. The emissions are claimed to be included in the total annual emissions reported by CER and in the average emissions intensity (t CO2/MWh), so the total emissions reported per year should be correct. However, the emissions are not being attributed to the correct time they were emitted. This means when the wind is generating at high power, emissions are understated and when wind is generating at low power, emissions are overstated (e.g. because the spinning reserve emissions are not included). This again makes wind energy seem more effective at reducing emissions than it actually is.
3. Whereas the Emissions Intensity published by AEMO (code CO2EII) should be multiplied by power sent-out from the power station, AEMO does not publish the power sent-out from the power station at sufficiently close time intervals for this data to be used for estimating the emissions caused by ramping and cycling (or the emissions avoided by intermittent generators). Therefore, we have to estimate the emissions sent out by subtracting power used by 'Auxiliaries' from power 'as-generated' (code SCADAVALUE). The SCADAVALUE is a measurement of power at a point in time and therefore, not as accurate as the metered energy sent-out. Bias occurs because the power used by Auxiliaries is not a linear relationship to the power generated. It is partly constant and partly variable in proportion to generation. Therefore, emissions are understated when the generator is operating

at low power (i.e. when wind generation is high) and overstated when the generator is operating at high power (i.e. when wind generation is low). This again makes wind energy seem more effective at reducing emissions than it actually is.

4. The emissions intensity values published by AEMO (code CO2EII) are calculated on the basis of generation sent-out as measured at the 'Regional Reference Node' for each state. Emissions are calculated by multiplying generation sent-out by emissions intensity sent-out (code CO2EII). However, this causes another source of bias. Because the transmission lines from wind farms are longer and lower capacity on average than from the fossil fuel power stations, the losses in transmission are likely to be greater for wind turbines than for fossil fuel power stations (on average). Furthermore, the losses from wind are greater when wind is generating high power than when generating low power. Yet again, this makes wind energy seem more effective at reducing emissions than it actually is.

3.4 Implications

The implications are:

- (1) Abatement from wind is very uncertain and the estimates of emissions avoided are overstated.
- (2) Current policy is flawed because the justification is based on analyses of inadequate data and has not properly accounted for the effectiveness being less than 100%.
- (3) A study by an authoritative government agency should be commissioned to do an economic analysis of the full economic cost of the RET, the emissions avoided and the cost per tonne CO₂ avoided. For fast results a study by a consultancy could be done initially.
- (4) CER is not gathering the data needed to estimate the emissions avoided by intermittent generators like wind and solar. However, I am not recommending the regulations be modified to collect the data (see Recommendations).

4 Issue 3 - Abatement cost (\$/t CO₂ avoided)

4.1 Background

As stated previously, abatement cost is dependent on effectiveness, e.g., if the effectiveness is 50%, then the CO₂ abatement cost is twice that calculated when assuming 100% effectiveness. Many analyses assume 100% effectiveness, so they understate the true CO₂ abatement cost of wind turbines. In this section I provide an estimate of abatement cost for three values of effectiveness.

There is a variety of methods used to calculate the CO₂ abatement cost of a technology. Here I use a simple approach using nominal values for Levelised Cost of Electricity (LCOE) based on [BREE Australian Energy Technology Assessment \(AETA\) 2012 and 2013 Update](#).

4.2 Additional costs

The LCOE quoted by AETA is for the technology only. In reality, integration of wind turbines imposes many other costs onto the network and other generators. For estimating the cost per tonne CO₂ avoided by wind, the LCOE needs to include:

1. The increased grid costs of including intermittent energy sources in the grid. These costs become increasingly significant as the proportion of electricity generated by wind increases.
2. Costs transferred to the dispatchable generators. Mandating renewable energy to substitute for existing dispatchable power plants transfers an array of costs onto those plants. For example, the existing dispatchable plants' fixed costs must be paid for by selling less electricity, so they must increase their price for the electricity they send out. A second example is the extra cycling of coal plants which incurs high costs.
3. The fact that more Open Cycle Gas Turbines (OCGT) and fewer Combined Cycle Gas Turbines (CCGT) are built than would be the case if not for the need to have highly flexible backup for wind power. OCGT are more flexible and responsive than CCGT but produce around 50% more emissions and are higher cost. This leads to higher electricity costs and higher CO₂ emissions.
4. Decommissioning of wind turbines at the end of their economic life and of other generators that are permanently displaced.

Mandating wind power (as the RET does) is increasing the cost of electricity not only by its own energy being twice the cost of the generators it replaces, but also by the items noted in the four points above.

A simple way to estimate CO₂ abatement cost (\$/t CO₂ avoided) is explained by [Oliver and Jackson \(2000\)](#):

The 'specific incremental cost' (SIC) of the abatement technology per unit of environmental abatement is calculated by deducting the cost of electricity supplied by the baseline technology (C_B) from the cost of electricity supplied by the abatement technology (C_A), and dividing this by the amount of abatement (tonnes of avoided emissions) that the new technology will provide (Eq. (2)):

$$SIC = (C_A - C_B)/(E_B - E_A), \quad (2)$$

where E_A is the emissions per unit of electricity supplied from the abatement technology and E_B the emissions per unit of electricity supplied through the baseline.

The costs should include the additional costs listed above.

4.3 CO₂ abatement cost vs effectiveness - an illustrative calculation:

I have calculated abatement costs as a function of effectiveness for different fuels using the method explained in Section 4.1 with inputs based on BREE AETA 2012 report and 2013 model update. Appendix 3 details the method, calculations and the intermediate results, with assumed inputs listed in Table 1. The effectiveness figures used represent:

100% = the common assumption, i.e. wind power is 100% effective at avoiding the emissions from the generators it displaces;

80% = the effectiveness of ERCOT for 2007-2009, when wind power generated 4.7% of total electricity generation – c.f. Australia [2.9% in 2012-13](#);

53% = the effectiveness of EirGrid in 2011, when wind power proportion was 17% of total generation (similar to what Australia's proportion of wind power is likely to be in 2020 if the RET legislation remains unchanged).

Table 1: Assumed LCOE of *existing* coal and gas generators and NEM average; and LCOE of *new* wind plants as well as CO₂ Emissions Intensity (EI) inputs used to calculate the CO₂ abatement costs shown in Figure 2.

Technology	LCOE \$/MWh	CO ₂ EI t CO ₂ /MWh
Coal	\$30	1.0
Gas	\$80	0.5
NEM avg.	\$50	0.9
Wind	\$110	0.0

For comparison with these assumed values of LCOE and EI, Table 2 lists estimates from Bureau of Resources and Energy Economics (BREE) [Australian Energy Technology Assessment \(AETA\) reports, 2012 and 2013 Update](#). BREE provide these average LCOE and emissions intensities for use in Australian economic modelling.

Table 2: LCOE and CO2 emissions intensity for coal, gas and wind technologies; source [AETA 2012 Report and AETA 2013 Model](#)

Parameter:	LCOE	LCOE	CO2 EI	
Source:	AETA 2012	AETA 2013	AETA 2012	AETA 2012 Table No.:
Technology:	\$/MWh	\$/MWh	t CO2/MWh	
Brown coal	26	not stated		3.1.2
Black coal	30	not stated		3.1.3
CCGT	103	89	0.368	3.2.1 & 4.16
OCGT	215	195	0.515	3.2.1 & 4.19
Wind	116	111	0	4.29

The results shown in Figure 2 are derived from the values in Table 1 (see analysis in Appendix 3). Figure 3 assumes the hidden costs of wind energy outlined in Section 4.2, points 1 and 2, are \$20/MWh higher than for the dispatchable technologies, giving an LCOE for wind of \$130/MWh. The \$20/MWh figure is based on Nicholson and Brook (2013) ‘[Counting the hidden cost of energy](#)’. This article summarizes an [OECD/NEA study](#) which gives ‘mid’ estimates for the hidden cost of wind were \$17/MWh for USA and \$22/MWh (interpolated for 15% wind energy penetration) across six OECD countries, compared with \$0.5-\$0.9/MWh for the dispatchable technologies, gas and coal.

Figure 2: Estimated CO2 abatement cost at 100%, 80% and 53% effectiveness with wind substituting for coal, gas or the average NEM emissions intensity and cost of electricity; assumed LCOE of wind is \$110/MWh (refer Table 1 for the assumed LCOE and emissions intensity used for each generator type).

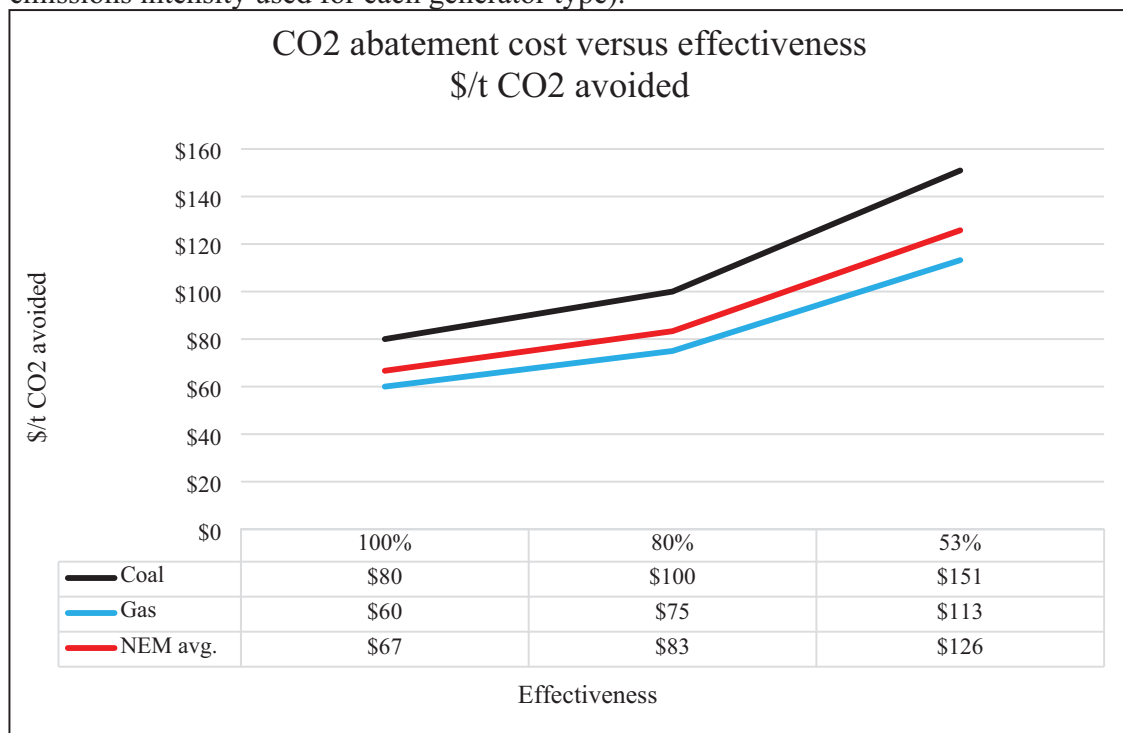
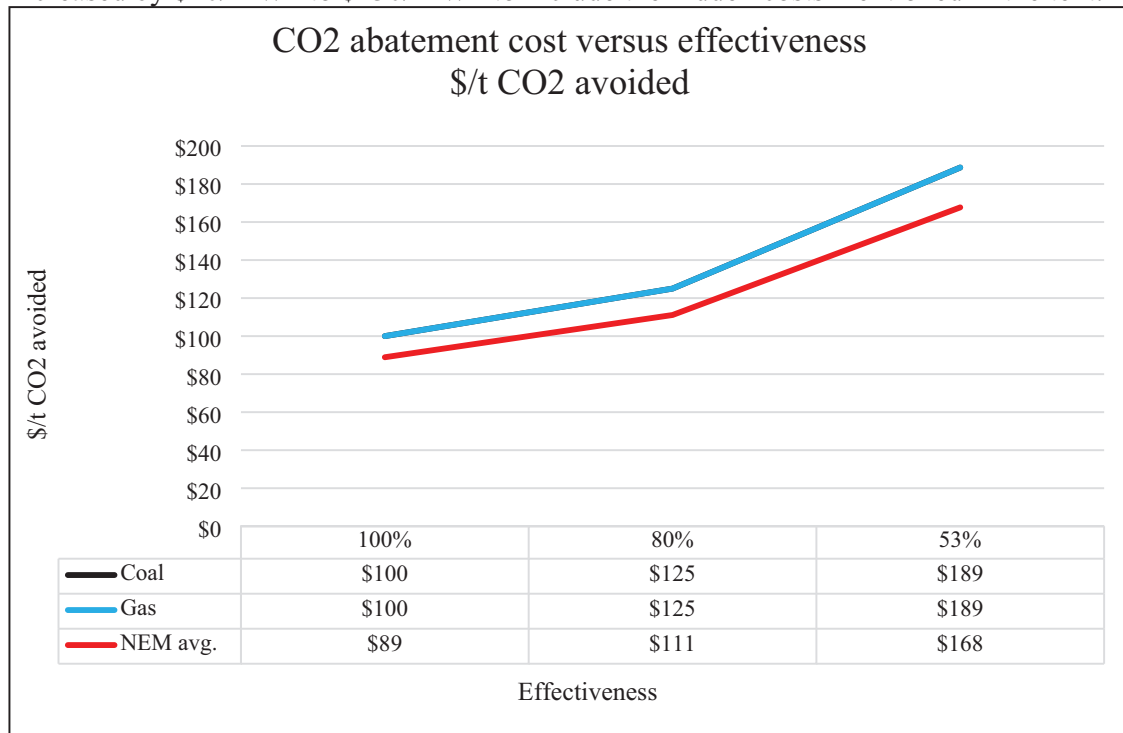


Figure 3: Estimated CO₂ abatement cost; inputs as for Figure 1 except wind LCOE is increased by \$20/MWh to \$130/MWh to include the hidden costs mentioned in the text.



Examination of Figures 2 and 3 shows that CO₂ abatement cost increases as the CO₂ abatement effectiveness decreases, i.e., abatement cost is inversely proportional to effectiveness. This highlights the importance of effectiveness in correctly estimating the CO₂ abatement cost.

It is worth considering that if the RET remains as currently legislated then the wind proportion of electricity generation in Australia may reach around 15% of total generation by 2020. Based on the 53% effectiveness of the EirGrid at 17% wind proportion, we could assume for this example, the effectiveness of wind turbines in Australia in 2020 might be similar to EirGrid in 2011. For the assumptions of \$130/MWh LCOE for wind with hidden costs included, the other inputs in Table 1 and wind displaces the average NEM emissions intensity, Figure 3 shows the CO₂ abatement cost would be about \$89/t CO₂⁵ if 100% effective or \$168/t CO₂ if 53% effective. For comparison, economic analyses submitted to the [RET Review \(Section 5.6\)](#) estimated the abatement cost with the LRET (which is mainly wind) at \$32-\$72/t CO₂.

I have examined the ACIL-Allen report, and the analyses by Deloitte, Frontier Economics and The Centre for International Economics. They don't explicitly address effectiveness. Therefore it is reasonable to assume that effectiveness is not fully

⁵ Comparison with other estimates suggests the abatement cost figures estimated by this simple LCOE analysis are reasonable. Other estimates are included in Appendix 3. However, note that they are based on different assumptions, are for different years and periods and do not take effectiveness into account.

accounted for in their analyses and consequently their estimates of \$32-\$72/t CO₂ are likely underestimated.

It should be noted that the \$168/tonne abatement cost (Figure 3) is about seven times the rate of carbon tax that was rejected by the electorate at the 2013 Federal election.

5 Issue 4 – Renewable Energy Target (RET)

Under the Renewable Energy Target (RET), the cost of abatement is high while reductions are uncertain. While this Select Committee is dealing with wind turbines, the same arguments apply to solar which is even higher cost.

The RET mandates 41,000 GWh of large scale renewable energy by 2020 regardless of cost. I interpret from the [RET Review Report, Figures 11 and 13](#), 41,000 GWh would be about 18% of generation in 2020. Wind would provide most of this, so it may supply around 15% of generation by then. Based on the estimates in the previous sections, the effectiveness may approach 53% by 2020, in which case the CO₂ abatement cost may approach \$168/t CO₂ (Figure 3).

Direct Action and the RET are in conflict. Direct Action is designed to achieve specified reductions at lowest cost. In contrast, the RET must achieve a specified amount of electricity to be generated by renewable energy irrespective of how much CO₂ it avoids and irrespective of cost.

Why do we need a RET as well as Direct Action? Why not allow Direct Action to do its job, to achieve emissions reductions at the lowest cost? Why distort the electricity market with mandated renewable energy requirements?

The RET should be either repealed or closed to new entrants with existing and committed projects incorporated in the Direct Action scheme. The Direct Action scheme should be renamed 'CO₂ Emissions Reduction Scheme' (CO₂ ERS). The CO₂ ERS should be technology neutral, i.e. it must not distort the market by favouring any one type or grouping of technologies. The scheme's name should be honest, objective and correctly state its purpose.

6 Recommendations

In consideration of the issues outlined above, I recommend that:

1. The Government task an appropriately qualified agency, such as the Productivity Commission and/or BREE with estimating the full economic cost of wind energy per MWh and the CO₂ abatement cost (\$/t CO₂ avoided).

2. To get an early indication, contract an appropriately qualified consultant (such as ACIL-Allen) to:
 - a. assemble the best estimates it can of the 'high quality' data required for the sophisticated analysis (this may include seeking information from generators with appropriate 'commercial in confidence' agreements), and
 - b. estimate the CO₂ abatement cost with wind power (including all the hidden costs and effects of higher electricity costs on the Australian economy).
3. Either, repeal the RET legislation which will:
 - a. avoid what will become an escalating compliance cost of emissions monitoring if it remains in place, and
 - b. allow Direct Action to operate without the RET being a major market distortion.
4. Or, if repeal of RET is not politically acceptable, close the RET to new entrants and incorporate the existing and committed RET installations into Direct Action.
5. Change the name of Direct Action to 'CO₂e Emissions Reduction Scheme' (CO₂e ERS). This should be technologically neutral with the primary selection criteria being objectively justifiable CO₂e avoidance cost (i.e. \$/t CO₂e avoided).

7 Responses to the Terms of Reference items

7.1 a. Household power prices

"a. the effect on household power prices, particularly households which receive no benefit from rooftop solar panels, and the merits of consumer subsidies for operators;"

The Levelised Cost of Electricity (LCOE) from wind turbines is around four times higher than the baseload power plants it is intended to displace (\$130/MWh v \$30/MWh, see Table 3). Clearly, the impact of wind turbines on power prices is substantial. Consider wind generation at 15% of the total, which is likely by 2020 under the existing RET, then 15% of our electricity would cost four times that from current baseload plants, i.e., an average increase of 45% in wholesale prices. This could mean a real increase in retail prices of around 20%.

7.2 b. Clean Energy Regulator

“b. how effective the Clean Energy Regulator is in performing its legislative responsibilities and whether there is a need to broaden those responsibilities”

The CER does not collect the information needed to accurately estimate the emissions avoided by intermittent generators such as wind turbines and solar panels.

However, I do not recommend that the CER regulations be broadened to require power stations to provide emissions estimates at 30 minute intervals because doing so would lead to escalating compliance costs of emissions monitoring forever. Although monitoring emissions from power stations is a requirement in EU and USA and is not hugely costly, the issue is that it will lead to ever increasing compliance costs for other emitters that are much more difficult to monitor. This can be seen from the example of the paint factory in NSW (Appendix 4). This is a slippery slope. Where do we stop before we have every farmer monitoring emissions from every cow, sheep and goat?

There is an alternative way to cut emissions from electricity without the need for emissions monitoring – France’s emissions intensity of electricity is 10% of Australia’s, its electricity is near the cheapest in EU, and they’ve been doing it for over 30 years (i.e. before ‘carbon’ restraint policies were introduced).

I do not recommend tightening the regulations for emissions monitoring. But if we continue with the RET mandating renewable energy, then it will inevitably become a requirement in order to estimate the cost of emissions avoided by wind and solar. This is just one example of how regulations and compliance costs will be ratcheted up over time if we continue with policies like the RET (and/or carbon pricing).

7.3 h. Energy & emission I/O equations

“h. the energy and emission input and output equations from whole-of-life operation of wind turbines;”

Wind power is less effective at avoiding emissions than commonly assumed in analyses of emissions avoided and cost per tonne avoided. Furthermore, the effectiveness decreases as the proportion of wind generation increases. Examples:

- Wind generation in ERCOT (Texas) was 79% effective in 2007-09 (Kaffine *et al.*, 2013) at 4.7% wind proportion of generation (c.f. 2.9% in Australia in 2012-13).
- Wind generation in EirGrid (Ireland) was 53% effective (Wheatley, 2013) at 17% wind proportion of electricity (i.e., similar to wind proportion expected in the NEM by 2020 if the RET remains as currently legislated).

Without the high quality emissions data from power stations, we may assume that wind generation in Australia is about 80% effective now and may approach 53% effective by 2020. At 50% effective the cost per tonne CO₂ avoided would be twice the estimates that do not take effectiveness into account.

7.4 i. Related matters

“i. any related matter.”

At 53% effective, the cost per tonne CO₂ avoided would be nearly twice the estimates that do not take effectiveness into account. Economic analyses submitted to the 2014 RET Review estimated abatement cost of the LRET, which is mostly wind generation, at \$32-\$72/t CO₂. These analyses may not have taken the effectiveness of wind generation fully into account; therefore, these analyses may have underestimated the abatement cost with wind turbines. If these analyses do not take effectiveness into account, and if effectiveness decreases to 53% by 2020, the estimates of abatement cost under the LRET would nearly double to \$60-\$136/t CO₂ with effectiveness included.

To put the estimated CO₂ abatement costs mentioned above in context, the ‘carbon’ tax was \$24.15/tonne when it was rejected by the voters at the 2013 Federal election. The current price of EU ETS carbon credits and international carbon credit futures are:

European Union Allowance (EUA) market price (10/3/2015) = [€6.83/tCO₂](#) (A\$9.50)

Certified Emissions Reduction (CER) futures price (9/3/2015) = [€0.40/tCO₂](#) (A\$0.56)

Therefore, the LRET in 2020 could be 2 to 5 times the carbon tax which was rejected by the electorate in 2013; 6 to 14 times the current price of the EUA; and more than 100 times the price of CER futures out to 2020.

Clearly, the RET is a very high cost way to avoid GHG emissions. The rational decision is to close the RET to future investments. Or, as an interim measure, wind the target back to a real 20% of electricity generation.

8 References

AEMC, 2014, [RET Review Analysis](#) prepared by Frontier Economics

AEMO, 2014, [Fuel and Technology Cost Review – Report \(ACIL Allen\), 12 June 2014](#)

BREE [Australian Energy Technology Assessment](#) (AETA), 2012 and 2013 Model Update

BREE, [2014 Australian Energy Update](#)

Herbert Inhaber, 2011, [Why wind power does not deliver the expected emissions reduction](#)

Daniel T. Kaffine, Brannin J. McBee, and Jozef Lieskovsky, 2013, [Emissions Savings from Wind Power Generation in Texas](#), IAEA, Volume 34 – Number 1.

Andrew Macintosh and Deb Wilson, 2011, [Searching for public benefits in solar subsidies: A case study on the Australian government's residential photovoltaic rebate program](#)

NGER, [Chapter 8 - Assessment of Uncertainty](#)

Martin Nicholson and Barry Brook, 2013, [Counting the hidden costs of energy](#)

OECD/NEA, 2012, [Nuclear Energy and Renewables - System Effects in Low-carbon Electricity Systems](#)

M. Oliver and T. Jackson, 2000, [The evolution of economic and environmental cost for crystalline silicon photovoltaics](#)

Australian Government, [Renewable Energy \(Electricity\) Act 2000](#)

Sustainable Energy Authority of Ireland (SEAI), 2014, [Quantifying Ireland's Fuel and CO2 emissions Savings from Renewable Electricity in 2012](#)

UARG, 2014, [Comments on the US EPA 'Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units; Proposed Rule'](#)

US EPA, 2009, [ECMPS Reporting Instructions - Emissions](#)

US EPA, 2009, [Plain English Guide to the Part 75 Rule](#)

Joseph Wheatley, 2012, [Quantifying CO2 savings from wind power](#) (Version submitted to journal prior to peer review, no paywall)

Joseph Wheatley, 2013, [Quantifying CO2 savings from wind power](#)

Appendix 1: ‘Quantifying CO2 savings from wind power’

Below are excerpts of the Outline and Conclusions of Wheatley, 2012, ‘[*Quantifying CO2 savings from wind power*](#)’ in Ireland (these excerpts are from the paper as submitted to the journal, not the published version, because the submitted version contains several points of relevance to this submission that are not included in the published version). This analysis is an example of what needs to be done to get a reasonable estimate of the effectiveness of wind turbines at avoiding CO2 emissions. The first take-away message is that CO2 avoided is likely to be less than commonly believed. (Therefore, the cost per tonne CO2 avoided is higher than commonly recognised.) The second take-away message is that Wheatley’s analysis using high quality data gave a significantly lower effectiveness than his preliminary, simple analysis using the data published by the Irish grid operator.

[My emphasis added in **bold**]

1 Outline

This communication describes a straightforward data-mining approach to the problem of quantifying emissions savings when wind power generation is used to displace fossil fuel based electricity generation. Using high-quality data from the Irish electricity grid in 2011, it is shown **that emissions savings were considerably lower than grid average emissions intensity**.

Increase in atmospheric greenhouse gases, due mainly to burning of hydrocarbons and coal, is shifting the Earth’s radiative balance in favour of a warmer climate.[1] Reduction of industrial CO2 emissions is a major focus of global environmental policy.[2] One widely adopted policy measure are state supports for wind power[3] on the grounds that wind generation displaces fossil fuel generation and therefore reduces emissions. Generous state supports have included mandatory targets, feed-in tariffs, subsidised finance for infrastructure etc. As a consequence, significant amounts of wind power have been embedded into electrothermal generation systems. On the other hand, it is known that thermal generation responds in a non-trivial way when operated in parallel to stochastic power sources to meet system demand. Not all thermal plant are displaced equally, with flexible and/or high marginal cost generation being displaced the most. Average efficiency is reduced and higher cycling rates occur than would otherwise be the case. These effects tend to reduce the effectiveness of wind power in meeting it’s primary policy goal, namely emissions reduction.

The task of quantifying emissions savings from wind power is not straightforward. Electricity grids are complex systems, with many competing components and feedbacks. Moreover each system has a unique combination of fuel-mix, generator types, wind penetration, interconnection, despatch practices etc. Estimates of emissions savings have ranged widely[4] from higher than

grid average[5, 6] to near zero[7, 8]. Savings assumptions by public authorities have trended lower over time.[9] **Meanwhile despatch models have demonstrated that marginal savings decrease as installed wind capacity increases[10, 11] and that high levels of wind penetration may even be counterproductive in terms of emissions.[12]**

Empirical approaches based on real world grid data can help shed further light on these issues. Ireland in 2011 is a good empirical test case for the following reasons:

1. high average wind penetration (17% in 2011)
2. minimal electricity exports meant that virtually all wind generation was accommodated on the domestic grid in 2011
3. modern thermal plant portfolio with large amounts of relatively flexible gas generation ($\approx 58\%$ of demand) as well as coal and peat plant
4. zero nuclear and a low level of hydro ($\approx 2\%$)
5. highly volatility of wind generation helps statistical analysis over relatively short timeframes such as one year
6. availability of relatively high frequency grid data and mandatory emissions reporting at plant level under EU-ETS.[13]

The Irish grid operator[14] reports approximate system demand, wind generation and total CO₂ emissions rate every $\frac{1}{4}$ -hour. It is easy to obtain a **preliminary estimate of emissions savings** from this dataset. Linear regression of the time-series of grid carbon intensity (emissions rate per unit demand) onto wind penetration (wind generation per unit demand) gives a zero-wind emissions intensity of 0.54tCO₂/MWh⁶ and wind power savings 0.35tCO₂/MWh in 2011. This is equivalent to a **displacement effectiveness of just 59%**⁷. A plausible interpretation is that wind power displaces primarily clean gas (which have typical emissions $\approx 0.35\text{tCO}_2/\text{MWh}$) rather than high emissions coal or peat.

While these numbers are suggestive, their origin and accuracy are unclear. Firstly, aggregate numbers cannot show which generators or fuels are being displaced by wind power. Secondly, cycling effects (startup and ramping of thermal plant) are not included in the carbon emissions algorithm used by the grid operator. Thirdly, the role played by interconnection (electricity imports and exports) is unclear. Fourthly, the result for emissions savings is sensitive to

⁶ 54t CO₂/MWh is updated to agree with the value in the peer reviewed version published in *Energy Policy*. The value in the version submitted to the journal was 51 t CO₂/MWh.

⁷ 59% is updated to agree with the value in version published in *Energy Policy*. The value was 65% in the version submitted to the journal.

the correlation between wind generation and system demand. Spurious correlation may be present because the estimate of total wind generation is also used in the calculation of system demand.

In this study, time-series of CO₂ emissions are estimated for each gridconnected thermal unit in 2011. This calculation is based on generation data and physical characteristics of each generator. Additional emissions due to startups are included. Based on this CO₂ data, and a careful treatment of the wind and system demand, we estimate wind savings of -0.28tCO₂/MWh with implied **effectiveness of only 53%**. Some implications of these numbers are discussed at the end of the article.

4 Conclusion

As currently deployed, wind power is a supplementary power source whose role is to displace fossil-fuel generation. Ireland is a typical case where rapidly growing wind penetration is embedded in a diverse portfolio of thermal plant. A detailed empirical model of operational CO₂ savings was developed for 2011. It is found that savings of 0.28tCO₂/MWh were achieved, versus a zero-wind emissions intensity of 0.53tCO₂/MWh. **This estimate is at the lower end of expectations.**[10] Notably, it is significantly lower than the emissions intensity of CCGT plant which play the primary role in balancing wind generation. **There is evidence that effectiveness is likely to fall further as wind penetration increases.**[11, 12]

Assessments of the economic or environmental benefit of wind power are not credible unless they are based on accurate emissions (and fuel) savings. This study suggests that savings are lower than have been contemplated by public agencies to date. In particular, the Irish government has an ambitious target of meeting 37% of domestic electricity demand using wind power by 2020. **It is of concern that at 17% wind penetration, the system is already in a regime where effectiveness is approaching $\approx 50\%$, even before significant curtailment and/or exports of wind power begin to occur.**

Finally, life-cycle estimates of CO₂ emissions involved in construction and installation of wind power are sensitive to assumptions about the capacity factor, economic life of wind turbines, infrastructure requirement etc.[20] Estimates are in the range 0.002-0.08 tCO₂/MWh. At the upper end of this range, life-cycle emissions form a significant fraction of operational CO₂ savings.

Appendix 2 – Ramp rates and heat rate curves

There is a widely held belief that the coal plants' fuel consumption rates do not change much during ramping and cycling. This is a misunderstanding. In most cases but not all, their rate of fuel consumption during ramping changes nearly in proportion to the electricity generated. According to [this](#) modelling study by the Sustainable Energy Authority of Ireland (SEAI) fuel consumption during cycling is only about 1% of total fuel used by thermal power plants in Ireland; the report is a response to the Wheatley analysis.

Ramp Rates

AEMO gives information about the ramp rates of all the NEM's power stations here: [Ramp rates](#) (Ref. sheet 'Existing Generators, Columns 0 to R). It also gives the annual average thermal efficiency and emission factors for each power station.

Example ramp rates (from AEMO):

Station	Ramp Up Rate (MW/h) - for start up	Ramp Up Rate (MW/h) - when running normally	Ramp Down Rate (MW/h) - for shut down	Ramp Down Rate (MW/h) - when running normally	Thermal Efficiency (% HHV sent-out)
Bayswater	120	310	100	230	35.9
Eraring	150	300	210	300	35.4
Loy Yang A	350	330	430	320	27.2
Hazelwood	120	120	120	120	22.0

Heat rate curves

Below are some example heat rate curves for US black coal and brown coal plants.

Note that the US and Canada use the term 'heat rate' whereas in UK and Australia the term 'thermal efficiency' is more commonly used. Thermal efficiency is the reciprocal of heat rate with unit conversion so that numerator and denominator are in the same units.

Thermal efficiency = 3.6 / heat rate

Where heat rate is measured in MJ/kWh, GJ/MWh or TJ/GWh.

If the charts below were plotted as thermal efficiency instead of heat rate, they would be rotated 180 degrees (top to bottom), i.e. start low on the left, rise rapidly then flatten.

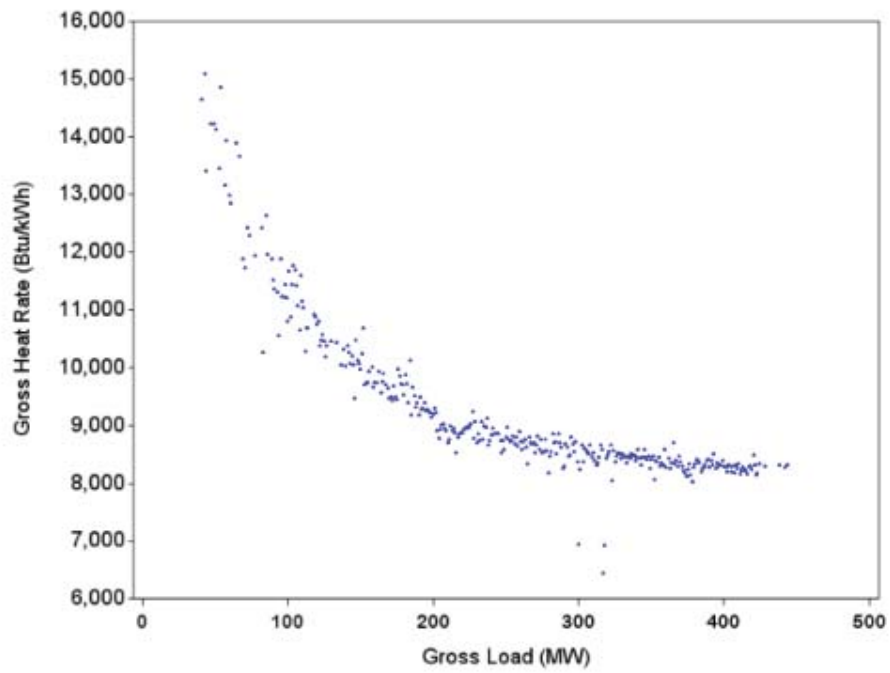


Figure 2-1. Gross Heat Rate vs. Load (MW): Indian River Unit 4 (Bituminous, Subcritical Opposed-fired Boiler)

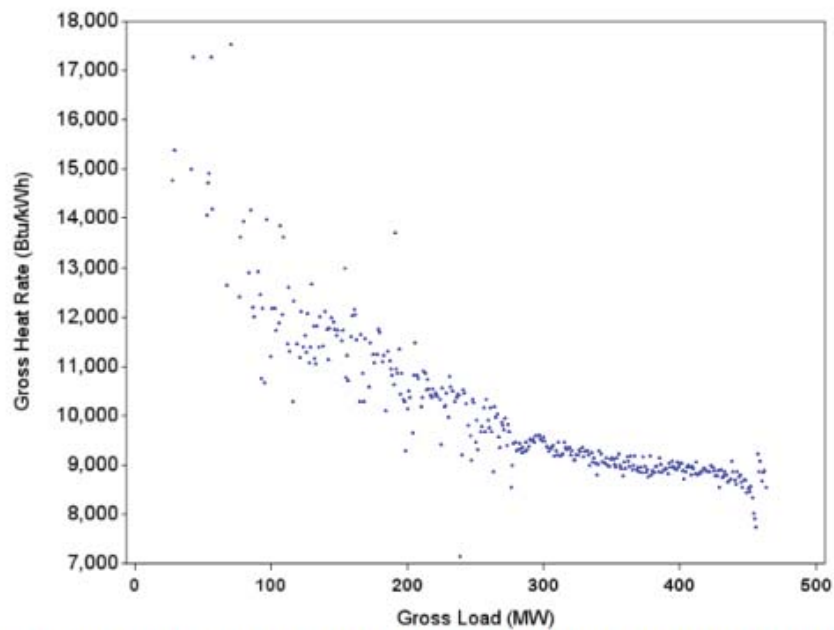


Figure 2-2. Gross Heat Rate vs. Load (MW): Springerville Unit 4 (Subbituminous, Subcritical Wall-fired Boiler)

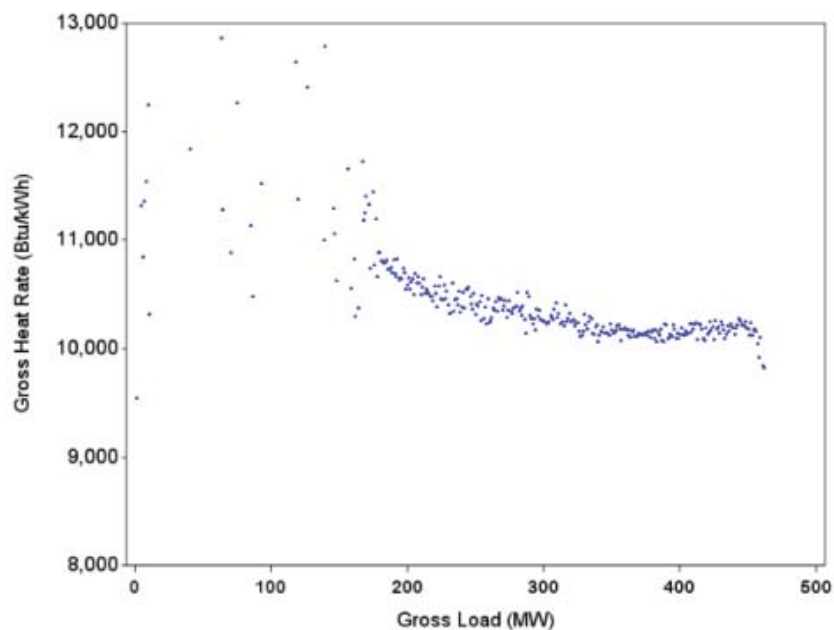


Figure 2-3. Gross Heat Rate vs. Load (MW): EW Brown Unit 3 (Bituminous, Subcritical Tangential-fired)

Source: [UARG \(2014\) Comments on the US EPA 'CARBON POLLUTION EMISSION GUIDELINES FOR EXISTING STATIONARY SOURCES: ELECTRIC UTILITY GENERATING UNITS; PROPOSED RULE'](#)

Appendix 3 – Simple calculation of CO2 abatement cost (\$/t CO2 avoided)

Calculation method:

From Table 1 (page 24):

Average LCOE of electricity from *existing* baseload generators (the intended target for wind turbines to force out of business) = \$30/MWh

The average LCOE of new wind turbines = \$110/MWh

Therefore, increase in costs due to replacing *existing* baseload generators with *new* wind turbines = \$80/MWh

From Table 1 (page 24):

CO2 emissions intensity of *existing* baseload generators = 1 t CO2/MWh

CO2 emissions intensity of wind turbines = 0 t CO2/MWh

Therefore, CO2 savings achieved by replacing baseload generators with wind turbines if wind turbines were 100% effective = 1.0 t CO2/MWh

It follows that CO2 savings achieved by replacing baseload generators with wind turbines if wind turbines were 50% effective = 0.5 t CO2/MWh

Abatement cost is calculated as LCOE increase divided by Emissions Intensity savings.

At **100% effective**, abatement cost = (\$80/MWh) / (1.0 t CO2/MWh) = **\$80/t CO2**

At **50% effective**, abatement cost = (\$80/MWh) / 0.5 t CO2/MWh = **\$160/t CO2**

Table 3 below shows inputs, intermediate calculation results and the abatement cost at 100%, 80% and 53% effectiveness. The columns show the results for three cases, assuming wind displaces coal, gas or the NEM avg. The inputs are nominal values (from Table 1) for the purpose of illustrating this simple method to estimate abatement cost.

Table 3:

Inputs and Assumptions

	Coal	Gas	NEM avg.	Wind
LCOE, \$/MWh	\$30	\$80	\$50	\$110
CO2 EI, t CO2/MWh	1.0	0.5	0.9	0.0
Wind substitutes for:	Coal	Gas	NEM avg.	
LCOE increase, \$/MWh	\$80	\$30	\$60	
CO2 EI savings, t CO2/MWh	-1.0	-0.5	-0.9	

CO2 abatement cost (\$/t CO2 avoided)

	Wind substitutes for:		
Effectiveness	Coal	Gas	NEM avg.
100%	\$80	\$60	\$67
80%	\$100	\$75	\$83
53%	\$151	\$113	\$126

Other estimates of CO2 abatement cost with the RET

This section includes CO2 abatement cost estimates from other sources for comparison. However the various estimates use different assumptions. Important differences from the estimates shown in Figures 2 are:

- The abatement costs in Figures 2 and 3 are calculated from the inputs in Table 1 which in turn are nominal values based on BREE AETA 2012 and 2013 Update. I've assumed no change in real LCOE to 2020. ACIL-Allen uses projected costs for the period 2014 to 2030 and to 2040. The abatement cost estimates would have very high uncertainty, but it is not quantified.
- The decreasing CO2 effectiveness as the proportion of wind generation increases is not taken into account.
- Some of the other costs that should be attributed to wind generation (see Section 4.2) may not be taken into account (Figure 3 includes an allowance for these additional costs).

Source	Applies to	year	\$/t CO2	Reference
This Submission, Figure 2, 100% effective, NEM avg.	Wind	2012	67	Figure 2
RET Review Report, ACIL-Allen report	LRET	2014 to 2030	62	Table 3, p42
Frontier Economics	RET		55-65	RET review p42
Deloitte	LGC only	2013	72	p20
Productivity Commission	LRET	2009-10	37-111	Appendix 3
AIGN, 2013, RET How it works and what it costs		2012	109	Table 3.4, p13
MIT CEEPR, 2013 - The Cost of Abating CO2 Emissions by Renewable Energy Incentives in Germany	Wind	2010	90	p14

The following is an excerpt from p42 of the [RET Review Report](#), 2014:

ACIL Allen's estimates for the cost of abatement of the RET are summarised in Table 3. The cost of abatement of the current RET policy is estimated to be \$35 to \$68 per tonne over the period 2014 to 2030, with the SRES being higher than the LRET at \$95 to \$175 per tonne in comparison with \$32 to \$62 per tonne to 2030.

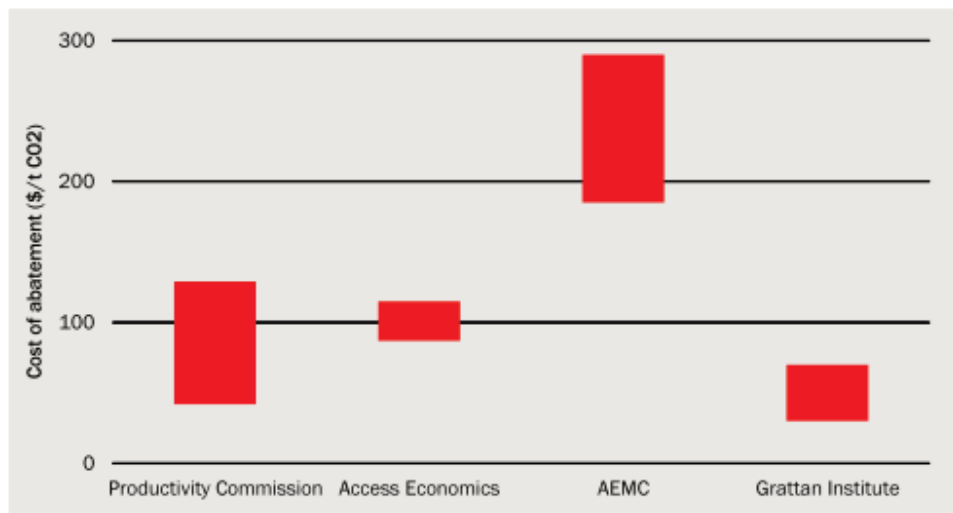
Table 3 ACIL Allen estimates of the cost of abatement of the RET (\$/t CO₂-e)

	2014 to 2030			2014 to 2040		
	RET	LRET	SRES	RET	LRET	SRES
Undiscounted	35	32	95	25	22	79
Discounted	68	62	175	62	56	185

Similar cost of abatement estimates have recently been made elsewhere. Modelling by Frontier Economics estimates that the cost of abatement from the RET is between \$55 and \$65 per tonne.⁴¹ Modelling by Deloitte estimates the cost of abatement (based on LGC costs alone) of the RET to be \$72 per tonne in 2020, increasing to \$82 per tonne in 2030.⁴²

The following charts, table and text are excerpts from AIGN, 2013, [RET How it works and what it costs](#):

3.6 Ranges for the cost of abatement under the overall RET scheme



3.7 Comparison of the cost of abatement under the RET

	Productivity Commission (2011)	Access Economics (2011)	AEMC (2011)	Grattan Institute (2011)
Measure of cost of abatement	Implicit abatement subsidy ³	Cost of purchasing RECs divided by total emissions abatement achieved	Cost relative to change in emissions ⁴	Cost of complying with scheme relative to abatement achieved
Relevant year(s)	2009-10	2020	2011-2020 ⁵	2010
Cost/subsidy equivalent under LRET scheme (A\$m)	283-459	n/a	320-495	
Abatement under LRET	4.1-7.6 Mt CO ₂	n/a	4.0-9.0 Mt CO ₂ -e	8.6 Mt CO ₂ -e
LRET cost of abatement (\$/t CO ₂)	37-111	n/a	55-80	
Cost/subsidy equivalent under SRES scheme (A\$m)	52-98	n/a	50-750	
Abatement under SRES	0.2-0.3 Mt CO ₂	n/a	0.1-2.5 Mt CO ₂ -e	0.2 Mt CO ₂ -e
SRES cost of abatement (\$/t CO ₂)	152-525	n/a	300-500	
Cost/subsidy equivalent under overall RET (A\$m)	335-556	3,944-3,982 ⁶	n/a	
Abatement under RET	4.3-8.0 Mt CO ₂	34.6- 45.3 Mt CO ₂ -e	4.1-11.5 Mt CO ₂ -e	8.8 Mt CO ₂ -e
Overall RET cost of abatement (\$/t CO ₂)	42-129	87-115	185-290 ⁷	30-70

Source: As shown in column headings

A number of important points emerge from these comparisons:

- the overall RET cost of abatement ranges from \$30 to \$290 per tonne of CO₂
- the cost of the LRET is lower, ranging from \$37 to \$111 per tonne of CO₂
- the cost of the SRES is considerably higher, ranging from \$152 to \$525 per tonne of CO₂
- each of these costs is higher than either the current or expected carbon price. The presence of the RET therefore raises the cost of abatement to the Australian economy as a whole.

Looking at the individual studies:

- Access Economics report on the impact of climate change policies estimates that abatement cost under the RET is approximately \$87-115/t CO₂-e at 2020
- The Productivity Commission also evaluated the 'effective' carbon price or the cost of reducing greenhouse gas emissions of different carbon emission policies. The commission estimated that the cost of abatement under the RET scheme was in the range of \$42-\$129 in 2009 and 2010. Although the study does not explicitly estimate the cost of the LRET and the SRES, it does measure the cost of abatement under the large-scale and small-scale component of the RET as it existed in 2010
- The relatively lower cost of abatement estimated by the Grattan Institute is based on certificate prices. The cost per tonne of CO₂-e abated has ranged from \$30-\$40/t CO₂-e when certificate prices have been low (reached as low as \$15 near 2007) to around \$70/t CO₂-e when certificate prices have been high (reached a peak of \$50 in 2008/09). The

price of certificates collapsed by 2005 when the scheme was substantially over supplied with renewable energy and revived soon after 2007 when policy commitments were made to expand the target (Grattan Institute 2011)

■ The cost of abatement for the overall RET scheme estimated by the Australian Energy Market Commission (AEMC) is significantly higher than other estimates. Importantly, the cost of abatement under the LRET estimated by the AEMC is in a similar range to that evaluated by the Productivity Commission, despite the use of entirely different approaches. However, as the AEMC takes an average of the abatement cost under the LRET and the SRES to estimate the cost of abatement under the overall enhanced RET, it is obvious that the SRES component of the RET is driving up abatement costs significantly

■ As AEMC note, estimating the cost of abatement under the SRES or other policies such as jurisdictional FiTs which support solar PV installations is difficult as it is not possible to entirely disaggregate the abatement or the cost that should be attributed to one particular policy. For this reason, the costs of abatement under the SRES have been based on the costs of abatement from solar PV installations, which reflect the cost premium borne by the economy as a whole when replacing solar PV with gridbased electricity (AEMC 2011). In this way, the cost of abatement is measured by the economic resource cost of PV installations divided by the abatement these installations manage to achieve. The costs range from around \$500/ tonne CO₂-e in 2010-11 to around \$300/ tonne CO₂-e in 2019-20, highlighting that solar PV offers a relatively expensive means of achieving abatement. The high cost associated with the SRES therefore translates to a relatively high average cost of abatement under the overall enhanced RET scheme.

References:

ACIL-Allen, 2014 [*RET Review Modelling*](#)

CIE for AIGN, 2013, [*RET How it works and what it costs*](#)

Deloitte, 2014, [*assessing the impact of the renewable energy target*](#)

DPMC, 2014, [*RET Review Report*](#), Section 5.6, Table 3

Frontier Economics for AEMC, 2014, [*RET Review Analysis*](#)

Productivity Commission, 2011, [*Carbon Emissions Policies in Key Economies*](#)

MIT CEEPR, 2013, [*The Cost of Abating CO₂ Emissions by Renewable Energy Incentives in Germany*](#)

Appendix 4: – Compliance costs of GHG emissions monitoring – a NSW paint factory's experience

Below are copies of some interesting comments by engineer 'Graeme No.3' on '[The ultimate compliance cost of the ETS](#)'. Some of his comments are copied below. Consider how much higher the cost per tonne CO₂ avoided would become as the requirements inevitably will be ratcheted up to require GHG emissions monitoring from smaller and smaller emitters. Consider this as an indication of the effect on medium and small businesses as requirements would inevitably be ratcheted up over time.

Extracts of four comments by Graeme No 3 [here](#):

"Estimates of emissions from the combustion of individual fuel types are made by multiplying a (physical) quantity of fuel combusted ... and a fuel-specific emission factor

I've retired from all that estimation but was involved when it started in NSW when I worked for a paint Company making some resins. The short answer is that we didn't know what specific fuel types or amounts were combusted in our after burner (to reduce all emissions to CO₂ and some nitrogen oxides).

Firstly, a portion of the resin ingredients were chemically changed during reaction, and a mixture of the reactants and the changed substances went straight to the oil fired after burner. It was a complex and variable mixture, and analysing each reaction would have been a nightmare of complexity.

Also into the afterburner went volatiles from the paint production. As there were over 6,000 products and hundreds of volatile ingredients it was impossible to calculate emissions.

The 4 "methods" put forward by the public servants ranged from idiotic to bizarre. (No-one in the paint industry could supply the answer, but were threatened with fines if they didn't).

I moved on, thankfully, and my successor was a practical (unscrupulous) fellow who responded by generating a vast spread sheet of over 600MB. 16 pages of calculations, I've forgotten how many pages of information on composition, tonnage produced, batch sizes and frequency of manufacture. All in 10 point Arial font with no graphics. Factors were assumed and buried in obscure corners with no explanations.

One resin might be spread over 200 products. And with 6000 rows and 120 columns on a page, try following through that, esp. with references from page to page to another page. It looked impressive, but trying to check it was nigh on impossible, but the public servants were pleased and even recommended that other paint companies consult him! His view was that he retired in 5 years and

they wouldn't figure it out in that time. His comment was "Brains baffle b*llsh*t".

This I add happened more than 5 years ago."

Posted by **Graeme No.3**, Thursday, 10 May 2012 5:54:18 PM"

"The CO2 emissions from the after burner were, as first comment above, impossible to measure. Installing a spectrophotometer 70' up (as was suggested by the public servants) exposed to the weather and to 300°C exhaust gases didn't appeal as reliable.

The point was that the highly variable flow of flammables from the resin plant and/or the paint factory was balanced by the oil firing to maintain the right temperature. Since we could only get an average figure for the oil consumption, and no figures at all for the flow of flammables, there was no way you could get the amount of CO2 emitted.

The Government assumptions were from a paint plant with 2 bulk tanks (of water based resin) and 3 mixing tanks. They assumed that all paint companies were similar. We had over 200 tanks of varying sizes. Even the bulk holding tanks could hold different materials at different times of the year.

Also, we had over 6,000 products. Classed into categories of similar composition, and in groups of 20 to 200 (roughly). The public servants came to a meeting and faced with arguments that their 4 suggested methods wouldn't (and couldn't) work, suggested that we install recording spectrophotometers at suitable points in the paint factory. We estimated we would need 112 measuring heads, and the figures would have been worthless without simultaneous air flow measurements."

Posted by **Graeme No.3**, Friday, 11 May 2012 6:33:31 PM

All the other paint companies were in the same position. One of the public servants got very agitated and arrogant about the lack of response (so much so that complaints from other companies resulted in him being disciplined and removed).

As I said the two of us worked on it for solid weeks, then had 2 or 3 meetings with the public servants over about another 6 weeks. All up about 10 weeks work for nil result.

The new engineer took that different approach. I think it took him 5-6 weeks to prepare the spreadsheet, which I think had to be copied onto a DVD to give to them.

The public servants were delighted, they had numbers! Other paint companies got together with him, and prepared their own sets of figures. And I believe for some years these were up-dated annually (at a cost of 2 weeks work).

As I indicated the figures were quite dubious, but that didn't seem to matter. I have no doubt that figures like this were carefully integrated into their planning.

I don't believe that many companies can make accurate measurements of all the emissions which the public servants want. They seem to think that everything is measured as a matter of course, and that Companies employ lots of people to do that, regardless of cost.

Personally I think the cost of accurate measurements will be beyond most companies resources, and an approach like the above will be adopted. After all, the public servants won't be able to measure them anyway, even if they wanted to do so.

Posted by **Graeme No.3**, Friday, 11 May 2012 6:51:26 PM

Peter Lang,
curious how the old memories come back.

At the time it seemed a clash of cultures; there wanted something and couldn't see why it wasn't supplied a.s.a.p. The public servants weren't interested in our difficulties, they expected us to drop everything and comply with their demands. Almost feudal, like a Baron addressing serfs.

The original demand came with a deadline, and threatened us with fines and/or imprisonment if we didn't supply the information on time and guarantee its accuracy.

I don't think that the question of the costs of compliance ever crossed the minds of this government or its advisors. For over 50 years the amount of paperwork they've demanded from industry has grown and grown. Each Department assumes their demands are reasonable and not much work (forgetting that collecting data takes far more time than filing it) and not allowing for other departments demands.

The howl from industry has been loud and clear for years, yet ignored. The burden is becoming too great, and will be resolved by either of two methods - that of the Israelites departing Egypt, or the French peasants revolting. For companies the first is in vogue.

That we might have other priorities wasn't considered, but even then the firm was trimming staff. We were down about 40 from 4 years before, and had about 170-180 working there.

I lost contact but I know that there are now less than 50 there. Drastic cuts have been made because they are struggling to compete with overseas competitors, yet they were exporting quite large volumes when I was there.

Posted by **Graeme No.3**, Saturday, 12 May 2012 9:23:33 AM

Consider the consequences and costs of regulatory ratcheting if we increase the requirements for emissions monitoring. Consider the number and size of companies, charities, etc. that would eventually have to monitor and report their emissions as, progressively, the countries of the world join in emissions monitoring and eventually all have to monitor some 80% of all emissions in each country (Australia monitors 53% EU 45% and USA 49%). It's difficult to see how Australia could monitor 80% of all human caused emissions, let alone Eretria, Ethiopia, Mogadishu, Somalia, etc.

Therefore, I urge the Select Committee to strongly resist asking for an increase in regulatory burden of emissions monitoring. Consider where it will lead eventually if the world goes down this path. It's not necessary. Emissions from electricity can be largely avoided with now emissions monitoring – France's emissions from electricity are 10% of Australia's and that was achieved mostly during the 1970s and 1980s. That's the future, no need for emissions monitoring and no RET. Just Direct Action to buy the least cost GHG emissions abatement.



ARREA

Researching Australia's Renewable Energy Future

ARREA Submission

Select Committee on Wind Turbines

Select Committee on Wind Turbines
PO Box 6100
Parliament House
Canberra ACT 2600

Introduction

ARREA believes Renewable Energy is very important for the sustainability of Australia's future. As outlined in the ARREA Submission of May 2014¹, Review of the Renewable Energy Target, it is of grave concern that the *Renewable Energy (Electricity) Act 2000* ("the Act"), and associated Acts, and associated Regulations ("the Regulations"), together hereafter referred to as ("the legislation") have not achieved its objectives to date and therefore will not achieve its objectives by 2020.

Terms of Reference

This submission directly addresses the second headline terms of reference being the "**economic impact of wind turbines**", including the associated matters on how effective the Clean Energy Regulator (CER) has been, the adequacy of monitoring, the 'energy and emission input and output equations' and related matters.

Economic Impact of Wind Turbines

In order to assess the economic impact, historical performance data is a crucial and fundamental benchmark against which the Select Committee can verify the economic impact of wind turbines.

This historical data provides the performance measures (key performance indicator – KPI's), which can then be assessed against the Objects of the Act, namely being to encourage additional generation from renewable energy sources, reduce greenhouse gas emissions (GHG) in electricity sector and ensure renewable energy sources are ecologically sustainable.

¹ <https://retreview.dpmc.gov.au/sites/default/files/webform/submissions/ARREA%20Submission%20-%20Review%20of%20Renewable%20Energy%20Target.pdf>

Under the current regime adopted by the CER, it appears that no real effort has been made by the CER to verify the claims of the wind industry as to the actual performance of wind turbines as they relate to the fundamental task of reducing GHG emissions in the electricity sector.

This is despite voluminous data being collected and publications being released – that have no direct financial impact under the Act (which this issue does) but rather support the wind industry.

In particular the CER refers to early/preliminary assumptions (including in external consultants reports) of a 100% effectiveness of wind in offsetting CO2 – but has taken no known action to verify these assumptions, or if it has, the CER has failed to advise the Government or the wider Australian community that under current policy settings subsidises the wind industry through higher electricity prices to the tune of many millions of dollars each year.

The current lack of performance measurement is not acceptable – it would not be tolerated in any other industry let alone one reliant on mandated subsidies. The CER should be admonished for this failure to properly monitor the true impact of an industry that comes at a high cost to the nation's economy and electricity consumers in particular.

Many are asking is this 'regulator' asleep at the wheel (refer to HII Royal Commission findings) – or do they already have information they are not acting upon or have failed to provide to Government or the community?

While performance measurement should be a fundamental and first step in any management regime, particularly where taxpayer funds and electricity consumers are involved, of equal concern is the impact this lack of measurement has on the CER fulfilling its responsibilities under the Act and the Regulations. There are

financial flow-on impacts to electricity consumers and in respect of Public Monies received (via inappropriately issued RECs).

If the CER has already carried out – as ARREA has done – a detailed analysis of the actual performance of the wind industry operations, it should make its analysis of that data public. The CER should have taken action as we have outlined below, and if it has not, the CER should be held accountable to explain to both the Australian Parliament and the Australian public why it has not acted.

Ultimately, it is through Federal Government legislation that the public funds the wind industry. The CER should as a result and as is required by the legislation, have a wider view of their role than unquestioningly supporting the wind industry as it openly seeks to maximise its financial claim on the public purse.

That claim is very substantial: between 2015 and 2031 the LRET requires electricity retailers to purchase and surrender 587 million RECs; with RECs soon to trade at a price in order of \$94 (as designed under the policy), the total value of those certificates will exceed \$55 billion.

That entire sum will be recovered by retailers via retail power bills, as a federal tax on all Australian electricity consumers, and returned mainly to wind power generators as a government mandated subsidy. This represents the largest single industry subsidy scheme in the history of the Commonwealth.

Yet despite its scale, there appears to have never been a cost/benefit analysis to determine whether there is any net benefit attached to the LRET policy and/or the value of the subsidies mandated under it.

In a recent report carried out by Rupert Darwall, “*Central Planning with Market Features*”², the author observes in relation to the UK’s energy policy, inter alia, that:

Foundational Error. The turning point which led to the demise of the market was not proceeded by extensive policy appraisals or analysis of alternatives to the market, but from the adoption of the renewables target at a European Council meeting. Target-driven policy objectives are inflexible. They prevent exploration of trade-offs. The more compressed the deadline, the higher the costs. The overriding focus on meeting the target narrows the field of vision, so that emerging difficulties from other countries, notably Spain and Germany, were ignored as evidence for reappraising the target.

Policy Lesson #4

Setting a target before analysing the costs, operational implications and likely unintended consequences, without considering alternatives constitutes the foundational error in the entire process from which, in one way or another, subsequent errors flowed.

Form over function. Having decided to adopt a renewables target, there has been no comprehensive analysis of its costs, benefits and implications for the market. In particular, decision - makers did not ask what exactly electricity consumers get in return for the use of high cost private sector capital and whether it represented value for money for them.

Policy Lesson #6

Before adopting EMR [Energy Market Reform], policymakers should have evaluated it against a public sector comparator so that the net cost/benefit of

² “Central Planning with Market Features: How renewables subsidies destroyed the UK electricity market”, Rupert Darwall, March 2015.

using private sector capital is identified and quantified, rather than being implicitly assumed.

ARREA adopts those observations, and Mr. Darwall's report, as part of its submission; they are directly applicable to the LRET and the cost of the subsidies awarded under it. Moreover, the failure of the CER on behalf of the Australian government to have carried out a cost/benefit analysis of the policy, upon which the LRET is based, represents a regulatory policy failure of monumental proportions. The economic implications flowing from that failure for Australia, both in terms of its electricity market and the broader economy, are precisely those identified in Mr. Darwall's report.

There can be no justification for permitting that failure to continue: with more than \$50 billion in subsidies to be directed to wind power generators over the remaining life of the LRET, a proper, independent cost/benefit analysis must be carried out as a matter of urgency and advised to Government and the Australian public who ultimately fund the scheme.

At least one aspect of such an analysis should involve an investigation into the veracity of claims made by the wind industry that wind power generation reduces or abates CO2 emissions in the electricity sector.

If those claims can be verified, to any extent, that analysis should go on to investigate what actual reduction or abatement of CO2 emissions is attributable to wind power generation; and further investigate the total cost to electricity consumers (whether through direct subsidies or other components of their retail power bills) of any such reduction or abatement found to exist.

If the 2nd Object under the Act (reducing GHG CO2 emissions) and the 3rd Object (be ecologically sustainable) are to be met, the *encouragement of additional*

generation (1st Object) must be achieved by displacing thermal production not by duplicating it. If not, it is not 'additional', it is 'duplicated'.

ARREA will provide an important preliminary analysis of this historical performance data.

We are pleased to advise the Select Committee that to fill this key gap in the CER and Government's knowledge we have taken the very necessary step of commissioning international research to independently investigate the effectiveness of wind power in reducing GHG emissions from electricity generation in Australia during 2014, crucially using empirical 5 minute data from the 256 grid connected generators.

CO2 Emissions Savings from Wind Power in the National Electricity Market (NEM), by Dr Joseph Wheatley, Biospherica Risk Ltd, Ireland.

This research will be provided to the Committee as a completed Phase 1 report made available by 3 May 2015. Appendix A provides further details.

Stage 1 Report Findings - CO2 emissions savings from wind power in the NEM.

Key Findings

- 1. The best empirical estimate of emissions avoided was found to be 6.2MtCo2 in 2014.**
 - 2. Wind power generated 8.7TWH or 4.5% of the NEM's electricity but only reduced emissions by 3.5%. With a 95% confidence level wind power in the NEM in 2014 has an effectiveness in terms of emissions reduction of only 78% (being 3.5%/4.5%).**
 - 3. The possibility that wind power is 100% effective (as is the current basis for issuing REC's) is rejected.**
-

4. The 34 industrial wind turbine complexes have installed capacity of 3394MW and produced on average 970MW – they have a capacity factor of under 30%.

As a result, of analysis of the actual data in the NEM in eastern Australia in 2014 shows that wind power production has overstated the emissions reductions by 22% (100%-78%) and this percentage will continue to increase if the percentage of wind power entering the NEM increases.

Impact of key findings

a. Legislative

Under S18(1) of the Act the nominated person for an accredited power station may create a certificate for each whole MWh of electricity generated. That is one certificate for one MWh (1:1 relationship).

However under S18(3) of the Act, the amount of electricity generated by an accredited power station is to be calculated in accordance with the regulations.

Under Regulation S15A(a) Electricity omitted from this calculation includes electricity that was generated by using an eligible renewable energy source that is not ecologically sustainable.

Ecologically Sustainable (S5) means that *an action is consistent with the following principles of ecologically sustainable development:*

(a) decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations;

Including the 22% of ineffective wind production in this calculation is clearly not consistent with this decision making process, particularly concerning long and short-term economic and equity considerations.

(b) if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation;

Including the 22% ineffective wind production does raise a threat of serious environmental damage through the relative financial impacts on other renewable energy sources particularly given the wind industry's already high renewable subsidy market share. Excluding the 22% of ineffective wind is an action consistent with this principle, while using the current 100% figure is not. 'Pinpointing' the exact effectiveness percentage at a given point in time should not be a reason for postponing. The CER needs to take action on this as a matter of priority.

(c) the principle of inter-generational equity, which is that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations;

Including the 22% ineffective wind production is clearly not consistent with this principle. In particular, asking this generation of Australians to pay for the wind industry's ineffectiveness is not appropriate and does nothing to maintain or enhance the environment for future generations – it actually reduces this capacity.

(d) the conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making;

N/A -Including the 22% ineffective wind production does concern biological diversity and ecological integrity.

(e) improved valuation, pricing and incentive mechanisms should be promoted.

Including the 22% ineffective wind production is clearly not consistent with this principle. In particular, it clearly diminishes valuations and distorts pricing. This includes the displacement of gas as a significant energy producer of energy, particularly when its emissions are around half that of coal.

Excluding the 22% ineffective wind production promotes improved valuation, pricing and incentive mechanisms.

The approach taken above is also what Parliament intended for Regulation S15A(a). This regulation was inserted by Selected Legislative Instrument 2007 No336, the Explanatory Statement of which includes:

- The purpose of clarifying the meaning of eligible renewable energy sources **and sources that are not eligible renewable energy sources.**

This issue was also at the core of the Amending Act – REE (Amending Act 2006), with the same Explanatory Statement stating it “**enhances market transparency** and improves business certainty, provides increased opportunities for solar and bioenergy technologies, and **improves the operational effectiveness and efficiency** of the Act”.

1. Through the ARREA sponsored study, it has now been clearly established, using the empirical actual 2014 data, that 22% of the electricity generated by using wind as the eligible renewable energy source, is not ecologically sustainable.
2. Under S18, this shows clearly that nominated persons can now only create 0.78 of one certificate for every one MWh produced by wind (0.78:1 relationship).
3. Furthermore this (0.78:1) relationship will continue to decline if more turbines are placed in production.

b. REC Register

The [official REC Registry](#) confirms 8,399,885 certificates (excluding WA and NT) in generation year 2014, by wind.

Based the best empirical estimate of emissions savings, only 6,200,000 have been appropriately authorised under S18(1) of the Act.

Based on the 78% effectiveness shown, with 95% confidence level, the number appropriately authorised therefore under S18(1) of the Act, should have been 6,551,910.

That means the number of unauthorized 2014 certificates is between 1,847,975 and 2,199,885 with a high degree of confidence.

Using the CER published 2014 volume weighted average market price of \$35.24 per certificate. **The dollar value of these unauthorized certificates that did not lead to a reduction in emissions is between \$65.1M and \$77.5M in 2014.**

While the immediate abatement and cost of abatement implications of this empirical evidence are compelling, it is of concern that the situation will only further deteriorate over time.

The Wheatley study commissioned by ARREA shows that by 2020, if the current policy continues and wind was allowed to achieve 15% penetration, its effectiveness is highly likely to drop to around 50%.

For the Government and the Australian community that fund the subsidies that support renewable energy, this means that wind electricity production is ultimately self-defeating in abatement terms, for policy objectives and for the purposes of the Act.

Conclusion

As we indicated at the outset, ARREA believes renewable energy is very important for the sustainability of Australia's future.

However, the current policy settings in regard to wind turbines are flawed and their implementation has led to systemic failure.

The simple production of electricity from wind, subsidised or otherwise, to the extent it does not effectively offset thermal production volume, does not serve any material economic purpose for the nation.

Wind power duplicates electricity production, distorts market signals, especially compared to other renewable energy sources, and leads to inappropriate public perceptions about the value of wind power to the long-term sustainability of our nation.

We urge the Government to act on this significant flaw in its current policy settings.

Recommendations

That this Committee

1. Receive the full Phase 1 report - CO2 Emissions Savings from Wind Power in the National Electricity Market (NEM), by Dr Joseph Wheatley, Biospherica Risk Ltd, Ireland.
2. Obtain an assurance from the CER that nominated persons – the wind energy companies - will be advised of the need to apply, consistent with the Act and its regulations, a 0.78:1 relationship when issuing certificates.
3. Confirm that the Regulator will use its powers under the Act, including Part 15A Civil Penalty Orders and/or Enforceable Undertaking under S15B, to uphold the purposes of the Act.
4. Seek that the Australian National Audit Office (ANAO), conduct a performance audit on the CER's compliance with its role under the legislation. In particular:
 - a. What information did the CER hold on wind effectiveness in offsetting CO2 emissions at both 30 June 2014 (end of financial year) and 3 May 2015?
 - b. What Risk Management and Fraud Mitigation practices and processes are in place, have they been appropriate? If not, who should be held responsible and what rectification actions is required.
 - c. If all public monies collected in respect of the Act are appropriate.
 - d. If there are financial or other incentives, including but not limited to, the collection of public monies under the Act that are distorting the CER's role in achieving the Objects of the Act.
 - e. If the expenditure of public monies by the CER has been appropriately focused on achieving the Acts objects.

Ends

Appendix 1

Phase 1 - CO₂ Emissions Savings from Wind Power in the National Electricity Market (NEM), by Dr Joseph Wheatley, Biospherica Risk Ltd, Ireland.

Investigate the effectiveness of wind power in reducing CO₂ emissions from electricity generation in 2014 using a systems-based, empirical method.

Inputs: 5-minute generation data for 268 grid-connected generators, 5-minute interconnector flows (including losses), estimated thermal generator characteristics. (AEMO)

Methods: Extension of the empirical wind/emissions Ireland model³ to the larger spatial-scale, interconnected NEM. For the purpose of wind power impacts, the NEM as a whole is treated as a collection of state-level sub-systems coupled via interconnector flows. This model will be implemented via custom-written computer code, with numerical and graphical outputs.

Milestones:

- Data acquisition, cleaning, exploratory analysis.
- Empirical overview of grid operation in 2014 including fuel-mix, wind generation, capacity displaced by wind, interconnector flows, role of hydro.
- Estimation of 5-min CO₂ emissions time-series at plant level from generation data and estimated/sourced thermal plant characteristics. Verification.
- Development of grid-scale CO₂ wind/emissions model based on coupled state-level models. Fitting of this model to state-level data and extraction of emissions parameters.
- Overall emissions savings (tCO₂ & tCO₂/MWh) including statistical error and the influence of parametric uncertainty.

In view of the time-line of the Select Committee, the project will be divided as follows.

- Initial submission to Senate Select Committee in the form of an interim report summarizing the underlying technical issues, giving any available preliminary results and identifying relevant data deficiencies (ASAP).
- Complete phase 1 study delivered before May 15. International comparisons and proposal for further investigation.

³ [1] *Quantifying CO₂ savings from wind power*, Joseph Wheatley, *Energy Policy*, 2013, vol. 63 C, p. 89-96

CO₂ Emissions Savings from Wind Power in the National Electricity Market (NEM)

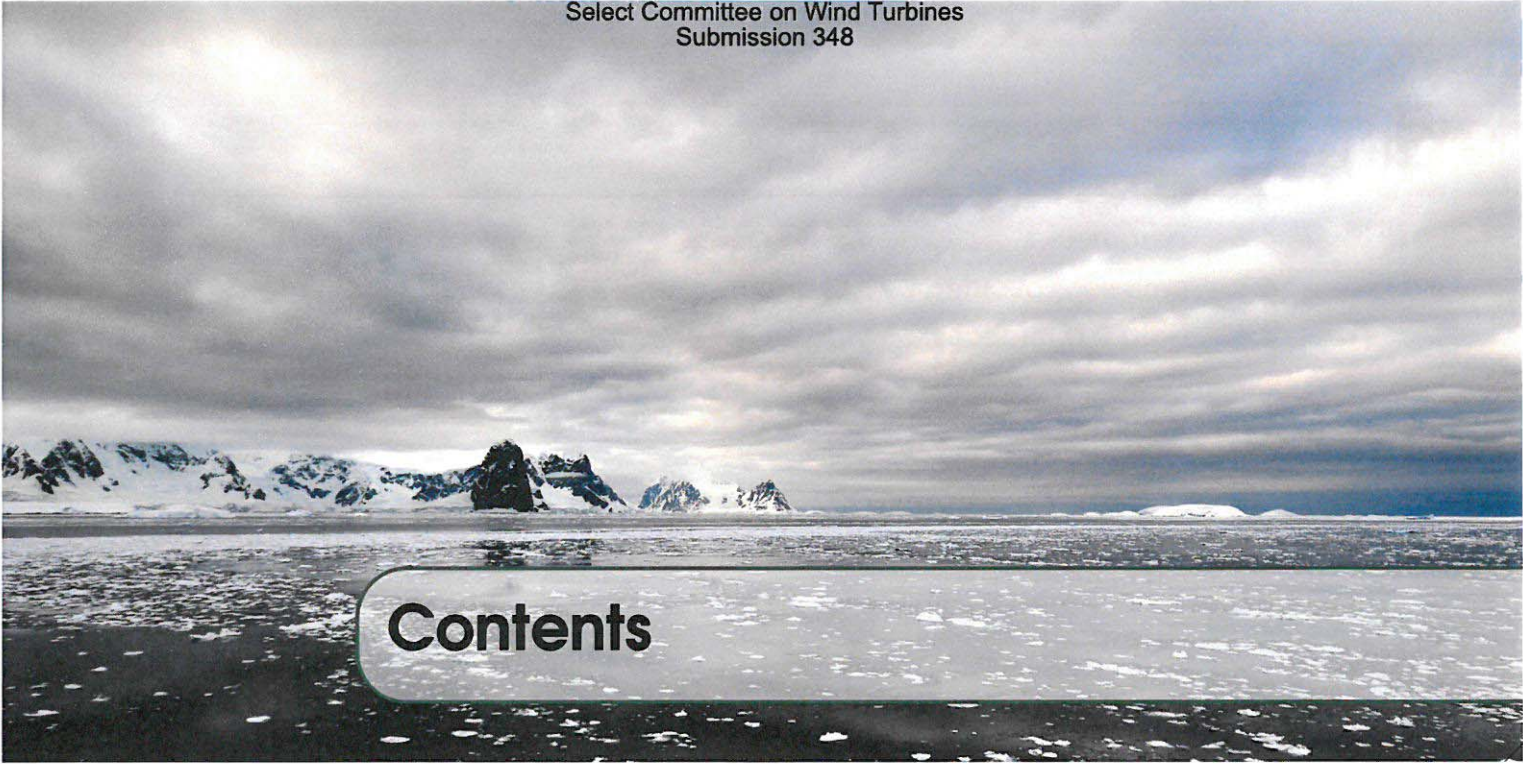
Submission to the Senate Select Committee on Wind Turbines

FINAL REPORT

PREPARED BY:
DR JOSEPH WHEATLEY
BIOSPHERICA RISK LTD

COMMISSIONED BY:
ASSOCIATION FOR RESEARCH OF RENEWABLE ENERGY IN AUSTRALIA LTD (ARREA)
ABN:65 166 633 263

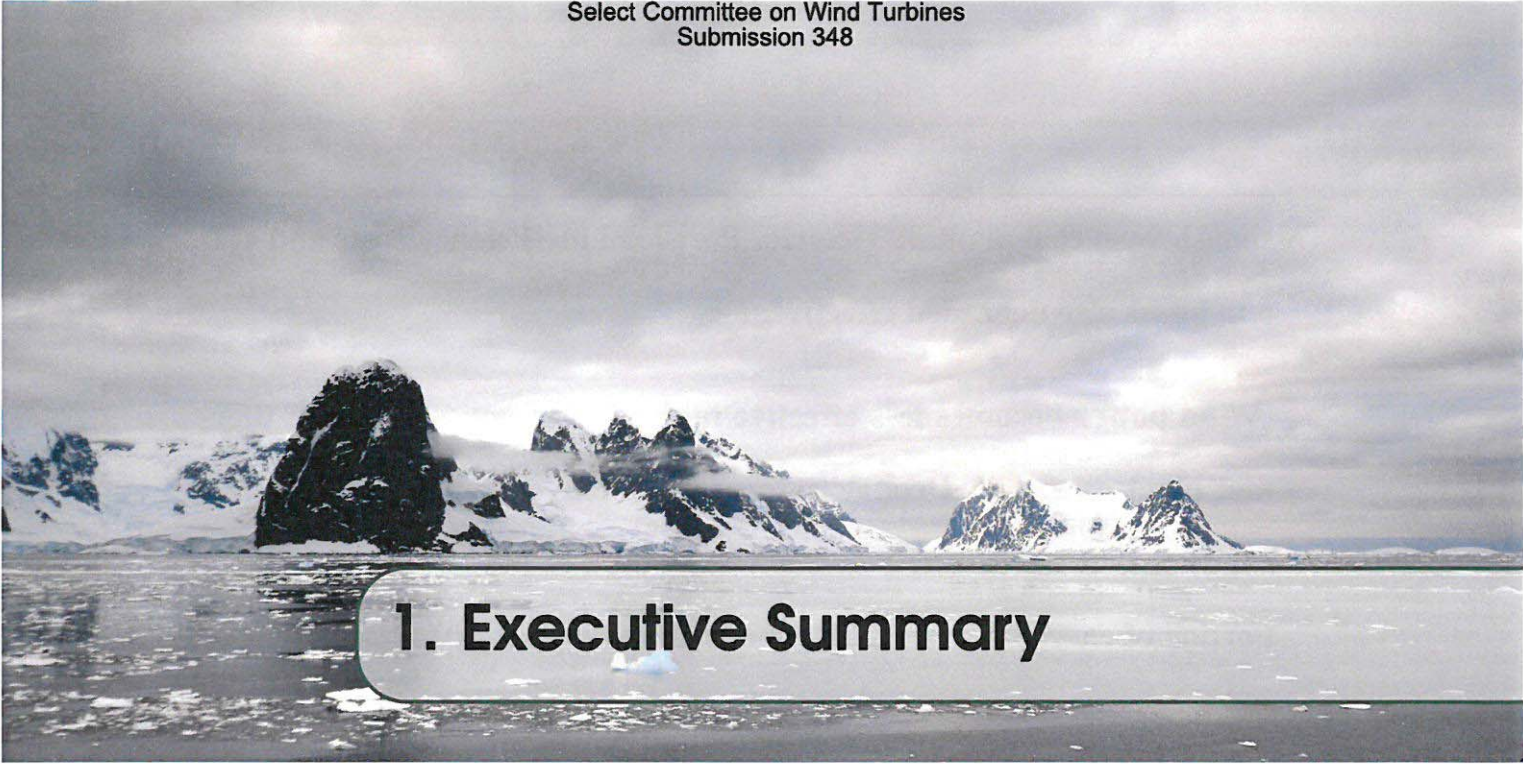
21 April 2015



Contents

1	Executive Summary	5
2	Overview of the NEM	7
2.1	renewables	10
2.2	fuel mix	12
2.3	outages	14
2.4	inter-regional flows	15
2.5	emissions	17
3	Empirical Method	20
3.1	emissions models	20
3.2	emissions avoided	22
3.2.1	hydro-wind	22
3.2.2	regression	22
3.2.3	peaking plant	24
3.3	discussion	25
3.4	limitations and suggested future work	28
4	Additional material	29
4.1	GLOSSARY	29

	4
4.2 parameters	32
4.3 emissions avoided by generator	36
4.4 data & references	41



1. Executive Summary

This report examines the contribution of wind power to CO₂-e emissions reduction in the NEM in 2014. Using a generation dataset at 5-minute intervals, CO₂-e emissions time-series are estimated for each of 151 thermal generators, giving total emissions from fossil fuel plant of 169.7MtCO₂-e. The best empirical estimate is that wind power avoided 6.2MtCO₂-e, a reduction in total emissions of 3.5%. Wind power contributed 4.5% of system demand and therefore the emissions displacement effectiveness of wind power was 3.5%/4.5% or 78% in 2014.

Several factors acted to limit the effectiveness of wind power in reducing emissions in 2014. A significant fraction of South Australia's wind output displaced low-emissions gas generation. Wind power tended to displace black coal plant in New South Wales rather than higher emis-

sions brown coal plant in Victoria. Part-load inefficiency costs and system losses also degraded effectiveness.

Wind power becomes less effective in displacing emissions from thermal plant as installed capacity increases. The evidence in this study suggests that effectiveness in the NEM would fall to $\approx 70\%$ if the proportion of energy provided by wind is doubled from 2014 levels.

The emissions parameters for individual power stations available for this study are approximate, which means that the quantitative results are subject to increased uncertainty. Data requirements for an improved investigation are described and a detailed multi-year study using such data is warranted.

2. Overview of the NEM

De-carbonisation of electricity production is a major goal of environmental policy. Wind power generation (WPG) is an emissions reducing technology which works by displacing fossil fuel generation. Unlike renewable sources such as hydro-electric power, WPG is not dispatchable generation i.e. it is not controlled by the grid operator. Instead the thermal system must adapt continuously to the natural variability (intermittency) of WPG. As the complexity of this interaction has become better understood, early optimism about the efficacy of wind power in emissions reduction has reduced. Under normal priority dispatch rules for WPG, one unit of wind energy (1 MWh) displaces close to one unit of conventional generation (slightly less due to system losses). However this relation need not be valid for CO₂ displacement. For instance, wind might selectively displace more flexible, high marginal cost gas plant rather than baseload coal plant. In that case the displacement effectiveness¹ of WPG is less than unity. In addition to this selective displacement effect, part-load inefficiency costs, ramping and startup costs tend to become significant as the installed wind capacity increases. This reduces the effectiveness of wind power in meeting it's primary policy goal.

In this report, empirical calculations[1] of the effectiveness of the WPG in the NEM during 2014 are described. The objective is two-fold:

- determine which information is required to answer this question empirically for the NEM
- provide estimates of operational emissions savings based on the available data

Operational emissions savings can be defined as the difference between the observed emissions and what emissions would be in a no-wind scenario all else being equal. This

¹ratio of % CO₂ emissions savings to % WPG, see Section 4.1

quantity can be investigated empirically. Empirical methods can assess the impact of wind power on the existing grid but they cannot indicate whether the existing technology mix or grid configuration is optimal from an emissions perspective.

Economic dispatch models are the standard approach to modelling electricity grids. The advantage of dispatch models is that they allow various scenarios to be investigated for planning purposes taking grid capacity constraints into account etc. However, dispatch models do not readily distinguish between conventional scheduled generation and non-forecastable generation such as WPG. Empirical methods are a complementary approach which have the advantage that they are based on real-world data. As intermittent renewable energy sources have become more important, use of empirical methods has increased.

The NEM consists of 5 interconnected regions (QLD,NSW,VIC,SA,TAS). Energy sources can be classified into seven types: brown and black coal (lignite and bituminous coal), natural gas, distillate (kerosene, diesel etc), hydro, wind and biomass. High frequency (5-min) SCADA generation data are [archived by AEMO\[2\]](#). These data describe the "as-generated" output of 256 metered generators which contributed power to the NEM in 2014, with a combined capacity of 46.6GW.² Generation can also be measured as "sent-out" i.e. power net of auxiliary loads and actually dispatched to the grid. The "as-generated" SCADA data are more directly relevant for calculation of emissions. Note that some smaller non-scheduled generation is omitted from the SCADA dataset. Apart from this, the 2014 SCADA archive is very nearly complete with just 0.3% of the data records missing. As is evident from Figure 4.1, a diverse range of thermal generator types, capacities and technologies are present on the NEM. Coal is the dominant fuel. 65 coal plant with a combined capacity of more than 25GW, accounted for 75% of electricity production.

Table 2.1 summarises total generation by fuel and region in 2014. This was compiled using generator location and fuel type information given in Tables 4.1-4.3.

region	Biomass	Black Coal	Brown Coal	Distillate	Gas	Hydro	Wind	TOTAL
NSW		54.5		0.0	3.8	1.5	1.1	60.9
QLD	0.4	41.7		0.0	13.6	0.9		56.6
SA			2.6	0.0	5.3		4.1	11.9
TAS					0.8	9.8	0.9	11.5
VIC			46.6		2.2	1.9	2.5	53.2
TOTAL	0.4	96.2	49.2	0.0	25.7	14.0	8.7	194.1

Table 2.1: Total energy (TWh) generated by region and fuel type in 2014.

²excluding pumped hydro capacity.

Figure 2.1 shows 5-minute time-series of NEM power generation by fuel type in 2014. Note the difference in vertical scales. Black coal is load-following, while hydro and gas also show peaking behaviour.

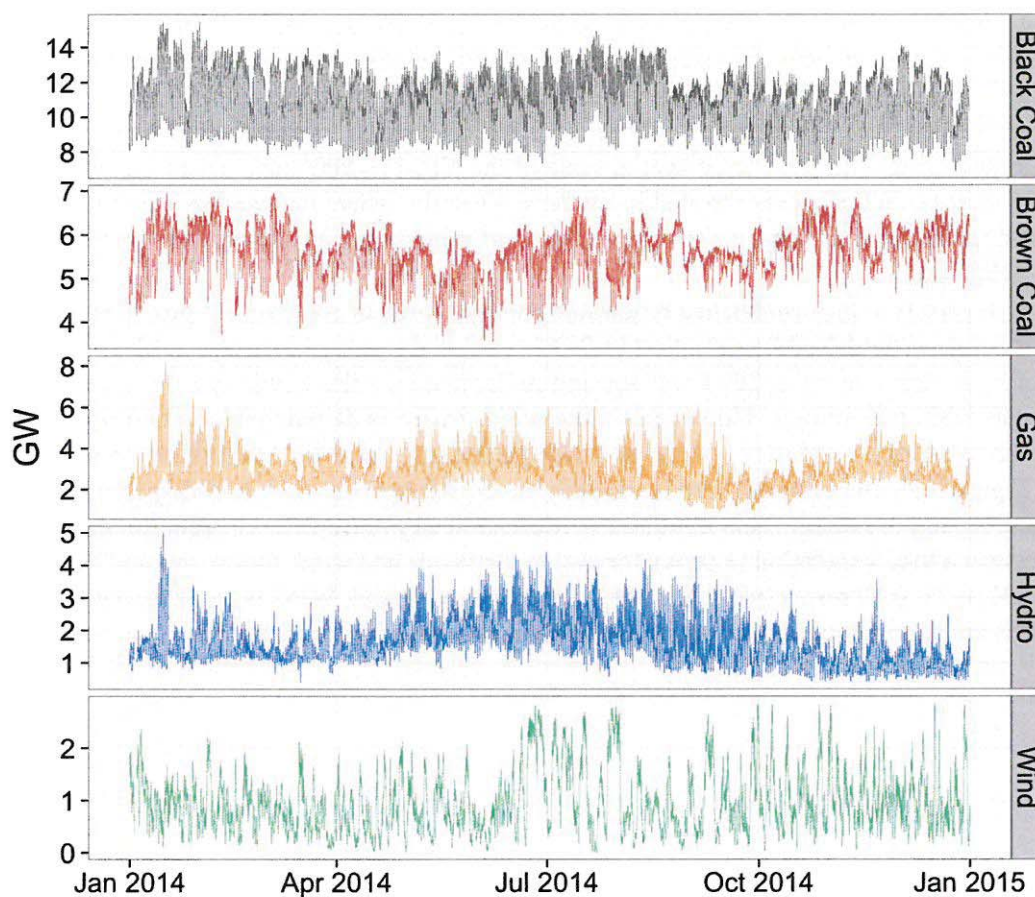


Figure 2.1: Total generation (GW) at 5-min intervals by fuel type from SCADA.

2.1 renewables

Wind provided 8.7TWh in 2014 or 4.5% of total energy generated. SCADA data is available for 34 wind farms with total installed capacity of 3394MW. These generated 970MW on average, which corresponds to a capacity factor of just under 29%. Capacity factors at regional level were 19%(NSW), 35% (TAS), 31%(SA) and 28%(VIC). Geographic diversification reduces the variability of total WPG relative to the output of individual wind farms. Nevertheless total wind power on the NEM remains highly variable or intermittent as can be seen from the bottom panel of Figure 2.1. The benefit of geographic diversification is limited despite the very large spatial scale of the NEM (~5000km). There are two reasons for this: (1) WPG is concentrated in southern Australia where the wind resource is strongest and (2) weather systems correlate the output of wind farms even over very large distances (>1000km).

Hydro is a long established renewable energy source in Australia. It provided 13.6TWh or 7.2% of total NEM generation in 2014 (excluding pumped storage). More than 70% of hydro generation in 2014 was located in Tasmania. Like wind, hydro is a low-carbon renewable technology. However, unlike wind, hydro is dispatchable generation. Hydro plant are flexible and may operate as peaking plant or as base-load depending on seasonality (Figure 2.1). In contrast, there is virtually no correlation between non-dispatchable WPG and system demand. This situation is illustrated in Figure 2.2. Correlation coefficients between total generation (a proxy for system demand) and wind, hydro, gas and WPG were 0.01, 0.73, 0.82 respectively in 2014. Like system demand, WPG is an exogenous variable. It is an external quantity to which the grid has to adapt continuously.

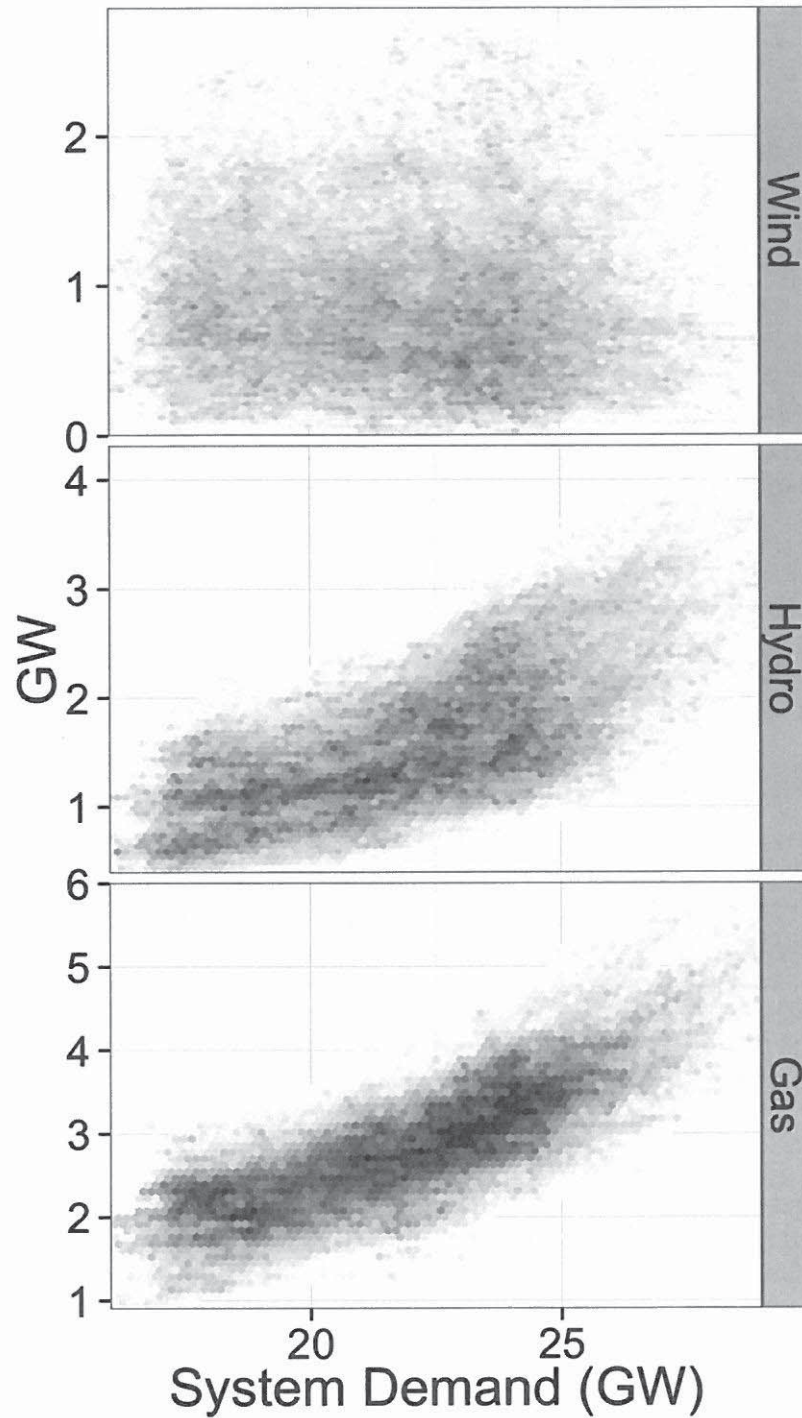


Figure 2.2: Generation by fuel type (GW) versus system demand (GW). Wind generation (top) is uncorrelated with demand.

2.2 fuel mix

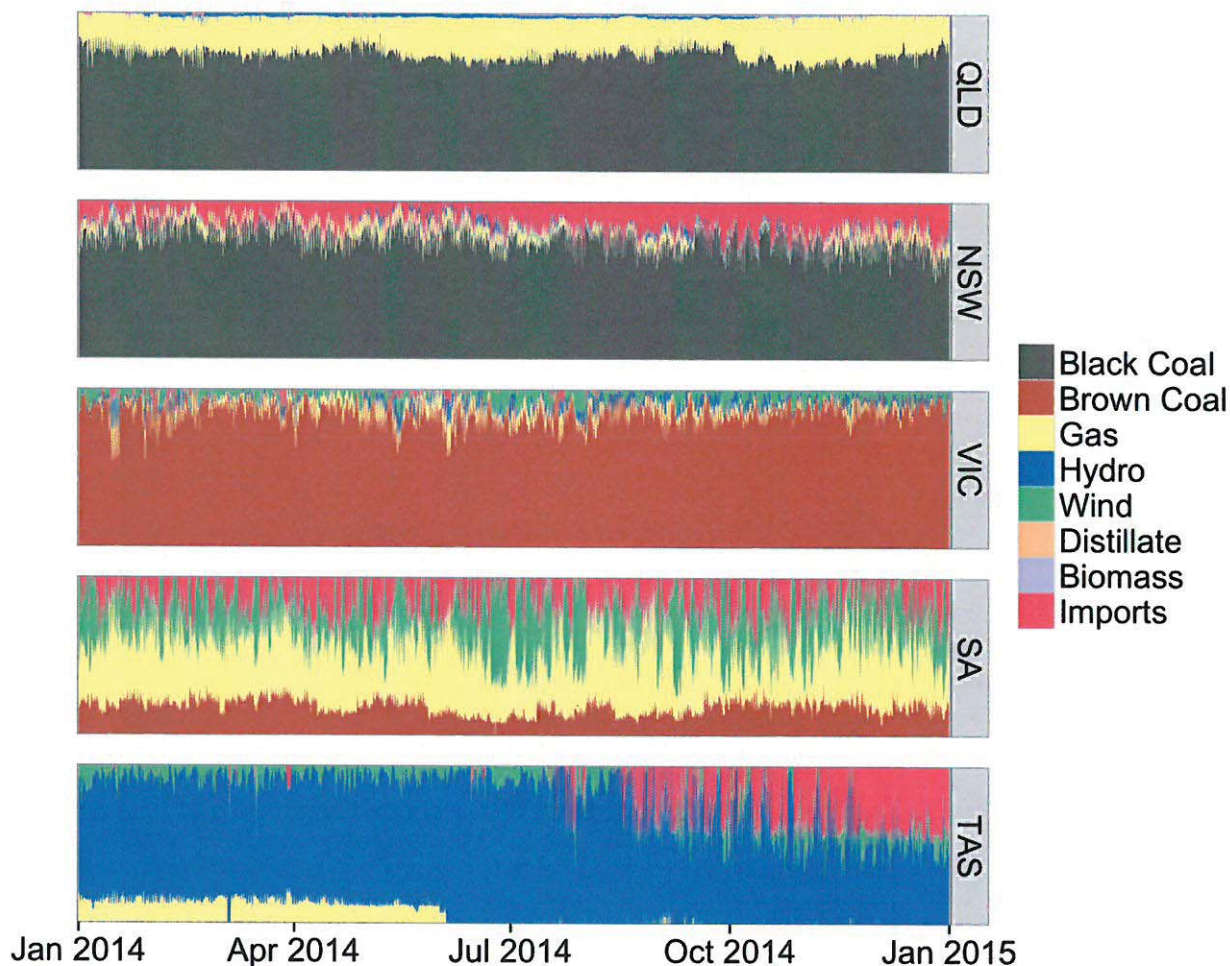


Figure 2.3: Hourly fuel mix plots for NEM regions in 2014.

Regional fuel mix plots (Figure 2.3) show the fraction of generation derived from each fuel type (including imports). QLD has a relatively stable mix between gas and black coal. NSW is almost always a net importer of power. WPG displaces both gas and imports strongly in SA. Hydro is dominant in TAS and the impact of the Tamar Valley CCGT outage from June 2014 is evident.

A simple measure of the displacement effect of WPG on other generation types can be obtained from the fuel-mix data, Table 2.2. By the definition of the fuel mix, the displacements sum to -1. In reality system losses mean that the displacement of scheduled generation by WPG is imperfect. Note also that no allowance is made for outages Section 2.3.

2.2 fuel mix

13

The high displacement of imports in SA and VIC in Table 2.2 signifies exports of WPG from these regions. On the other hand, wind power in TAS displaces hydro primarily with little impact on imports.

region	Black Coal	Brown Coal	Gas	Hydro	Imports
SA		-0.06 ± 0.01	-0.32 ± 0.02		-0.63 ± 0.03
VIC		0.03 ± 0.17	-0.26 ± 0.03	-0.17 ± 0.03	-0.60 ± 0.15
TAS			-0.08 ± 0.06	-0.99 ± 0.20	0.07 ± 0.22
NEM	-0.36 ± 0.05	-0.07 ± 0.06	-0.38 ± 0.04	-0.20 ± 0.05	

Table 2.2: Wind displacement fractions for NEM regions and for NEM as a whole from the fuel-mix data. By definition displacement fractions sum to -1.

2.3 outages

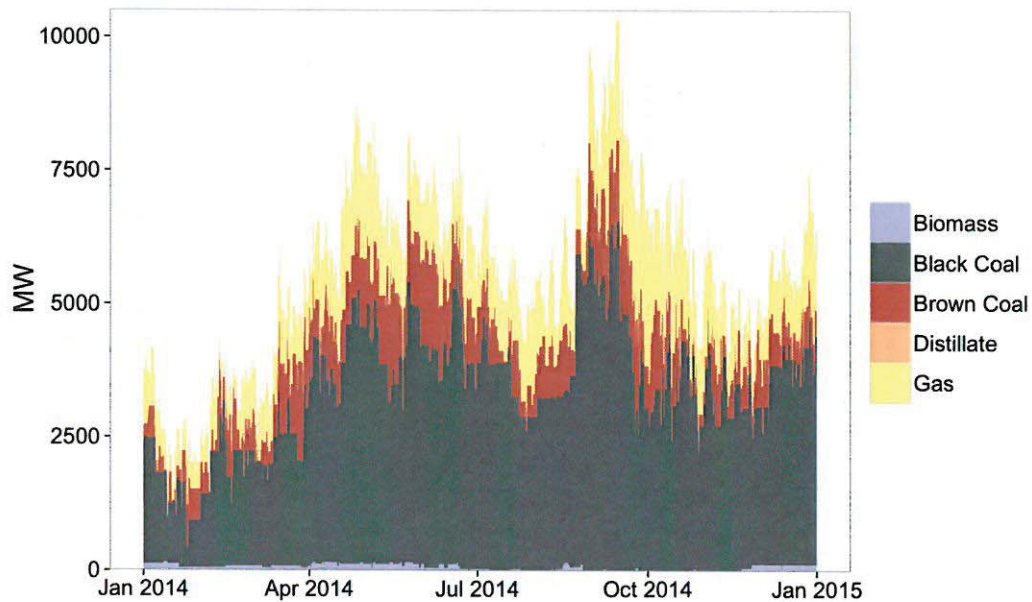


Figure 2.4: Thermal plant outages in the NEM in 2014.

Outages alter the fuel mix and play an important role in emissions variability. Aggregate outages also increase the effective system demand seen by available plant. Figure 2.4 shows the large variability in total outages in the NEM during 2014. Median availability factor for coal plant was $\approx 85\%$. Significant outages in 2014 include the shutdown of the 1GW Wallerawang plant and 50% availability factor at the 2GW Liddell plant in NSW. For load-following and base-load plant it is assumed that periods of zero generation longer than 12 hours are an outage event. These can be easily inferred from the generation data. It is not possible to infer outage events for peaking plant which operate intermittently. Here it is simply assumed that there are no outages for peaking plant. These assumptions were used in Figure 2.4 and are also used in Section 3.2.2.

2.4 inter-regional flows

Interconnectors link pricing regions in the NEM. 5-minute flow and loss data for six interconnectors are [archived by AEMO\[3\]](#).

NSW	SA	TAS	QLD	VIC
9.3	1.4	-0.9	-5.0	-5.5

Table 2.3: Net interchange (TWh) between regions. NSW and SA are net importers (+ve interchange).

Table 2.3 shows net energy interchange for each NEM region (TWh, +ve is net imports) in 2014. The numbers do not sum to zero because of system losses (exports > imports). NSW is a significant net importer of electricity through interconnection to QLD and VIC. Indeed a significant fraction of WPG from SA and VIC is exported to NSW where it displaces load-following coal plant. Positive flow through the VIC-NSW interconnector is correlated with WPG. In 2014 correlation between WPG and VIC-NSW interconnected flow was 0.42, while the correlation between WPG and interconnected losses was 0.36.

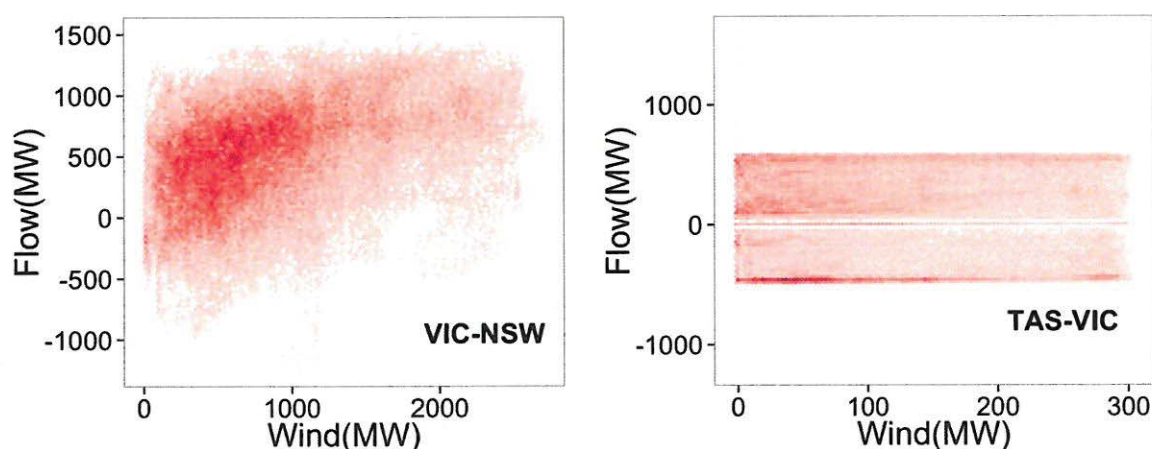


Figure 2.5: Left: VIC-NSW interconnector flow at 5-min intervals (MW) versus NEM wind power (excluding Tasmania) (MW). Right: TAS-VIC interconnector flow (MW) vs Tasmanian wind power (MW).

Losses are significant in the NEM. [AEMO estimate](#) that overall system losses in the transmission and distribution system are $\sim 10\%$. Figure 2.6 shows that periods of high WPG are associated with higher interconnection losses.

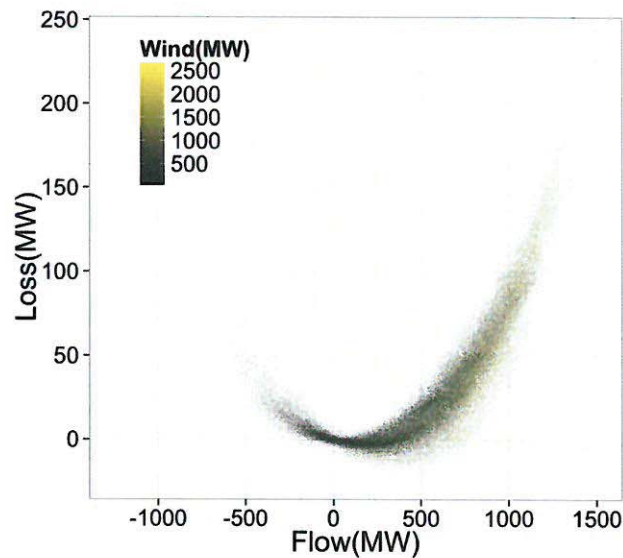


Figure 2.6: VIC-NSW interconnector losses at 5-min intervals (MW) vs interconnector flow (MW). Periods of high wind generation (highlighted) correlate with increased system losses.

Tasmania is connected via the Basslink HVDC interconnection to VIC. This has capacity 594MW for exports from TAS to VIC and 478MW for reverse flow. Interconnector flow is uncorrelated with Tasmania wind generation. This is consistent with the finding of Section 2.2 that TAS WPG displaces hydro generation. Losses through Basslink are $\approx$ 3-4%. The correlation between Tasmanian wind and Basslink flow is less than 0.02.

2.5 emissions

Greenhouse gas emissions associated with electricity production can be reported in different ways. "Scope 1" carbon accounting includes emissions directly associated with combustion of fuel while "scope 3" are indirect contributions associated with extraction and transport of the fuel. Minority greenhouse gas contributions can be included as carbon dioxide equivalents (CO₂-e). Following AEMO, emissions numbers quoted in this report are on a scope 1 plus scope 3 CO₂-e basis.

The SCADA generation data were used to calculate emissions from each generator at 5 minute intervals as described in Section 3.1. Results for 2014 summarised by fuel and region are given in Table 2.4.

region	Biomass	Black Coal	Brown Coal	Distillate	Gas	TOTAL
NSW		54.6		0.0	2.2	56.8
QLD	0.0	37.4		0.1	8.1	45.6
SA			2.8	0.0	3.8	6.6
TAS					0.3	0.3
VIC			59.0		1.4	60.4
TOTAL	0.0	92.0	61.8	0.1	15.8	169.7

Table 2.4: Calculated Scope 1+3 emissions (MtCO₂-e) by region and fuel in 2014.

Total emissions for the NEM were 169.7Mt, which equates to a mean emissions rate of 19.3ktCO₂-e per hour. Coal accounted for 91% of emissions (versus 75% of generation, Table 2.1). Table 2.4 and Table 2.1 give average emissions intensities by fuel and region shown in Table 2.5.

state	Biomass	Black Coal	Brown Coal	Distillate	Gas	Average
NSW		1.00		1.60	0.57	0.93
QLD	0.02	0.90		6.15	0.60	0.81
SA			1.06	1.18	0.73	0.55
TAS					0.42	0.03
VIC			1.27		0.62	1.14
Average	0.02	0.96	1.26	5.63	0.62	0.87

Table 2.5: Emissions intensities (tCO₂-e/MWh "as-generated") by fuel and region in 2014. Weighted average intensities are also shown. Emissions intensity in the NEM as a whole was 0.874tCO₂/MWh.

Note that these intensities are expressed with respect to "as-generated" energy (emissions intensities expressed with respect to "sent-out" energy would be higher, because sent-out energy is net of auxiliary loads). Brown coal has the highest average intensity of 1.26tCO₂-e/MWh, while gas has the lowest at 0.62tCO₂/MWh. Scope 3 emissions for black coal are considerably higher than those of brown coal (Tables 4.1-4.3) which tends to reduce the difference between black coal and brown coal.

Regional emissions intensity time-series are shown in Figure 2.7.

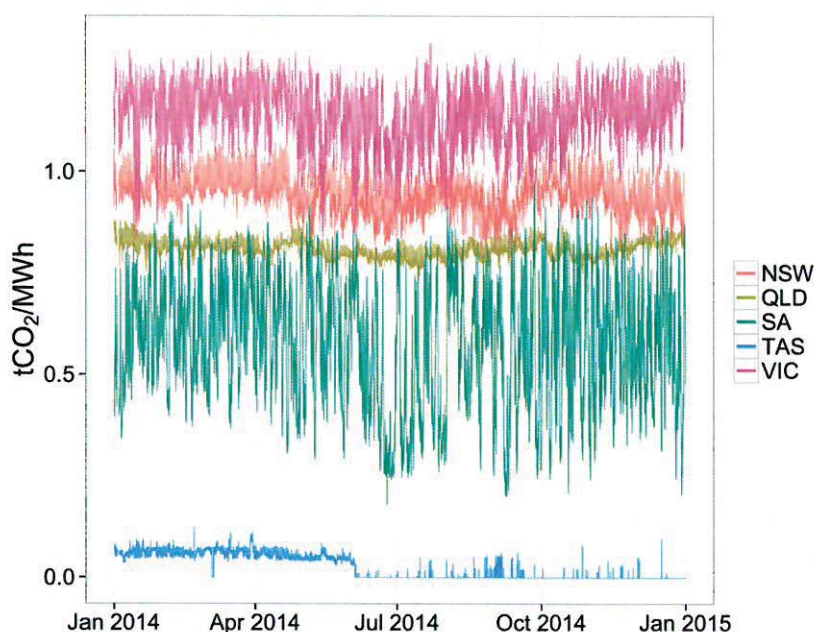


Figure 2.7: Estimated emissions intensity (tCO₂/MWh) time-series for NEM regions in 2014.

South Australia had extreme emissions intensity variability due to interplay of gas, WPG and interchange. QLD has the lowest variability consistent with the relative stability of the fuel mix Figure 2.3.

On average periods of high WPG are associated with lower NEM emissions intensity. Figure 2.8 shows scatterplots of grid emissions intensity at 5-min intervals versus fraction of total generation provided by wind, hydro and gas (for clarity, using binned scatterplots rather than plotting all 105,120 data points). The top panel shows lower emissions intensity as wind generation increases as expected. However this relationship is quite diffuse compared to hydro (middle panel). The comparison suggests that WPG is less effective in lowering emissions in the NEM than hydro.

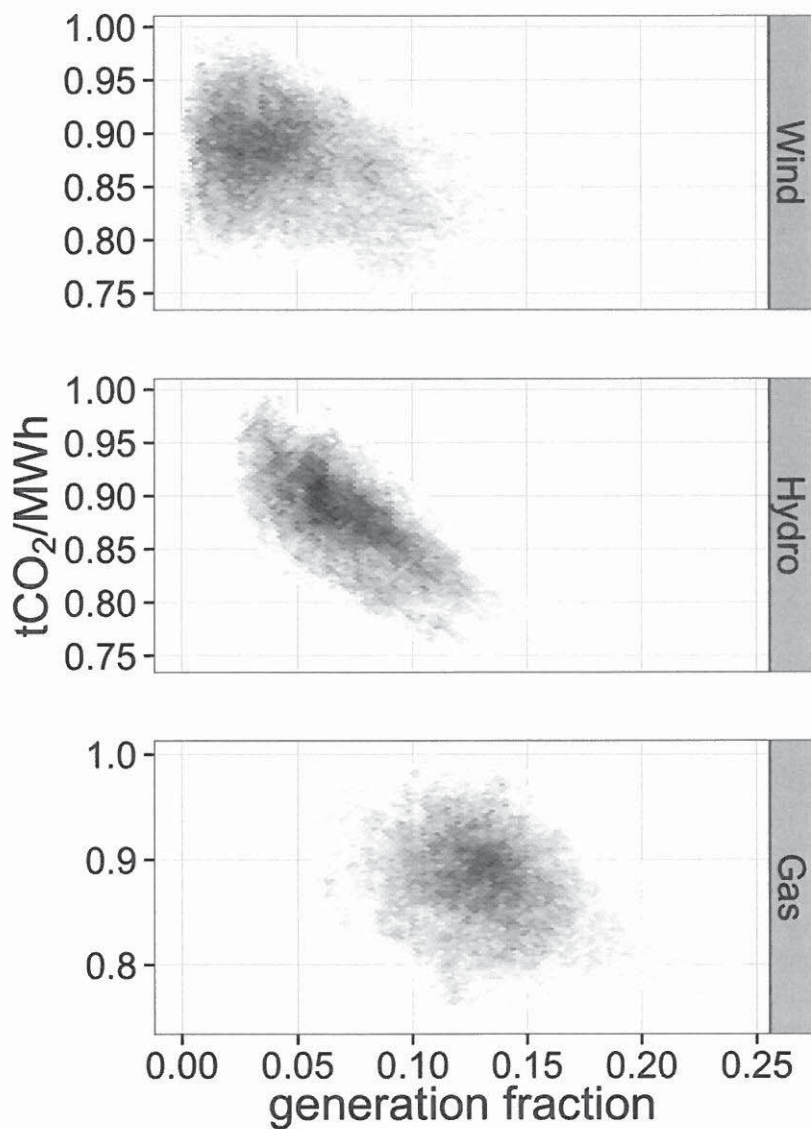


Figure 2.8: Emissions intensity(tCO_2/MWh) of the NEM in 2014 versus generation fractions.

A detailed calculation of emissions savings from displaced thermal plant is described in Section 3.2. However a simple estimate can be obtained by combining the mean emission intensities of Table 2.5 with the displacement fractions of Table 2.2. This gives savings $(-0.36 \times 0.96 - 0.07 \times 1.26 - 0.38 \times 0.62) = -0.67 \text{tCO}_2\text{-e/MWh}$. Alternatively, a straight line fit to the top panel of Figure 2.8 gives a slope of $-0.51 \text{tCO}_2\text{-e/MWh}$. While these estimates are oversimplified, both suggest that emissions savings per unit wind energy are lower than grid average emissions intensity ($0.87 \text{tCO}_2\text{-e/MWh}$ Table 2.5).

3. Empirical Method

3.1 emissions models

The simplest model assumes a linear relationship between fuel energy consumption of a generator and its output G . The hourly CO₂-e emissions rate is:

$$\text{emissions} = \frac{f}{\varepsilon} (aC + (1 - a)G) \quad (3.1)$$

Here ε is "as-generated" generator efficiency, f is a scope 1 + scope 3 emissions factor (expressed in units tCO₂-e/MWh), C is the generator capacity and a is the zero-load fuel consumption expressed as a fraction of maximum load fuel consumption. $a > 0$ implies that the generator operates less efficiently under part load. Equation 3.1 can be combined with SCADA generation data to create 5-minute emissions time-series for each of the 151 thermal generators which supplied power to the NEM in 2014. An approximate [set of emissions parameters](#) were prepared by consultants ACIL-Allen *Fuel and Technology Cost Review Report, 2014*[4]. These parameters are used in this report and summarised in Tables 4.1-4.3. Examples of calculated 5-minute emissions time-series are given on the left hand side of Figure 3.2. Note that this procedure omits start-up and ramping emissions from power plant cycling. Also, emissions are set to zero during periods of zero generation, an assumption (zero generation implies zero fuel use) which is correct in most but not every case.

It is important to compare emissions calculated using Equation 3.1 with emissions reported using other methodologies. Annual scope 1 emissions from power stations in the NEM are published under the *National Greenhouse and Energy Reporting* scheme[5], administered by the Clean Energy Regulator. These are based on actual fuel consumption determined on site, with fuel emissions factors determined locally. AEMO also report greenhouse gas emissions based on "sent-out" generation data. This methodology, called

3.1 emissions models

21

the *Carbon Dioxide Emissions Intensity Index (CDEII)*[6], calculates emissions as a simple product of "sent-out" energy (available 1/2-hourly) and a generator-specific emissions intensity. Starting from June 2014 the CDEII emissions intensities at generator level have been reconciled closely with the NGER values.[7] Note that scope 3 emissions are included in CDEII but not in the NGER. The additional scope 3 fuel emission factors values are sourced from the National Greenhouse Accounts Factors workbook (NGA).[8]

Figure 3.1 compares emissions reported by AEMO[9] to emissions calculated using Equation 3.1 and "as-generated" data. Despite different underlying generation datasets used, there is very good agreement. Total emissions agree to within 1%.¹

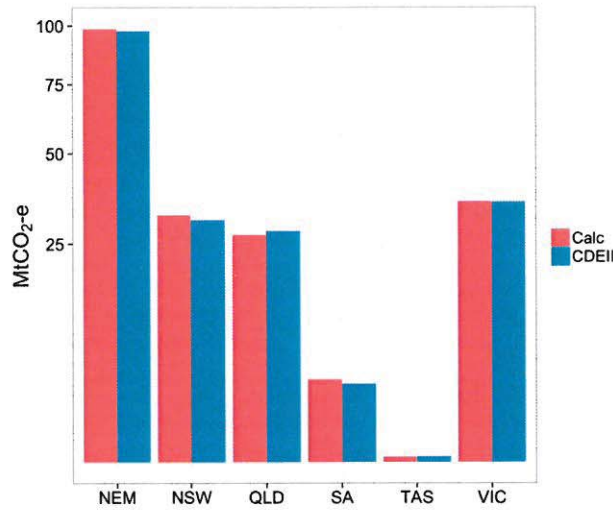


Figure 3.1: June-December 2014 CO₂-e emissions reported by AEMO (using CDEII methodology) compared to emissions calculated using Equation 3.1 (denoted "Calc").

Emissions intensity of a generator can vary from one period to another due to differences in operating regime. Dividing Equation 3.1 by G gives:

$$\text{intensity} = \frac{f}{\epsilon} \left(\frac{a}{CF} + (1 - a) \right) \quad (3.2)$$

Equation 3.2 shows that emissions intensity depends on the inverse of the capacity factor (CF). WPG lowers capacity factor of a displaced plant and therefore increases the mean emissions intensity. This "part-load efficiency cost" becomes more significant as wind penetration increases.

¹In principle "as-generated" data are a better basis for calculation of emissions than "sent-out" generation data.

3.2 emissions avoided

3.2.1 hydro-wind

Hydro-wind systems need special consideration when calculating emissions avoided from wind power. When wind power displaces thermal plant there is a coincident reduction in emissions. There is no coincident emissions reduction when wind displaces hydro generation. However displaced hydro energy is stored and is therefore available to displace thermal plant at some later time.

Hydro accounted for 85% of Tasmanian electricity production in 2014 with 24 hydro generators providing baseload/load-following power. Wind produced 8% of total TAS generation. Table 2.2 suggests that almost all TAS wind displaces hydro. This is supported by Figure 2.5 which shows that flow through the Basslink interconnector is uncorrelated with Tasmanian WPG. Tasmanian hydro storage capacity is $\approx 15\text{TWh}$, while **actual hydro energy stored** in 2014 was $\approx 4\text{TWh}$.^[9] Since Tasmanian WPG was only 0.95TWh , there is ample storage capacity and no constraints on the displacement of hydro by wind at current installed wind capacity.

If Tasmania were a stand-alone system without interconnection to the NEM, emissions avoided due to Tasmanian wind-hydro system would be close to zero. This implies that any emissions savings on the NEM must derive from Basslink flow. Mean Basslink flow was 100MW in 2014, while mean TAS WPG was 108MW . Thus mean flow would have been reversed (-8MW net imports) in the absence of TAS wind power. Detailed calculations including the impact of Basslink flow on emissions from individual power plant is described in the next Section 3.2.2. A rough estimate (assuming that the hydro-wind system displaces emissions at grid average intensity via increased Basslink flow) gives emissions avoided by Tasmanian WPG $\approx 0.8\text{MtCO}_2$.

Hydro plays a minor role outside of Tasmania, where it provided just 2% of energy generated and operates as peaking or seasonal load-following plant. A contribution to emissions savings from displaced non-TAS hydro plant is estimated in Section 3.2.3.

3.2.2 regression

Empirical methods can be used to relate emissions from individual generators to 4 covariates:

- total system demand
- total system outages
- total wind power generation excluding Tasmania
- flow through the TAS-VIC interconnector

The first three covariates are exogenous variables, largely outside the control of the grid operator or other market participants.² As discussed in Section 3.2.1, TAS-VIC interconnector flow is also included as an explicit covariate to account for the impact of the Tasmanian hydro-wind system.

²Although WPG may be curtailed by a grid operator in some circumstances, Figure ?? shows that curtailment was not significant in the NEM in 2014.

Each generator responds differently to changes in the covariates. For example, a load-following coal plant is likely to be found in a high emissions state when system demand is high, system outages are high, WPG is low and Basslink flow is negative (i.e. flow is from VIC to TAS). On the other hand, base-load generators are less sensitive to effective system demand and WPG. In addition to generator characteristics, the response also depends on grid constraints and interconnection. For example, a QLD CCGT plant is likely to be less responsive to changes in WPG compared to a CCGT plant in SA.

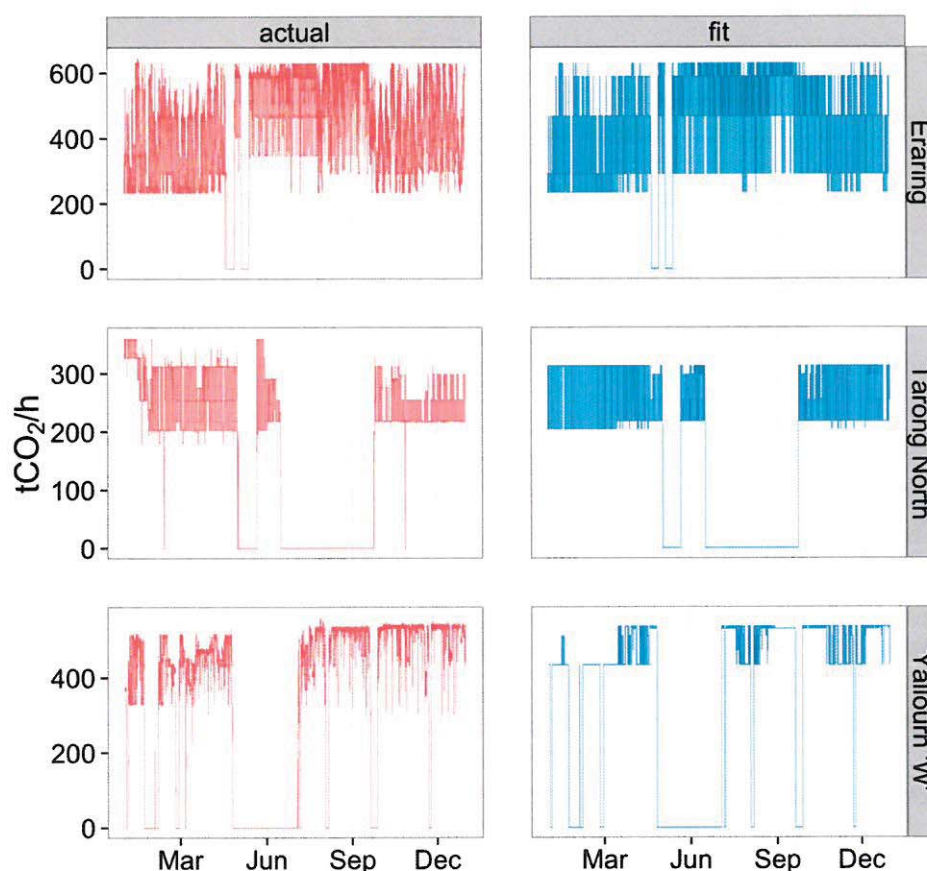


Figure 3.2: Examples of regression model fits to emissions time-series. Top: Eraring 1. Middle: Tarong North. Bottom: Yallourn 'W' power stations. Left: emissions. Right: most probable state logistic regression fit.

Regression fits^[10] were created for all grid-connected thermal generators using the four linear covariates above. Outage periods were determined for each generator (described in Section 2.3) and these periods are excluded from the regression fit. Thermal plant do not respond smoothly to changes in effective demand. A rigid response where a generator

3.2 emissions avoided

24

switches between a set of discrete states can be modelled using multi-level logistic regression. This model can give semi-realistic descriptions of the generator output as shown in Figure 3.2.

Regression models can be used to assess the sensitivity of emissions to changes in WPG, keeping other covariates (system demand and outages) unchanged. For example, emissions in the absence of WPG can be calculated by setting non-Tasmanian WPG to zero and decreasing Basslink flow by an amount equivalent to mean TAS WPG (108MW). The resulting emissions savings for each generator are given in Tables 4.4–4.6. Results (excluding peaking plant, see Section 3.2.3) are summarised in Table 3.1. Savings aggregated up to power station level are summarised graphically in Fig 4.2.

region	Black Coal	Brown Coal	Gas	TOTAL
NSW	2.10		0.01	2.11
QLD	0.74		0.12	0.86
SA		0.24	0.22	0.46
TAS			-0.00	-0.00
VIC		1.72	0.11	1.83
TOTAL	2.84	1.96	0.46	5.26

Table 3.1: Summary of emissions avoided (MtCO₂) by region and fuel from non-peaking thermal plant in 2014.

From Table 3.1, total emissions avoided at non-peaking thermal plant were 5.26MtCO₂ in 2014. This accounts for most of the savings due wind power on the NEM. The significant saving arising at NSW coal plant reflects imports of WPG from SA and VIC. Some emissions savings also arise in QLD because exports from QLD to NSW are displaced by WPG.

3.2.3 peaking plant

Peaking plant (primarily of OCGT and hydro) typically operate when system demand exceeds a threshold value or to ensure frequency stability. The response of peaking plant to system demand is non-linear both at an individual generator level and also collectively (see Figure 4.3). Empirical estimates of emissions savings from wind power at individual thermal peaking plant can be problematic. The reason is that peaking plant often contain periods of intermittent generation. As a consequence, spurious correlations (or anti-correlations) can arise between intermittent WPG and emissions. A better approach in this case is to model thermal peaking plant emissions as a whole. Fortunately, outage effects are less significant for individual peaking plant (availability factors are generally higher) and therefore it is less important to keep track of outages at individual plant as done in Section 3.2.2.

Multi-variate regression for thermal peaking plant can be created using the same covariates as Section 3.2.2 but including non-linear terms in system demand. This approach

yields aggregate savings of 0.60MtCO₂-e versus total thermal peaking plant emissions of 2.06MtCO₂-e. In percentage terms emissions avoided from peaking plant is far higher than found in Section 3.2.2 for load-following plant. In fact percentage savings are comparable to the capacity factor for WPG. This is plausible because, when periods of high system demand and high WPG coincide, the requirement for peaking generation is reduced.

Outside of Tasmania, hydro power on the NEM has characteristics of peaking and seasonal load-following plant. The displacement of this generation by WPG can be estimated using the same regression model described above. Assigning this displaced generation an emissions intensity of 0.8tCO₂-e/MWh, gives additional savings of ≈ 0.35 MtCO₂. Total emissions avoided from thermal and non-TAS hydro plant is therefore 0.95MtCO₂-e or 14% of total emissions avoided.

Table 3.2 summarises emissions avoided broken down by plant characteristic.

type	emissions	avoided	% avoided
baseload	94.99	2.45	2.5%
loadfollowing	72.67	2.81	3.7%
peaking	2.06	0.60	24.3%
hydro*	-	0.35	-
TOTAL	169.7	6.2	3.5%

Table 3.2: Emissions savings (MtCO₂-e) in 2014 by generation type. Emissions saving fractions at peaking plant are far higher than for other types of plant. Hydro* indicates non-Tasmanian hydro plant.

3.3 discussion

Total emissions avoided by WPG on the NEM in 2014 were found to be 6.2MtCO₂-e (Table 3.2) compared to actual emissions 169.7MtCO₂ (Table 2.4). Emissions in a no-wind scenario were therefore 175.9MtCO₂-e and WPG reduced emissions by $6.2/175.9=3.5\%$. WPG produced 8.7TWh (Table 2.1) compared to total energy generated in the NEM 194.1TWh. Therefore while WPG provided $8.7/194.1=4.5\%$ of energy generated, it reduced emissions by a lesser fraction 3.5%. The *effectiveness* of WPG in terms of emissions reduction is the ratio 3.5:4.5 or 78%.

An equivalent way to express this finding is to note that average emissions intensity in the absence of wind power is $175.9\text{MtCO}_2\text{-e}/194.1\text{TWh} = 0.91\text{tCO}_2\text{-e/MWh}$ while emissions avoided per unit wind energy is $6.2\text{MtCO}_2\text{-e}/8.7\text{TWh} = 0.71\text{tCO}_2\text{-e/MWh}$. The ratio 0.71:0.91 is equivalent (within rounding error) to the effectiveness of 78% quoted above.

Several factors act to degrade effectiveness of WPG. Firstly, wind power selectively displaces lower emissions plant such as SA gas plant or even NSW black coal in preference

to higher emissions brown coal plant in VIC. Secondly, wind power generation is correlated with relatively higher system losses (Section 2.4). Thirdly, the part-load efficiency cost can be quantified by re-calculating emissions savings with the parameter a in Equation 3.1 set to zero, keeping all other parameters unchanged. Total emissions are lowered to 163.5MtCO₂ while savings due to wind power increase to 6.86MtCO₂. This equates to effectiveness of 89% i.e. part-load efficiency costs explain half the observed loss of effectiveness. This effect of part-load efficiency may be enhanced because only a small subset of the thermal plant are involved in balancing wind power (see Figure 4.2).

Unlike dispatch models, empirical methods have limited ability to predict behaviour when large changes are made to the grid (as this requires extrapolation beyond the range of observations). However, the explanation of WPG effectiveness in terms of selective displacement and part-load efficiency cost gives insight into the impact of, say, doubling wind penetration to $\sim 10\%$ with no other system changes. Assuming the NEM operates as it did in 2014, selective displacement is unchanged while part-load efficiency cost is doubled. Therefore a reasonable guess is effectiveness $\lesssim 70\%$ at 10% wind penetration.

It is important to emphasise that the above results are best estimates only. They are subject to two independent sources of error: *a*) statistical uncertainty *b*) unknown biases in emissions parameters. The latter are discussed in Section 3.4. Figure 3.3 illustrates the main findings of this report along with estimated statistical uncertainty.³ Note that effectiveness of 100% would correspond to savings of 8MtCO₂-e and emissions savings per unit wind energy of 8MtCO₂/8.7TWh = 0.92tCO₂/MWh. This slope lies outside the 95% confidence interval illustrated in Figure 3.3. Within the current framework, it can be said that the hypothesis that wind power effectiveness was 100% in 2014 can be rejected.

³Statistical confidence intervals were determined using a bootstrap method. For practical reasons confidence intervals were estimated using a simplified linear regression model rather than the full multi-level logistic model of Section 3.2.2.

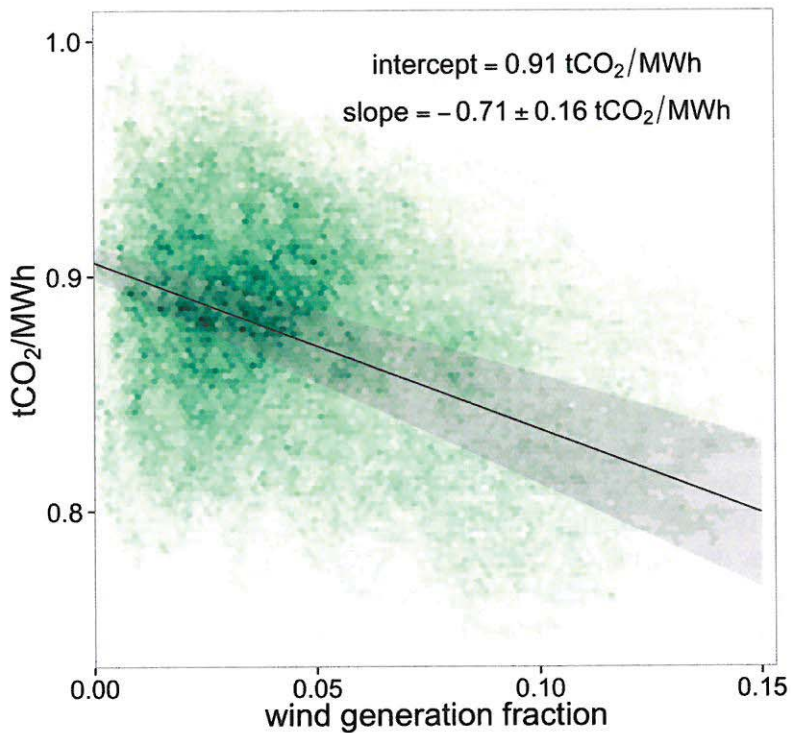


Figure 3.3: Emissions intensity (tCO₂-e/MWh) versus wind penetration at 5-min intervals compared to the findings of this report. The "intercept" corresponds to mean NEM emissions intensity in the absence of wind power, and "slope" corresponds to emissions avoided per unit wind energy. The grey region indicates the width of the statistical 95% confidence intervals from bootstrap.

3.4 limitations and suggested future work

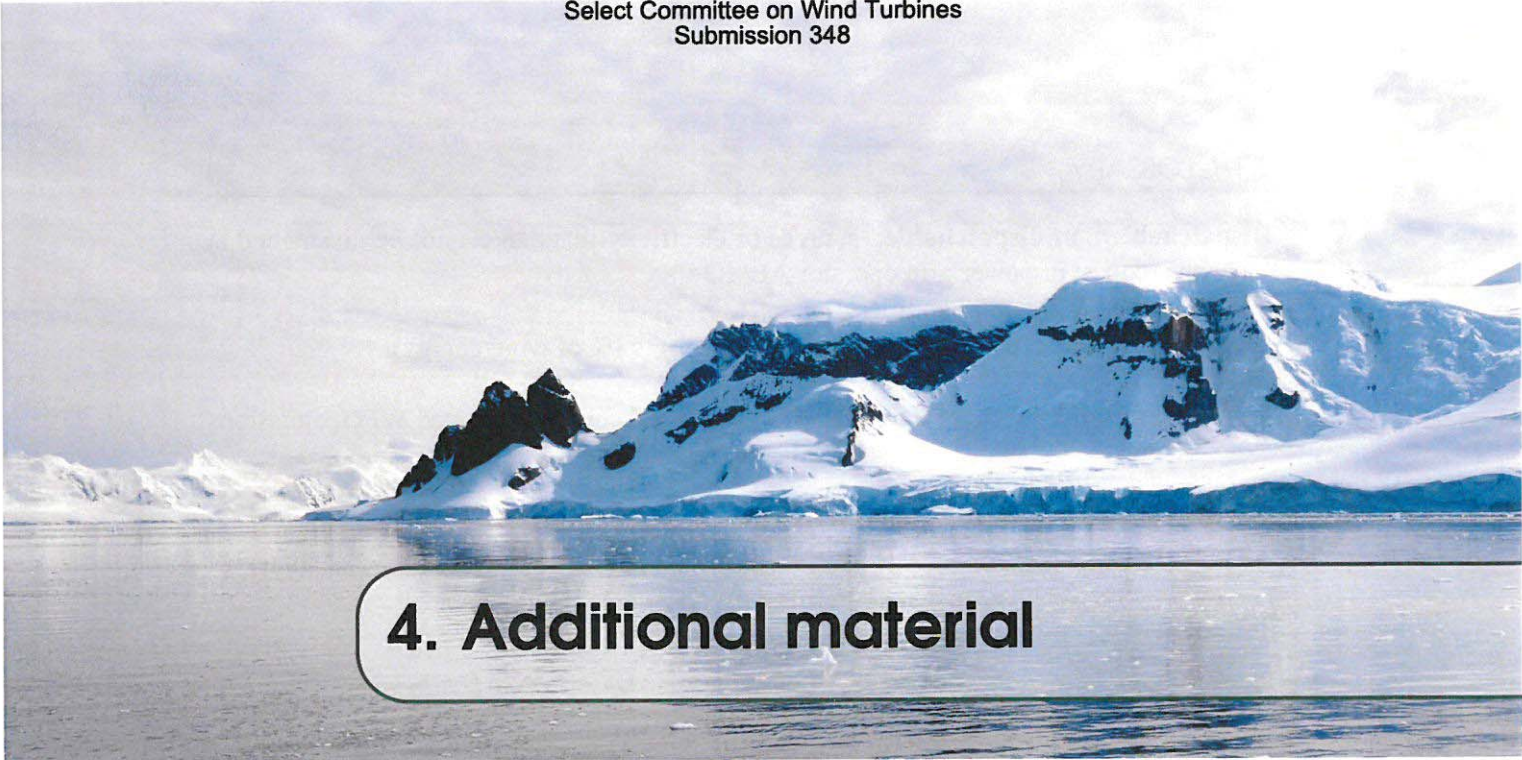
This report describes the findings of an empirical study into emissions reductions associated with wind power on the NEM in 2014. While wind power reduced operational CO₂-e emissions, its effectiveness is evidently less than 100% (Figure 3.3).

It is a concern that the quantitative findings in this report are subject to unknown biases in the emissions parameters used to describe individual generators. For example, in the dataset available for this study[4] (Table 4.1-4.3), the zero-load parameter (α appearing in Equation 3.1) has a value 10% for all coal power stations. While this may be a reasonable average, it is unrealistic to assume that diverse coal plant share the same part-load efficiency characteristics. Moreover, Figure 4.2 indicates that 80% of the estimated CO₂ savings arose from just 12 power stations (or 20 generators, primarily coal). The effectiveness of wind power is likely to depend strongly on the detailed emissions characteristics of this subset of power stations. Therefore these need to be known as accurately as possible. In addition, the linear model Equation 3.1 is an oversimplification. Several more parameters are needed to describe the fuel consumption characteristics fully.

The input data could be improved in several ways. The most valuable emissions information is actual fuel used by individual generators at short time intervals. If sufficient, this data could be related to wind generation directly. If not sufficient, even low frequency (e.g. monthly) fuel use information is valuable for calibration and verification of emissions models. Emissions could also be calculated from SCADA generation data (as done here) but using more completely parameterised heat-rate curves. For example, power engineers often specify energy input-output curves of a generator in terms of a set of significant output capacity points (MW) and incremental heat rate slope between these capacity points. Another data issue concerns use of "as-generated" data as a proxy for total system demand in Section 3.2.2. There are reasons to believe that "sent-out" market data, which is net of auxiliary loads, may give more accurate results. "Sent-out" generation data were not available for this report.

In summary, the following additional data should be incorporated into a future study:

- [1] actual fuel consumption data for individual generators at the shortest available time intervals. Even limited or incomplete data of this type is valuable for emissions model calibration and verification.
- [2] emissions parameters for individual generators including
 - (a) zero-load energy consumption data (GJ/h)
 - (b) incremental heat rate slopes between capacity points for all generators (GJ/MWh).
 - (c) hot, warm and cold start-up energy costs (GJ) and associated thermal relaxation times.
 - (d) confidence intervals on the parameters where appropriate
- [3] "sent-out" market data (e.g. $\frac{1}{2}$ -hourly) for each generator, to complement "as-generated" SCADA data used in this report.
- [4] multi-year data (e.g. 2011-2014) could reduce statistical uncertainty and give information about variability of wind power effectiveness.



4. Additional material

4.1 GLOSSARY

AEMO: Australian Energy Market Operator

"As generated": supply measured at the generator terminals, representing the entire output from a generator. Suitable data for calculation of emissions.

Auxiliary load: electric power used on-site or self-load of a power plant

Availability Factor: amount of time that a generator is available to produce electricity over a certain time interval, divided by the time interval.

Base-load: power plants which supply a dependable and consistent amount of electricity, meeting the minimum demand.

Bootstrapping: a method of error or confidence interval estimation obtained by repeated sub-sampling of the data.

Capacity Factor: total amount of energy a generator produces during a period of time, divided by the amount of energy the generator could have produced at full (nameplate) capacity.

Capacity: the maximum output or name-plate output of a generator (MW).

CCGT: combined cycle technology uses both gas and steam turbine cycles in a single plant to produce electricity with high conversion efficiencies and low emissions.

CDEII: Carbon Dioxide Equivalent Intensity Index (CDEII). AEMO's formal framework for reporting of greenhouse gas emissions.

CO₂-e versus CO₂ emissions: carbon dioxide equivalent is the conversion of a quantity of a greenhouse gas into an equivalent quantity of CO₂ that has the same atmospheric greenhouse impact. For example, 1kg of emitted nitrous oxide has a higher global warming potential than 1kg of carbon dioxide. Here, only combustion-derived carbon dioxide is considered and therefore CO₂-e and CO₂ are equivalent for the purposes of this report.

4.1 GLOSSARY

30

Dispatchable/non-dispatchable: sources of electricity that can/cannot be dispatched at the request of power grid operator AEMO

DUID: dispatchable unit identifier

Effectiveness: the ratio of (% emissions reduction) to (% of wind energy).

In terms of total energy generated G , total wind energy generated WPG , emissions savings ΔCO_2 and actual total grid emissions CO_2^{actual} , this can re-expressed as:

$$\begin{aligned} \text{Effectiveness} &= \left(\frac{\Delta CO_2}{CO_2^{actual} + \Delta CO_2} \right) \div \left(\frac{WPG}{G} \right) \\ &= \left(\frac{\Delta CO_2}{WPG} \right) \div \left(\frac{CO_2^{actual} + \Delta CO_2}{G} \right) \\ &= \frac{\text{emissions savings per unit wind energy}}{\text{no-wind emissions intensity}} \end{aligned}$$

Thermal efficiency: a generator's thermal efficiency is the fraction of fuel energy input that is actually converted into electricity.

Emissions factor, combustion: CO_2 or CO_2 -e emissions from combustion of a specific thermal energy unit of fuel (e.g. tCO_2/TJ or $kgCO_2/GJ$). Used to calculate Scope 1 emissions.

Emissions emissions, fugitive: fuel emissions factor (tCO_2/TJ) used to calculate Scope 3 emissions associated with extraction and transport of the fuel.

Emissions Intensity: CO_2 emissions rate (tCO_2/h) divided by power output (MW) of a generator, often averaged over a period of time. May refer to an individual or group of generators or to the NEM as a whole.

Exogenous variable: exogenous variables are not systematically affected by changes in the other variables of the system e.g. wind is an exogenous variable because wind affects coal generation but not the other way around.

Fuel mix: fractions of total generation derived from the different fuel sources as a function of time. Fuel mix fractions sum to 1.

Heat rate: the fuel energy input needed for a power plant to produce one unit of electrical energy output e.g. GJ/GWh . Generally a function of power output.

Intermittent Generation: a generating unit whose output is not readily predictable, including wind turbine generators, some run-of-river hydro-generators etc

Joule(J): unit of energy. $1TJ = 10^{12}J = 277.77 MWh$

Load-following: or mid-merit power plant, is a power plant that adjusts its power output as demand for electricity fluctuates throughout the day

Logistic regression: probabilistic statistical classification model where the state of the system depends on external covariates or driving variables.

Non-market generation: A generator whose sent-out generation is purchased in its en-

4.1 GLOSSARY

31

tirety locally or at the same network connection point under a power purchase agreement.

Non-scheduled generation: AEMO classification of generators with capacity less than 30MW which do not participate in central dispatch

OCGT: Open cycle gas turbine. A gas or liquid fuel combustion turbine often used as peaking plant. Less efficient than CCGT but with rapid low-cost startup.

Peaking: power plants that generally run only when there is a high demand for electricity. May be operated periodically or intermittently.

Regression model: a statistical process for estimating the relationships among variables

SCADA: "supervisory control and data acquisition system". Used by grid operators such as AEMO to control remote plant. This system is the source of the 5-min 'as-generated' generation data used in this report.

Scheduled/semi-scheduled generation: AEMO classify generation with intermittent output and with an aggregate nameplate capacity of 30 MW or more as semi-scheduled.

Scope 3 emissions: emissions associated with extraction and transport of fuel to power plant.

Scope 1 emissions: emissions associated with direct combustion of fossil fuel, excluding indirect sources of emissions.

"Sent-out": supply as measured at the generator's grid connection point, therefore excluding auxiliary loads.

Steam sub/super-critical: refers to low and high pressure steam turbines, the latter operating at higher efficiency.

Watt(W): unit of power $1W = 1J/s$.

Wind Penetration: fraction of all generation provided by wind power over a certain time interval.

WPG: refers to either wind power generation (MW), or wind energy generation (MWh) depending on the context.

4.2 parameters

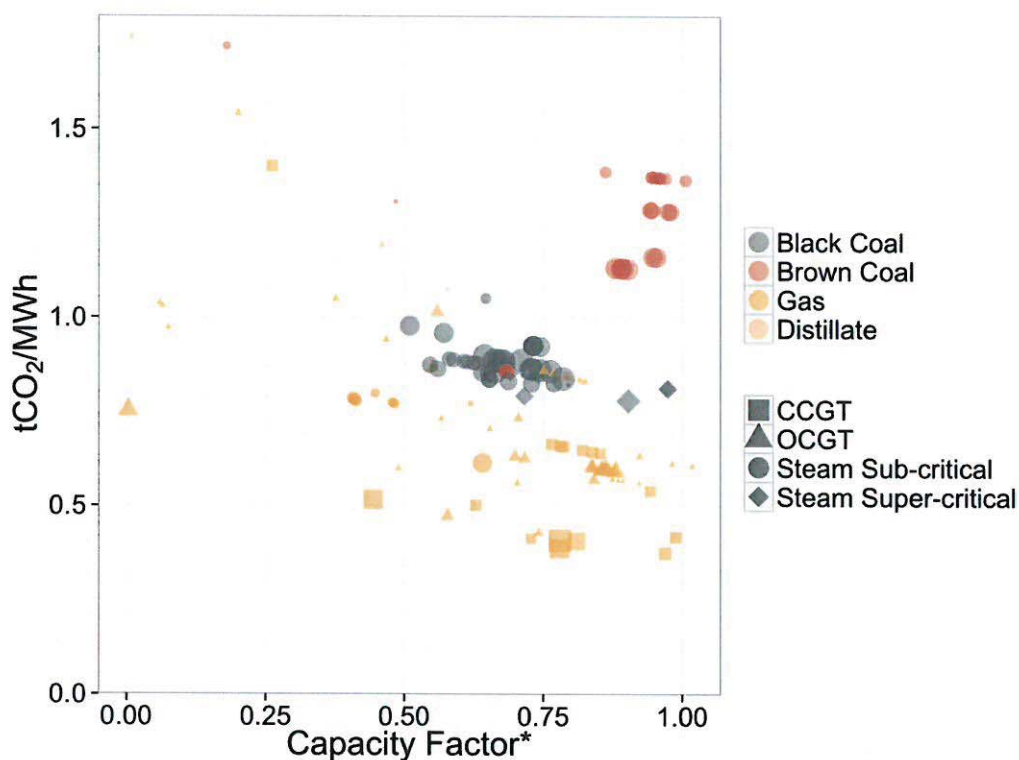


Figure 4.1: Estimated emissions intensity versus modified capacity factor for individual generators. Symbol areas represent generator capacity, symbol colours represent fuel type, and symbol shapes represent technology. Brown coal plant have high capacity factor and highest emissions intensity. CCGT have the lowest emissions. The new super-critical steam coal plant operate at high capacity and with relatively lower emissions intensity. There is a trend for increasing emissions intensity with decreasing capacity factor. The modified capacity factor is capacity factor excluding outage periods or Capacity Factor divided by Availability Factor.

4.2 parameters

33

DUID	name	fuel	region	technology	a	ε	C	f_1^*	f^*
AGLHAL	Hallett	Gas	SA	CCGT	0.3	0.242	180	57.24	67.44
AGLSOM	Somerton	Gas	VIC	OCGT	0.3	0.242	160	49.06	52.96
ANGAS1	ANGASTON	Distillate	SA	ICE	0.3	0.283	30	69.70	75.00
ANGAS2	ANGASTON	Distillate	SA	ICE	0.3	0.283	20	69.70	75.00
APS	Anglesea	Brown Coal	VIC	Steam Sub-critical	0.1	0.296	165	92.43	92.83
BARCALDN	Barcaldine	Gas	QLD	CCGT	0.3	0.283	37	78.56	86.16
BBTHREE1	Bell Bay Three	Gas	TAS	OCGT	0.3	0.299	35	51.30	51.30
BBTHREE2	Bell Bay Three	Gas	TAS	OCGT	0.3	0.299	35	51.30	51.30
BBTHREE3	Bell Bay Three	Gas	TAS	OCGT	0.3	0.299	35	51.30	51.30
BDL01	Bairnsdale	Gas	VIC	OCGT	0.3	0.343	47	50.02	53.92
BDL02	Bairnsdale	Gas	VIC	OCGT	0.3	0.343	47	50.02	53.92
BRAEMAR1	Braemar	Gas	QLD	CCGT	0.3	0.303	168	48.02	55.62
BRAEMAR2	Braemar 2	Gas	QLD	CCGT	0.3	0.303	168	49.82	57.42
BRAEMAR3	Braemar	Gas	QLD	CCGT	0.3	0.303	168	48.02	55.62
BRAEMAR5	Braemar	Gas	QLD	CCGT	0.3	0.303	173	48.02	55.62
BRAEMAR6	Braemar	Gas	QLD	CCGT	0.3	0.303	173	48.02	55.62
BRAEMAR7	Braemar	Gas	QLD	CCGT	0.3	0.303	173	48.02	55.62
BW01	Bayswater	Black Coal	NSW	Steam Sub-critical	0.1	0.382	660	91.82	101.02
BW02	Bayswater	Black Coal	NSW	Steam Sub-critical	0.1	0.382	660	91.82	101.02
BW03	Bayswater	Black Coal	NSW	Steam Sub-critical	0.1	0.382	660	91.82	101.02
BW04	Bayswater	Black Coal	NSW	Steam Sub-critical	0.1	0.382	660	91.82	101.02
CALL_A_4	Callide A	Black Coal	QLD	Steam Sub-critical	0.1	0.397	30	94.19	96.49
CALL_B_1	Callide B	Black Coal	QLD	Steam Sub-critical	0.1	0.397	350	94.19	96.49
CALL_B_2	Callide B	Black Coal	QLD	Steam Sub-critical	0.1	0.397	350	94.19	96.49
CG1	Colongra GT	Gas	NSW	OCGT	0.3	0.323	181	58.94	72.44
CG2	Colongra GT	Gas	NSW	OCGT	0.3	0.323	181	58.94	72.44
CG3	Colongra GT	Gas	NSW	OCGT	0.3	0.323	181	58.94	72.44
CG4	Colongra GT	Gas	NSW	OCGT	0.3	0.323	181	58.94	72.44
CPP_3	Callide Power Plant	Black Coal	QLD	Steam Super-critical	0.1	0.388	420	96.57	98.87
CPP_4	Callide Power Plant	Black Coal	QLD	Steam Super-critical	0.1	0.388	420	96.57	98.87
CPSA	Condamine	Gas	QLD	CCGT	0.3	0.495	144	62.45	70.05
DDPS1	Darling Downs	Gas	QLD	CCGT	0.3	0.489	644	57.12	64.72
DRYCGT1	Dry Creek	Gas	SA	OCGT	0.3	0.263	52	58.36	68.56
DRYCGT2	Dry Creek	Gas	SA	OCGT	0.3	0.263	52	58.36	68.56
DRYCGT3	Dry Creek	Gas	SA	OCGT	0.3	0.263	52	58.36	68.56
ER01	Eraring	Black Coal	NSW	Steam Sub-critical	0.1	0.377	720	90.21	99.41
ER02	Eraring	Black Coal	NSW	Steam Sub-critical	0.1	0.377	720	90.21	99.41
ER03	Eraring	Black Coal	NSW	Steam Sub-critical	0.1	0.377	720	90.21	99.41
ER04	Eraring	Black Coal	NSW	Steam Sub-critical	0.1	0.377	720	90.21	99.41
ERGT01	Eraring	Distillate	NSW	ICE	0.1	0.377	42	69.70	75.00
GB01	Broken Hill	Distillate	NSW	OCGT	0.3	0.283	25	69.70	75.00

Table 4.1: Parameters used to estimate CO₂-e emission time-series for thermal generators (Equation 3.1). a is zero-load emissions expressed as a fraction of maximum load emissions. ε is "as-generated" efficiency, C is generator capacity (MW). f_1^* is combustion emissions factor (units tCO₂/TJ). f^* is sum of combustion and fugitive emissions factor. In Equation 3.1 f corresponds to $f = f^*/277.78$ (1 TJ = 277.78 MWh)

4.2 parameters

34

DUID	name	fuel	region	technology	a	ϵ	C	f_1^*	f^*
GERMCRK	German Creek	Gas	QLD	ICE	0.3	0.323	45	55.60	55.60
GSTONE1	Gladstone	Black Coal	QLD	Steam Sub-critical	0.1	0.383	280	90.35	92.65
GSTONE2	Gladstone	Black Coal	QLD	Steam Sub-critical	0.1	0.383	280	90.35	92.65
GSTONE3	Gladstone	Black Coal	QLD	Steam Sub-critical	0.1	0.383	280	90.35	92.65
GSTONE4	Gladstone	Black Coal	QLD	Steam Sub-critical	0.1	0.383	280	90.35	92.65
GSTONE5	Gladstone	Black Coal	QLD	Steam Sub-critical	0.1	0.383	280	90.35	92.65
GSTONE6	Gladstone	Black Coal	QLD	Steam Sub-critical	0.1	0.383	280	90.35	92.65
HVGTS	Hunter Valley	Distillate	NSW	OCGT	0.3	0.283	50	69.70	75.00
HWPS1	Hazelwood	Brown Coal	VIC	Steam Sub-critical	0.1	0.244	200	94.81	95.21
HWPS2	Hazelwood	Brown Coal	VIC	Steam Sub-critical	0.1	0.244	200	94.81	95.21
HWPS3	Hazelwood	Brown Coal	VIC	Steam Sub-critical	0.1	0.244	200	94.81	95.21
HWPS4	Hazelwood	Brown Coal	VIC	Steam Sub-critical	0.1	0.244	200	94.81	95.21
HWPS5	Hazelwood	Brown Coal	VIC	Steam Sub-critical	0.1	0.244	200	94.81	95.21
HWPS6	Hazelwood	Brown Coal	VIC	Steam Sub-critical	0.1	0.244	200	94.81	95.21
HWPS7	Hazelwood	Brown Coal	VIC	Steam Sub-critical	0.1	0.244	200	94.81	95.21
HWPS8	Hazelwood	Brown Coal	VIC	Steam Sub-critical	0.1	0.244	200	94.81	95.21
INVICTA	Invicta cogen	Biomass	QLD	Steam Sub-critical	0.3	0.368	50	1.50	1.50
JLA01	Jeeralang A	Gas	VIC	OCGT	0.3	0.236	51	53.77	57.67
JLA02	Jeeralang A	Gas	VIC	OCGT	0.3	0.236	51	53.77	57.67
JLA03	Jeeralang A	Gas	VIC	OCGT	0.3	0.236	51	53.77	57.67
JLA04	Jeeralang A	Gas	VIC	OCGT	0.3	0.236	51	53.77	57.67
JLB01	Jeeralang B	Gas	VIC	OCGT	0.3	0.236	76	53.77	57.67
JLB02	Jeeralang B	Gas	VIC	OCGT	0.3	0.236	76	53.77	57.67
JLB03	Jeeralang B	Gas	VIC	OCGT	0.3	0.236	76	53.77	57.67
KPP_1	Kogan Creek	Black Coal	QLD	Steam Super-critical	0.1	0.412	744	87.03	89.33
LADBROK1	Ladbroke Grove	Gas	SA	OCGT	0.3	0.303	40	46.40	56.60
LADBROK2	Ladbroke Grove	Gas	SA	OCGT	0.3	0.303	40	46.40	56.60
LAVNORTH	Laverton North	Gas	VIC	OCGT	0.3	0.313	320	64.89	68.79
LD01	Liddell	Black Coal	NSW	Steam Sub-critical	0.1	0.356	500	90.91	100.11
LD02	Liddell	Black Coal	NSW	Steam Sub-critical	0.1	0.356	500	90.91	100.11
LD03	Liddell	Black Coal	NSW	Steam Sub-critical	0.1	0.356	500	90.91	100.11
LD04	Liddell	Black Coal	NSW	Steam Sub-critical	0.1	0.356	500	90.91	100.11
LOYYB1	Loy Yang B	Brown Coal	VIC	Steam Sub-critical	0.1	0.289	500	91.24	91.64
LOYYB2	Loy Yang B	Brown Coal	VIC	Steam Sub-critical	0.1	0.289	500	91.24	91.64
LYA1	Loy Yang A	Brown Coal	VIC	Steam Sub-critical	0.1	0.299	560	96.30	96.70
LYA2	Loy Yang A	Brown Coal	VIC	Steam Sub-critical	0.1	0.299	530	96.30	96.70
LYA3	Loy Yang A	Brown Coal	VIC	Steam Sub-critical	0.1	0.299	560	96.30	96.70
LYA4	Loy Yang A	Brown Coal	VIC	Steam Sub-critical	0.1	0.299	560	96.30	96.70
MACKAYGT	Mackay	Distillate	QLD	OCGT	0.3	0.283	30	69.70	75.00
MBAHNTH	Moranbah North	Gas	QLD	ICE	0.3	0.434	63	55.60	55.60
MINTARO	Mintaro	Gas	SA	OCGT	0.3	0.283	90	67.38	77.58
MOR1	Energy Brix Complex	Brown Coal	VIC	Steam Sub-critical	0.1	0.282	90	109.51	109.91
MOR2	Energy Brix Complex	Brown Coal	VIC	Steam Sub-critical	0.1	0.282	30	109.51	109.91
MOR3	Energy Brix Complex	Brown Coal	VIC	Steam Sub-critical	0.1	0.282	75	109.51	109.91
MORTLK11	Mortlake	Gas	VIC	OCGT	0.3	0.323	283	46.13	50.03
MORTLK12	Mortlake	Gas	VIC	OCGT	0.3	0.323	283	46.13	50.03
MP1	Mt Piper	Black Coal	NSW	Steam Sub-critical	0.1	0.389	700	93.29	102.49
MP2	Mt Piper	Black Coal	NSW	Steam Sub-critical	0.1	0.389	700	93.29	102.49
MPP_1	Millmerran	Black Coal	QLD	Steam Super-critical	0.1	0.393	426	90.52	92.82
MPP_2	Millmerran	Black Coal	QLD	Steam Super-critical	0.1	0.393	426	90.52	92.82
MSTUART1	Mt Stuart	Distillate	QLD	OCGT	0.3	0.303	146	80.46	85.76
MSTUART2	Mt Stuart	Distillate	QLD	OCGT	0.3	0.303	146	80.46	85.76
MSTUART3	Mt Stuart	Distillate	QLD	OCGT	0.3	0.303	131	80.46	85.76
NPS	Newport	Gas	VIC	Steam Sub-critical	0.3	0.351	500	50.85	54.75
NPS1	Northern	Black Coal	SA	Steam Sub-critical	0.1	0.388	265	108.81	109.61
NPS2	Northern	Black Coal	SA	Steam Sub-critical	0.1	0.388	265	108.81	109.61

Table 4.2: Continuation of Table 4.1

4.2 parameters

35

DUID	name	fuel	region	technology	a	ϵ	C	f_1^*	f^*
Oakey1	Oakey	Gas	QLD	OCGT	0.3	0.329	141	82.12	89.72
Oakey2	Oakey	Gas	QLD	OCGT	0.3	0.329	141	82.12	89.72
OSB-AG	Osborne	Gas	SA	CCGT	0.3	0.442	180	61.74	71.94
PIONEER	Pioneer Sugar	Biomass	QLD	Steam Sub-critical	0.3	0.368	68	1.50	1.50
POR01	Port Lincoln	Distillate	SA	OCGT	0.3	0.283	50	67.90	73.20
POR03	Port Lincoln	Distillate	SA	OCGT	0.3	0.283	24	67.90	73.20
PPCCGT	Pelican Point	Gas	SA	CCGT	0.3	0.490	478	54.05	64.25
QPS1	Quarantine	Gas	SA	OCGT	0.3	0.337	24	64.45	74.65
QPS2	Quarantine	Gas	SA	OCGT	0.3	0.337	24	64.45	74.65
QPS3	Quarantine	Gas	SA	OCGT	0.3	0.337	24	64.45	74.65
QPS4	Quarantine	Gas	SA	OCGT	0.3	0.337	24	64.45	74.65
QPS5	Quarantine	Gas	SA	OCGT	0.3	0.337	128	64.45	74.65
REDBANK1	Redbank	Black Coal	NSW	Steam Sub-critical	0.1	0.318	150	105.03	114.23
ROMA_7	Roma	Gas	QLD	OCGT	0.3	0.303	40	55.88	63.48
ROMA_8	Roma	Gas	QLD	OCGT	0.3	0.303	40	55.88	63.48
RPCG	Rocky Point	Biomass	QLD	Steam Sub-critical	0.3	0.368	30	1.80	1.80
SITHE01	Smithfield	Gas	NSW	CCGT	0.3	0.432	176	57.66	71.16
SNUG1	Snuggery	Distillate	SA	OCGT	0.3	0.268	63	67.90	73.20
STAN-1	Stanwell	Black Coal	QLD	Steam Sub-critical	0.1	0.400	365	95.66	97.96
STAN-2	Stanwell	Black Coal	QLD	Steam Sub-critical	0.1	0.400	365	95.66	97.96
STAN-3	Stanwell	Black Coal	QLD	Steam Sub-critical	0.1	0.400	365	95.66	97.96
STAN-4	Stanwell	Black Coal	QLD	Steam Sub-critical	0.1	0.400	365	95.66	97.96
SWAN_E	Swanbank E	Gas	QLD	CCGT	0.3	0.485	385	51.89	59.49
TALWA1	Tallawarra	Gas	NSW	CCGT	0.3	0.515	460	51.28	64.78
TARONG#1	Tarong	Black Coal	QLD	Steam Sub-critical	0.1	0.393	350	94.00	96.30
TARONG#3	Tarong	Black Coal	QLD	Steam Sub-critical	0.1	0.393	350	94.00	96.30
TARONG#4	Tarong	Black Coal	QLD	Steam Sub-critical	0.1	0.393	350	94.00	96.30
TNPS1	Tarong North	Black Coal	QLD	Steam Super-critical	0.1	0.417	443	96.49	98.79
TORRA1	Torrens Island A	Gas	SA	Steam Sub-critical	0.3	0.316	120	50.04	60.24
TORRA2	Torrens Island A	Gas	SA	Steam Sub-critical	0.3	0.316	120	50.04	60.24
TORRA3	Torrens Island A	Gas	SA	Steam Sub-critical	0.3	0.316	120	50.04	60.24
TORRA4	Torrens Island A	Gas	SA	Steam Sub-critical	0.3	0.316	120	50.04	60.24
TORRB1	Torrens Island B	Gas	SA	Steam Sub-critical	0.3	0.337	200	49.12	59.32
TORRB2	Torrens Island B	Gas	SA	Steam Sub-critical	0.3	0.337	200	49.12	59.32
TORRB3	Torrens Island B	Gas	SA	Steam Sub-critical	0.3	0.337	200	49.12	59.32
TORRB4	Torrens Island B	Gas	SA	Steam Sub-critical	0.3	0.337	200	49.12	59.32
TVCC201	Tamar Valley CCGT	Gas	TAS	CCGT	0.3	0.495	208	56.41	56.41
TVPP104	Bell Bay Three	Gas	TAS	OCGT	0.3	0.299	58	51.30	51.30
URANQ11	Uranquinty	Gas	NSW	OCGT	0.3	0.323	166	52.23	65.73
URANQ12	Uranquinty	Gas	NSW	OCGT	0.3	0.323	166	52.23	65.73
URANQ13	Uranquinty	Gas	NSW	OCGT	0.3	0.323	166	52.23	65.73
URANQ14	Uranquinty	Gas	NSW	OCGT	0.3	0.323	166	52.23	65.73
VP5	Vales Point B	Black Coal	NSW	Steam Sub-critical	0.1	0.373	660	87.25	96.45
VP6	Vales Point B	Black Coal	NSW	Steam Sub-critical	0.1	0.373	660	87.25	96.45
VPGS	Valley Power	Gas	VIC	OCGT	0.3	0.242	300	54.79	58.69
WW7	Wallerawang C	Black Coal	NSW	Steam Sub-critical	0.1	0.356	500	85.51	94.71
WW8	Wallerawang C	Black Coal	NSW	Steam Sub-critical	0.1	0.356	500	85.51	94.71
YABULU	Townsville	Gas	QLD	OCGT	0.3	0.474	160	56.09	63.69
YABULU2	Townsville	Gas	QLD	OCGT	0.3	0.474	82	56.09	63.69
YARWUN_1	Yarwun CoGen	Gas	QLD	CCGT	0.3	0.347	160	51.30	58.90
YWPS1	Yallourn	Brown Coal	VIC	Steam Sub-critical	0.1	0.261	360	96.96	97.36
YWPS2	Yallourn	Brown Coal	VIC	Steam Sub-critical	0.1	0.261	360	96.96	97.36
YWPS3	Yallourn	Brown Coal	VIC	Steam Sub-critical	0.1	0.261	380	96.96	97.36
YWPS4	Yallourn	Brown Coal	VIC	Steam Sub-critical	0.1	0.261	380	96.96	97.36

Table 4.3: Continuation of Table 4.2

4.3 emissions avoided by generator

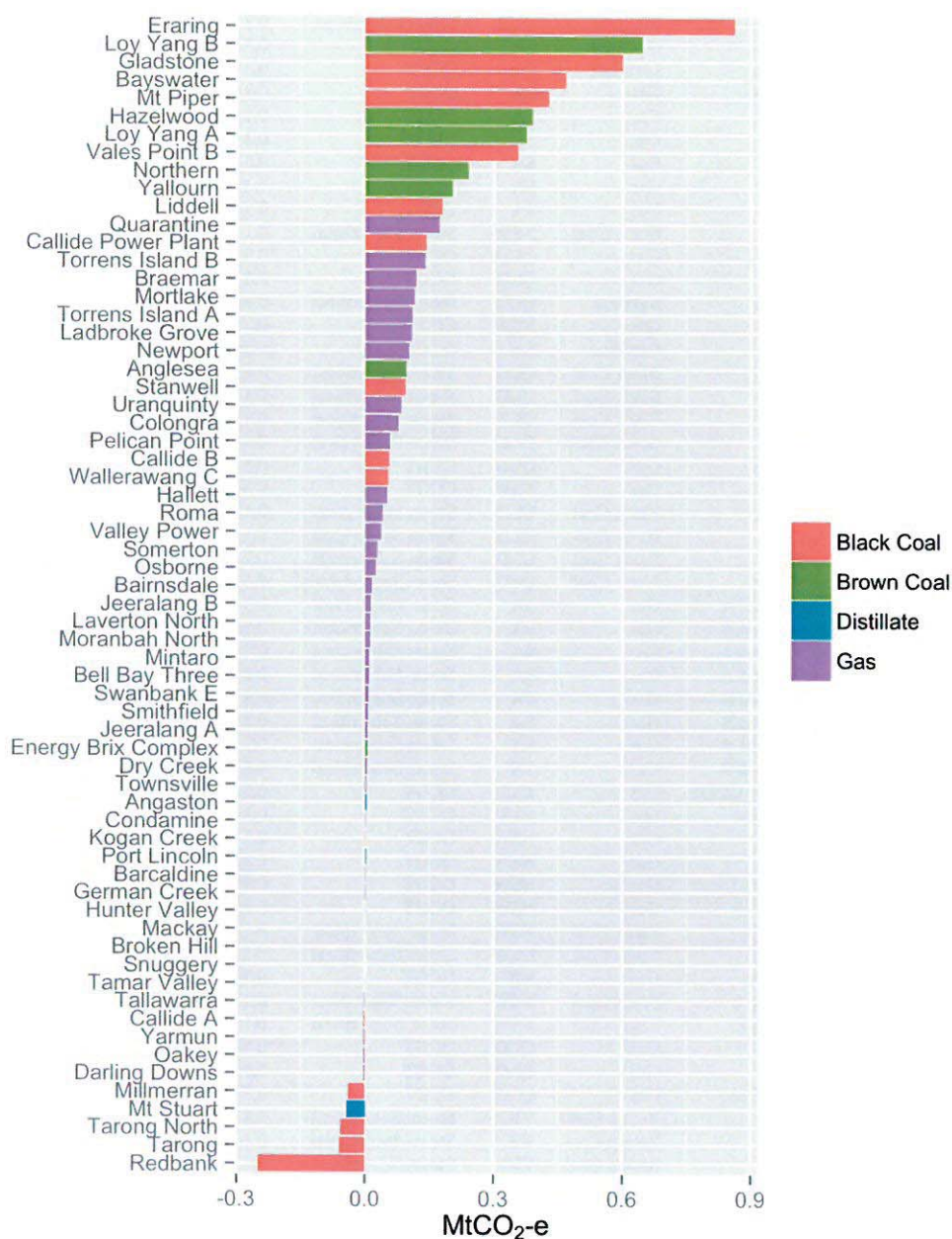


Figure 4.2: CO₂-e emissions avoided at thermal power stations due to wind power in 2014. Just 12 power stations accounted for 80% of emissions savings.

4.3 emissions avoided by generator

37

DUID	region	fuel	technology	type	emitted	avoided
LOYYB2	VIC	Brown Coal	Steam Sub-critical	baseload	4669697	376260
LYA3	VIC	Brown Coal	Steam Sub-critical	baseload	5036857	313846
LOYYB1	VIC	Brown Coal	Steam Sub-critical	baseload	3950502	269907
NPS1	SA	Brown Coal	Steam Sub-critical	baseload	1379426	140317
GSTONE3	QLD	Black Coal	Steam Sub-critical	baseload	1132820	126214
GSTONE6	QLD	Black Coal	Steam Sub-critical	baseload	1171115	122866
YWPS1	VIC	Brown Coal	Steam Sub-critical	baseload	2885691	110702
GSTONE4	QLD	Black Coal	Steam Sub-critical	baseload	1258764	100856
GSTONE1	QLD	Black Coal	Steam Sub-critical	baseload	1170920	100644
NPS2	SA	Brown Coal	Steam Sub-critical	baseload	1379858	100280
APS	VIC	Brown Coal	Steam Sub-critical	baseload	1466318	95458
HWPS1	VIC	Brown Coal	Steam Sub-critical	baseload	2229183	93106
HWPS2	VIC	Brown Coal	Steam Sub-critical	baseload	1874568	86656
HWPS8	VIC	Brown Coal	Steam Sub-critical	baseload	2096979	80500
STAN-3	QLD	Black Coal	Steam Sub-critical	baseload	2131113	57622
YWPS2	VIC	Brown Coal	Steam Sub-critical	baseload	3280173	49693
HWPS6	VIC	Brown Coal	Steam Sub-critical	baseload	2054781	49312
CALL_B_1	QLD	Black Coal	Steam Sub-critical	baseload	633150	42745
TORRB2	SA	Gas	Steam Sub-critical	baseload	348838	42343
STAN-2	QLD	Black Coal	Steam Sub-critical	baseload	1938491	41881
LD02	NSW	Black Coal	Steam Sub-critical	baseload	1691820	41252
YWPS4	VIC	Brown Coal	Steam Sub-critical	baseload	4172421	28135
TORRB4	SA	Gas	Steam Sub-critical	baseload	344561	28089
OSB-AG	SA	Gas	CCGT	baseload	887950	24326
LYA2	VIC	Brown Coal	Steam Sub-critical	baseload	4882644	18803
GSTONE2	QLD	Black Coal	Steam Sub-critical	baseload	869867	15981
YWPS3	VIC	Brown Coal	Steam Sub-critical	baseload	4084712	14948
HWPS5	VIC	Brown Coal	Steam Sub-critical	baseload	2153333	14010
HWPS3	VIC	Brown Coal	Steam Sub-critical	baseload	1789847	13836
CALL_B_2	QLD	Black Coal	Steam Sub-critical	baseload	1935285	13507
BRAEMAR7	QLD	Gas	CCGT	baseload	431726	10406
STAN-1	QLD	Black Coal	Steam Sub-critical	baseload	2026230	2324
CPSA	QLD	Gas	CCGT	baseload	440774	1494
KPP_1	QLD	Black Coal	Steam Super-critical	baseload	4474790	1480
GERMCRK	QLD	Gas	ICE	baseload	199728	1000
MOR2	VIC	Brown Coal	Steam Sub-critical	baseload	10927	710
CALL_A_4	QLD	Black Coal	Steam Sub-critical	baseload	117839	-2010
YARWUN_1	QLD	Gas	CCGT	baseload	791136	-2215
HWPS4	VIC	Brown Coal	Steam Sub-critical	baseload	1916581	-2557
LD01	NSW	Black Coal	Steam Sub-critical	baseload	1880043	-3435
STAN-4	QLD	Black Coal	Steam Sub-critical	baseload	1742848	-8385
TARONG#1	QLD	Black Coal	Steam Sub-critical	baseload	1852329	-8853
LYA1	VIC	Brown Coal	Steam Sub-critical	baseload	4667481	-8915
MPP_2	QLD	Black Coal	Steam Super-critical	baseload	2984503	-13300
TARONG#4	QLD	Black Coal	Steam Sub-critical	baseload	808765	-14087
MPP_1	QLD	Black Coal	Steam Super-critical	baseload	2680455	-25024
TARONG#3	QLD	Black Coal	Steam Sub-critical	baseload	1410301	-36562
TNPS1	QLD	Black Coal	Steam Super-critical	baseload	1651637	-56182
TOTAL					94997171	1716454

Table 4.4: Emissions avoided (tCO₂-e) at baseload generators in 2014 (positive numbers savings)

4.3 emissions avoided by generator

38

DUID	region	fuel	technology	type	emitted	avoided
ER04	NSW	Black Coal	Steam Sub-critical	loadfollowing	3670238	261210
ER01	NSW	Black Coal	Steam Sub-critical	loadfollowing	4078600	258313
VP6	NSW	Black Coal	Steam Sub-critical	loadfollowing	3692931	222143
MP2	NSW	Black Coal	Steam Sub-critical	loadfollowing	4045401	220411
BW01	NSW	Black Coal	Steam Sub-critical	loadfollowing	4176337	214504
ER03	NSW	Black Coal	Steam Sub-critical	loadfollowing	3878657	213250
MP1	NSW	Black Coal	Steam Sub-critical	loadfollowing	4070542	208805
BW02	NSW	Black Coal	Steam Sub-critical	loadfollowing	4097546	155556
GSTONE5	QLD	Black Coal	Steam Sub-critical	loadfollowing	1194559	134087
VP5	NSW	Black Coal	Steam Sub-critical	loadfollowing	2332530	133905
ER02	NSW	Black Coal	Steam Sub-critical	loadfollowing	3199887	129275
LD04	NSW	Black Coal	Steam Sub-critical	loadfollowing	2371957	84185
CPP_4	QLD	Black Coal	Steam Super-critical	loadfollowing	2245797	82699
BW04	NSW	Black Coal	Steam Sub-critical	loadfollowing	3621512	79029
MORTLK11	VIC	Gas	OCGT	loadfollowing	468456	72330
CPP_3	QLD	Black Coal	Steam Super-critical	loadfollowing	1957821	59839
LD03	NSW	Black Coal	Steam Sub-critical	loadfollowing	2011373	57553
PPCCGT	SA	Gas	CCGT	loadfollowing	1018222	57370
WW8	NSW	Black Coal	Steam Sub-critical	loadfollowing	632844	56528
HWPS7	VIC	Brown Coal	Steam Sub-critical	loadfollowing	1259375	55147
LYA4	VIC	Brown Coal	Steam Sub-critical	loadfollowing	4363422	52138
MORTLK12	VIC	Gas	OCGT	loadfollowing	508509	41728
TORRB1	SA	Gas	Steam Sub-critical	loadfollowing	367628	41446
BRAEMAR3	QLD	Gas	CCGT	loadfollowing	595537	32620
TORRB3	SA	Gas	Steam Sub-critical	loadfollowing	262049	28436
BRAEMAR6	QLD	Gas	CCGT	loadfollowing	583079	27181
BRAEMAR5	QLD	Gas	CCGT	loadfollowing	548948	22688
BRAEMAR1	QLD	Gas	CCGT	loadfollowing	593758	21723
BW03	NSW	Black Coal	Steam Sub-critical	loadfollowing	4013726	19204
SWAN_E	QLD	Gas	CCGT	loadfollowing	1104960	7590
SITHE01	NSW	Gas	CCGT	loadfollowing	677740	6681
MOR1	VIC	Brown Coal	Steam Sub-critical	loadfollowing	173149	4253
BRAEMAR2	QLD	Gas	CCGT	loadfollowing	310414	3218
TVCC201	TAS	Gas	CCGT	loadfollowing	305357	-383
TALWA1	NSW	Gas	CCGT	loadfollowing	1214058	-1664
WW7	NSW	Black Coal	Steam Sub-critical	loadfollowing	162470	-2838
DDPS1	QLD	Gas	CCGT	loadfollowing	1915205	-2969
REDBANK1	NSW	Black Coal	Steam Sub-critical	loadfollowing	948188	-248205
TOTAL					2062575	775179

Table 4.5: Emissions avoided (tCO₂-e) at load-following generators in 2014 (positive numbers are savings).

4.3 emissions avoided by generator

39

DUID	region	fuel	technology	type	emitted	avoided
NPS	VIC	Gas	Steam Sub-critical	peaking	179590	101150
QPS5	SA	Gas	OCGT	peaking	89881	61851
LADBROK2	SA	Gas	OCGT	peaking	93477	57343
AGLHAL	SA	Gas	CCGT	peaking	55967	50857
LADBROK1	SA	Gas	OCGT	peaking	82005	50724
TORRA4	SA	Gas	Steam Sub-critical	peaking	36762	39616
VPGS	VIC	Gas	OCGT	peaking	52868	37917
QPS3	SA	Gas	OCGT	peaking	33014	30639
CG3	NSW	Gas	OCGT	peaking	22238	30080
TORRA2	SA	Gas	Steam Sub-critical	peaking	39306	29284
QPS4	SA	Gas	OCGT	peaking	27902	28359
AGLSOM	VIC	Gas	OCGT	peaking	15381	27917
QPS1	SA	Gas	OCGT	peaking	32368	27630
URANQ13	NSW	Gas	OCGT	peaking	52357	26314
QPS2	SA	Gas	OCGT	peaking	26680	25544
URANQ12	NSW	Gas	OCGT	peaking	45406	25299
TORRA3	SA	Gas	Steam Sub-critical	peaking	46968	25193
CG2	NSW	Gas	OCGT	peaking	14245	24531
ROMA_8	QLD	Gas	OCGT	peaking	76131	22734
URANQ11	NSW	Gas	OCGT	peaking	73468	18420
ROMA_7	QLD	Gas	OCGT	peaking	84693	18327
CG4	NSW	Gas	OCGT	peaking	28806	18278
TORRA1	SA	Gas	Steam Sub-critical	peaking	26694	15105
URANQ14	NSW	Gas	OCGT	peaking	61553	13668
LAVNORTH	VIC	Gas	OCGT	peaking	10302	11950
MBAHNTH	QLD	Gas	ICE	peaking	212165	11194
BDL01	VIC	Gas	OCGT	peaking	34579	10106
MINTARO	SA	Gas	OCGT	peaking	12043	9608
TVPP104	TAS	Gas	OCGT	peaking	8029	6126
BDL02	VIC	Gas	OCGT	peaking	72001	5279
JLB01	VIC	Gas	OCGT	peaking	10563	4718
JLB03	VIC	Gas	OCGT	peaking	7815	4660
JLB02	VIC	Gas	OCGT	peaking	7856	4139
CG1	NSW	Gas	OCGT	peaking	3260	3812
YABULU	QLD	Gas	OCGT	peaking	94558	3575
DRYCGT3	SA	Gas	OCGT	peaking	3551	2937
JLA02	VIC	Gas	OCGT	peaking	3023	1784
JLA04	VIC	Gas	OCGT	peaking	2973	1723
ANGAS1	SA	Distillate	ICE	peaking	920	1656
POR01	SA	Distillate	OCGT	peaking	943	1133
DRYCGT2	SA	Gas	OCGT	peaking	1453	1113
BARCALDN	QLD	Gas	CCGT	peaking	3735	1073
BBTHREE2	TAS	Gas	OCGT	peaking	1077	1056
JLA03	VIC	Gas	OCGT	peaking	2219	1034
ANGAS2	SA	Distillate	ICE	peaking	568	969
BBTHREE1	TAS	Gas	OCGT	peaking	1174	778
JLA01	VIC	Gas	OCGT	peaking	2402	733
BBTHREE3	TAS	Gas	OCGT	peaking	982	682
HVGTS	NSW	Distillate	OCGT	peaking	476	415
MACKAYGT	QLD	Distillate	OCGT	peaking	10654	320
GB01	NSW	Distillate	OCGT	peaking	168	262
Oakey2	QLD	Gas	OCGT	peaking	46119	111
SNUG1	SA	Distillate	OCGT	peaking	254	0
POR03	SA	Distillate	OCGT	peaking	49	0
DRYCGT1	SA	Gas	OCGT	peaking	264	-183
YABULU2	QLD	Gas	OCGT	peaking	47201	-503
Oakey1	QLD	Gas	OCGT	peaking	29058	-2415
MSTUART1	QLD	Distillate	OCGT	peaking	5424	-5531
MSTUART2	QLD	Distillate	OCGT	peaking	12667	-5707
MSTUART3	QLD	Distillate	OCGT	peaking	114152	-31508
TOTAL					2062575	775179

Table 4.6: Emissions avoided (tCO₂-e) at peaking generators in 2014 (positive numbers are savings). A more accurate estimation of aggregate emissions avoided from peaking plant is discussed in Section 3.2.3.

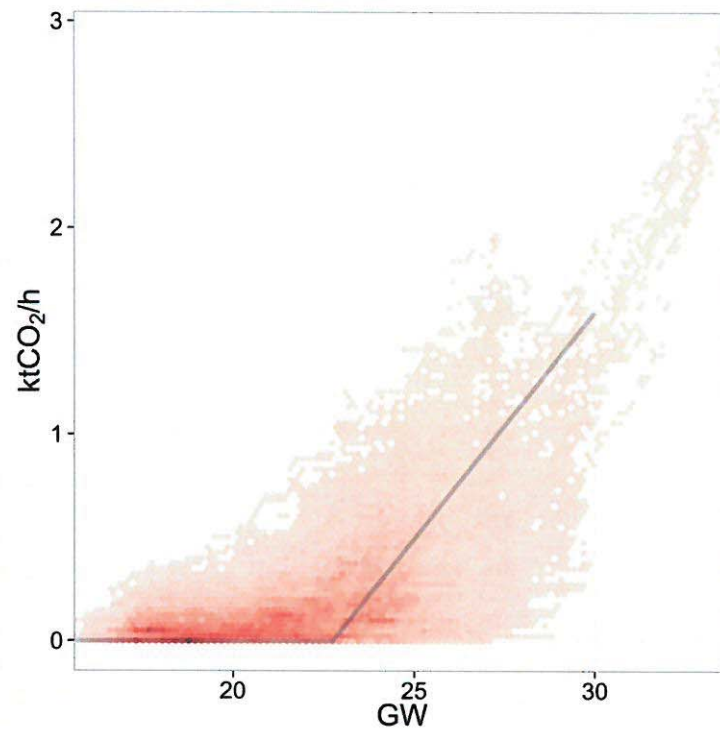


Figure 4.3: Emissions from thermal peaking plant (ktCO₂-e per hour) vs system demand (total NEM generation). Use of peaking plant increases when system demand exceeds ~ 23GW.

4.4 data & references

- [1] *Quantifying Emissions Saving from Wind Power*, Joseph Wheatley, Energy Policy, Elsevier, December 2013.
<http://www.sciencedirect.com/science/article/pii/S0301421513007829>
- [2] SCADA generation were downloaded (Feb 2015) from:
http://www.nemweb.com.au/REPORTS/ARCHIVE/Dispatch_SCADA/
- [3] Interconnector flow data were downloaded (Feb 2015) from:
http://www.nemweb.com.au/Reports/ARCHIVE/DispatchIS_Reports/
- [4] *Fuel and Technology Cost Review Report*, ACIL Allen 2014
spreadsheet: [Fuel_and_Technology_Cost_Review_Report_ACIL_Allen.xlsx](#)
- [5] *National Greenhouse Accounts Factors*, Government of Australia, Department of Environment, 2013.
<http://www.environment.gov.au/climate-change/greenhouse-gas-measurement/publications/national-greenhouse-accounts-factors-july-2013>
- [6] *Carbon Dioxide Equivalent Intensity Index Procedure*, AEMO, December 2014
<http://www.aemo.com.au/Electricity/Settlements/Carbon-Dioxide-Equivalent-Intensity-Index>
- [7] CDEII emissions intensities report: [20140411_Emissions_report_ACILALLEN.pdf](#)
- [8] Jun-Dec 2014 AEMO emissions reported by region:
http://nemweb.com.au/Reports/CURRENT/CDEII/CO2EII_SUMMARY_RESULTS_2014_PT2.CSV
- [9] Hydro Tasmania spreadsheet:
http://www.hydro.com.au/system/files/water-storage/storage_summary-4.xls
- [10] R Development Core Team (2008). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria.
<http://www.R-project.org>

Implications of Australian Renewable Energy Mandates for the Electricity Sector

Brian S. Fisher and Sabine Schnittger

BAE Research Report 2016.2

Implications of Australian Renewable Energy Mandates for the Electricity Sector

Brian S. Fisher and Sabine Schnittger

August 2016

BAEconomics Pty Ltd

© BAEconomics Pty Ltd, 2016

This work is copyright. The Copyright Act 1968 permits fair dealing for study, research, news reporting, criticism or review. Selected passages, tables or diagrams may be reproduced for such purposes provided acknowledgement of the source is included. Major extracts or the entire document may not be reproduced by any process without the written permission of the Managing Director of BAEconomics Pty Ltd.

ISBN: 978-0-9945697-1-4

Brian S. Fisher and Sabine Schnittger, 2016, *Implications of Australian Renewable Energy Mandates for the Electricity Sector*, BAE Research Report 2016.2, Canberra, August.

BAEconomics Pty Ltd

GPO Box 5447 Kingston, ACT 2604, Australia

Telephone +61 437 394 309; Facsimile +61 2 6239 5864

www.baeconomics.com.au

Foreword

The Minerals Council of Australia has requested that BAEconomics assess the implications of increasing shares of renewable energy in the Australian electric power system for the stability of the system itself and more broadly for the Australian economy as a whole.

The Renewable Energy Target operates alongside other government policies designed to reduce greenhouse gas emissions. Applying multiple policies to achieve one target – a given reduction in emissions by a particular year – is unlikely to be efficient because of the inherent conflicts between multiple policy instruments. The issue addressed in this paper is the narrower one of the implications of increasing shares of renewable energy generation on the overall (system) cost of supplying consumers with electricity. The corresponding challenges are common to all power systems as the share of intermittent generation increases, but the so-called integration costs of mandating greater shares of intermittent technologies are higher in power systems that have been traditionally dependent on thermal generation plants such as Australia's east coast power network.

The value of electricity depends on when (and where) it is generated. The electricity that can be supplied by a wind generator at a low cost is not 'cheap', if the output is mostly available at night when demand is low, supply is plentiful, and the value of electricity to consumers is also low. Conversely, the electricity that can be supplied by a gas turbine at a high cost is not 'expensive', if it can be called on to generate during peak demand periods when the system is stretched to capacity and the value of electricity to consumers is very high. Levelised cost comparisons between different generation technologies are then largely meaningless because they implicitly assume that the electricity generated from different sources has the same value. The empirical observation is that the market value of intermittent renewables is relatively low and further declines as their market share rises. Notwithstanding projected cost reductions for these technologies therefore, the subsidies required to deploy increasing shares of intermittent renewables can be expected to increase disproportionately.

Our aim in this report is to review some of the key issues facing the power sector as governments strive to achieve higher renewable energy targets.

Dr Brian Fisher
Managing Director
BAEconomics Pty Ltd
August, 2016

Table of contents

Foreword	iii
Executive summary and conclusions	1
Consumers' demand for electricity and power systems	1
Integration costs of intermittent generation technologies	2
System value of intermittent renewables.....	4
Conclusions.....	5
1 Introduction.....	6
1.1 Context	6
1.2 Structure of this report	6
2 Electrical power systems.....	7
2.1 Balancing demand and supply.....	7
2.2 Power stations and the merit order	8
2.3 Electricity wholesale markets and prices	10
3 The renewable energy target	12
3.1 Government investment mandates.....	12
3.2 Renewable generation subsidies	12
4 Wholesale market cost implications of the RET	14
4.1 Integration costs of intermittent generation technologies.....	14
4.2 Intermittency of wind and solar PV generation technologies	15
5 Integration cost components of intermittent generation technologies	20
5.1 Balancing costs	20
5.2 Profile costs	23
5.3 Grid-related costs	28
5.4 Broader system challenges	30
5.5 Aggregate integration costs	31
6 Minimising the total costs of a power system	32
6.1 System versus stand-alone costs of intermittent renewables.....	32
6.2 Value versus stand-alone cost of intermittent renewables	33

6.3	Value versus price of intermittent renewables.....	34
7	Intermittent generation and price volatility	36
8	Integrating an increasing share of renewable generation into Australia's electricity markets	38
	References	40

Executive summary and conclusions

This report focuses on the cost and value implications of mandating increasing shares of intermittent renewable generation technologies – such as wind and solar PV – in electric power systems, including in Australia.

Consumers' demand for electricity and power systems

Consumers' demand for electricity varies over timescales of seconds, minutes and hours, depending on whether a day is a working day, a weekend day or a holiday, and by season. During the working week, the demand for electricity generally peaks relatively early in the morning, declines somewhat during the day and peaks again in the early evening, and is generally lowest in the early hours of a new day. There are also shifts in the timing of peaks over different days of the week. Such load profiles are overlaid with temperature-related variability arising from the use of air-conditioning and heating appliances.

The power systems that supply consumers with electricity have evolved are complex. Such systems must be administered by a system operator whose role it is to coordinate the operation of all power stations in a very precise way. This coordination task requires that the electricity supplied by power stations exactly equals the electricity that consumers demand by turning on electrical appliances at all times, and that power stations furthermore operate in such a way that the 'technical envelope' of the system is not violated. In circumstances where electricity demand and supply are not balanced or technical constraints are breached, the operation of a power system is no longer 'secure'. Unless the system operator takes immediate action to address a particular issue or contingency, the power system may collapse and black-outs will result. Black-outs, where some or all parts of an electricity system are no longer supplied with electricity are extremely costly for the affected customers, and represent events that a system operator will try to avoid at a high cost.

In most developed countries, including in Australia, the electricity generation sector has been liberalised to enable private sector entities to generate electricity, and wholesale markets have been established where electricity is traded. Thus the National Electricity Market (NEM) operates across the Eastern Seaboard power system, while the Wholesale Electricity Market (WEM) operates in south-west Western Australia. While the designs of the NEM and the WEM differ in important respects, both wholesale markets post a single market-clearing electricity spot price for each half-hour of the day. That spot price reflects the intersection of demand and supply in a given half-hour, so that the incremental cost of producing the electricity in that half-hour equals its value to customers.

Electricity demand varies over short timescales, but wholesale electricity cannot generally be stored cost-effectively at present. This has an important implication for electricity wholesale prices, namely, that these prices have a very significant temporal dimension. In the NEM, half-hourly spot prices are typically low during off-peak periods (although they may fall as low as zero or below zero in some instances), but may rise to hundreds of dollars per MWh at high levels of demand, and up to the market price cap of currently \$14,000 per MWh. Such price variations reflect the fact

that the cost of supplying an additional increment of electricity varies a great deal for different levels of demand, reflecting the type of generation technology that is dispatched and the availability of additional generation capacity. Overnight, for instance, when electricity demand is low and there is ample generation capacity to supply it, a low spot price may reflect the ‘marginal cost’ of the coal-fired baseload plants that are operating. In periods when demand is higher and peaks, spot prices rise as increasingly expensive mid-merit and peaking power stations with higher marginal costs are dispatched to operate. As demand rises, the output of power stations that are available to generate therefore becomes increasingly valuable.

Integration costs of intermittent generation technologies

Whenever a particular generation technology is added to and integrated with the operations of a power system, other generation and network components of that system are affected in some way. As a result, total system costs may increase or decrease. The concept of integration costs of a specific generation technology then captures the effect that deploying that technology causes costs elsewhere in the power system. However, while these costs in principle arise for other types of generation technologies, what distinguishes the integration costs of wind and solar PV technologies is not their existence, but their size. Specifically, these technologies interact differently with the power system than is the case for conventional plant that can be dispatched, and are far more difficult to integrate, particularly at high levels of penetration (or shares of generation capacity or demand).

In one way or another, the high integration costs of wind and solar PV technologies derive from the fact that these renewable technologies operate in a manner that is fundamentally different from conventional generation technologies. The electricity output from these technologies is ‘intermittent’; that is, they are not continuously available to generate electricity because of external factors that cannot be controlled (such as the strength of wind or the amount of sunlight). There are therefore significant limitations in the extent to which intermittent technologies can be dispatched by the system operator, and therefore the extent to which they can usefully be deployed to meet demand at any given time of the day or night. When it reaches a certain point, the intermittent production of electricity poses a threat to the security of a power system because supply and demand cannot be balanced using intermittent resources alone. The deployment of intermittent renewable generation (IRG) resources then implies that specific actions need to be taken – and corresponding costs incurred – in the non-intermittent (or ‘residual’) part of the power system. In this context, integration costs are then defined as all additional costs in the residual part of the power system when IRG resources are deployed.

The integration costs of IRG technologies into electric power systems consist of three approximately additive components. Balancing costs occur because the supply from IRGs is uncertain until realisation and forecasting errors therefore arise. The corresponding costs take the form of adjustments that have to be made to the least-cost dispatch schedule of dispatchable generators, and the need to hold additional short-term reserves. Profile costs are caused by the variability and particular intertemporal generation profile of IRG technologies, which is often not well correlated with demand. These attributes imply that while IRG resources contribute some electricity, they hardly reduce the need for the overall capacity that needs to be maintained in a power system. Profile costs take the form of flexibility costs that arise because of the specific

operational requirements placed on dispatchable generators, utilisation or back-up costs that reflect the need to maintain significant conventional generation capacity (even if it is hardly used), and overproduction costs when IRG technologies need to be constrained down or off because they produce more electricity than is demanded by consumers. Grid costs arise from the specific location of IRG resources. These costs that arise if additional network investment is necessary to accommodate IRG resources, for instance if high quality IRG sites are located far from demand centres, and additional transmission losses and congestion costs, for instance, if the additional output from renewable generators constrains existing transmission infrastructure.

Looking beyond integration costs, conventional generators – particularly large coal-fired plants – have certain inherent characteristics that contribute to the security of the power system, but that are presently not generally provided by IRG resources. When conventional generators operate they provide ‘inertia’; that is, they contribute to the ability of the power system to ‘ride through’ fault events and limit system frequency excursions. As conventional generators are displaced by non-synchronous (wind and solar) generation technologies, the overall reduction in inertia tends to increase the frequency and magnitude of power system disturbances, so that the power system becomes more vulnerable to fault events unless some other action is taken.

Integration costs depend on the characteristics of IRG technologies, but also on the flexibility of the particular power system into which they are being integrated. Thus integration costs tend to be higher in power systems dominated by less flexible thermal generation resources (as is the case in Australia) than in predominantly hydroelectric systems. These costs also tend to be less in larger and interconnected power systems, than in smaller systems with weak interconnections. Integration costs are therefore system-specific.

The components that constitute the integration costs of IRG resources – balancing, profile and grid costs – are not constant parameters, but are functions of many system properties. A review of the literature nevertheless reveals a number of important trends that apply across predominantly thermal power systems. The most important of these is that integration costs increase with the penetration of IRG resources.

At low levels of penetration, the integration costs of intermittent renewables may be low or even negative. In these circumstances, the additional balancing and profile costs are outweighed by the fuel cost savings from wind and solar PV resources. Overall, integration costs are considered to be relatively small at penetration levels of up to 10 per cent.

Even allowing for adaptation in the generation mix to account for the uncertainty and variability of intermittent renewables, however, the integration costs of IRG technologies can become very high at high penetration rates. When wind penetration reaches 30 to 40 per cent, balancing costs are estimated to be AU\$ 6 per MWh of renewable energy generated, while profile costs are in the range of AU\$ 30 per MWh of renewable energy generated. Profile costs – which arise from the need to maintain additional costly generation capacity in the system to manage the significant output variability of intermittent resources – are significantly higher than balancing costs. Overall, and allowing for long-term changes in the generation mix, integration costs are estimated to be in the range of AU\$ 37 to AU\$ 53 per MWh when wind penetration reaches 30 to 40 per cent.

System value of intermittent renewables

Given that the price of electricity varies a great deal over time and that different generators have differing intertemporal operating profiles, the marginal value of different generation technologies in a power system also does not coincide. The optimal deployment for each generation technology that minimises costs to consumers therefore also varies, depending on its value in the power system. Government policies that set a targeted level of IRG output as part of a renewable energy mandate without considering the value of the electricity produced by that technology are therefore almost certainly inefficient, and will increase costs to consumers at higher levels of IRG technology penetration.

Unlike what is commonly claimed by proponents of renewable energy mandates, it is not the case that IRG technologies will invariably become ‘competitive’ as the stand-alone costs of these technologies continues to fall. Levelised cost of electricity (LCOE) comparisons between IRG and other generation technologies are misleading because they fail to consider the value of IRG resources within a power system. From a social welfare or competitiveness perspective, it is irrelevant whether or not the LCOE of wind or solar technologies is below or above that of other generation technologies; what matters instead is a given technology’s cost relative to its value. Thus, the electricity that can be supplied by a wind generator at a low levelised cost is not ‘cheap’, if the output is mostly available at night when demand is low, supply is plentiful, and the value of electricity to consumers is also low. Conversely, the electricity that can be supplied by a gas turbine at a very high levelised cost is not ‘expensive’, if it can be called on to generate during peak demand periods when the system is stretched to capacity and the value of electricity to consumers is very high. Simplistic levelised cost comparisons between different generation technologies are therefore largely meaningless because they implicitly assume that the electricity generated from different sources has the same value in the power system.

In a well-functioning liberalised power system, the value of a particular generation technology is reflected in the market prices that it earns from producing electricity. In power systems with high shares of intermittent renewables, technologies such as wind consistently earn less than overall weighted-average spot prices, indicating a ‘value factor’ that is less than one. The observation that the value factor of IRG technologies strictly declines as their share in a power system increases is referred to as the ‘self-cannibalisation effect’. It arises because renewable technologies tend to produce disproportionately during times when the electricity price is low, and because their output is correlated. As more capacity is added to the system, IRG technologies will tend to generate at similar times, so that there is increasingly an abundance of electricity at these times, which in turn leads to lower prices, a lower system value, and a lower value factor.

The exact magnitude of the value decline of IRG resources is system-specific. However, the studies that have been undertaken commonly find that in predominantly thermal power systems, at high penetration rates (such as 20+ per cent for wind or 10+ per cent for solar, intermittent technologies produce the least-value electricity. At such penetrations, integration costs play an increasing and material role. Thus intermittency increasingly reduces the market value of renewable generation such that, on average, one MWh from wind power is worth increasingly less than one MWh from a conventional power station or other dispatchable source. The implication is that the greater the share of renewables in a power system, the lower its value, and the higher the overall system cost

of supplying consumers with electricity.

Conclusions

As has also been noted by the International Energy Agency, the economic challenge of integrating wind and solar technologies in a power system is reflected in their declining value. As the penetration of these renewables increases, the level of support to meet deployment targets also rises. System and market integration then become a critical priority for renewables policy.

There are a number of studies which suggest that high shares of renewable generation are technically feasible in the Australian electricity market, albeit at a high cost. Achieving these targets will require the deployment of new generation technologies and forms of storage, as well as a greater emphasis on demand side management. However, few such studies consider the market context in which electricity markets operate and whether, given current market structures, financing models exist that will allow the necessary investment both in increasing renewable capacity and the supporting generation and storage technology necessary to ensure that system reliability is maintained. In the light of the recent experience in South Australia's electricity market Nelson and Orton (2016) conclude that a 'root-and-branch' review of energy market design and governance is required – to consider how best to decarbonize Australia's electricity supply across the generation, transmission, distribution, and retail components of the supply chain while maintaining supply security, efficient pricing, and appropriate risk allocation.' Such a review seems essential if further increases in the RET are contemplated given that substantial new investment in the power system overall will be required to achieve such targets while maintaining a reliable power system.

1 Introduction

1.1 Context

There have been increasing calls for a greater share of electricity generation to be sourced from renewable technologies such as solar and wind. While they differ in terms of their precise targets, all of the major parties envisage a renewable energy target (RET) where a share of electricity generated in Australia would need to come from renewable generation facilities, as well as other policies targeted at the electricity sector. For example, the Australian Labor Party in the run up to the recent federal election stated its intention to implement a reduction target of net zero emissions by 2050, partly facilitated by a further target of 50 per cent renewable energy by 2030 in the event that it won government. The Australian Greens announced a desire to reach at least 90 per cent renewable energy generation by 2030 to be achieved by increasing the RET and increasing clean energy finance to \$30 billion over 10 years. The Greens' policy also included a promise of \$2.9 billion over five years in support of homes and business uptake of renewable energy storage units. The current Coalition government implemented a 23.5 per cent RET by 2020 in its previous term.

In one way or another, therefore, all of these policies would accelerate moves toward increasing the share of electricity generated from renewables and correspondingly reduce the share of conventional (thermal) generation, in particular generation from coal. Given the reliance of the Australian economy on energy as a vital input, the effects of these policies – in terms of their costs and the corresponding impacts on prices and, more broadly, on the reliability of electricity supply – are potentially far-reaching.

1.2 Structure of this report

This paper describes the costs and broader implications of the RET for the electric power system:

- Section 2 describes the operations of electrical power systems and the wholesale power markets that operate around these systems;
- Section 3 describes the RET and how it interacts with the power system;
- Section 4 describes the concept of integration costs that arise in integrating intermittent renewable technologies such as wind and solar into a power system;
- Section 5 describes the specific integration costs of intermittent renewable technologies;
- Section 6 comments on the implications of integration costs for a competitiveness or welfare analysis of power systems;
- Section 7 describes the implications for electricity price volatility of increasing shares of renewable generation in power systems dominated by thermal generators; and
- Section 8 discusses some of the implications of including an increasing share of renewables in Australia's electricity markets.

2 Electrical power systems

The increased deployment of small- and large-scale renewable energy technologies creates material challenges for the operation of electrical power systems. Understanding these challenges requires an appreciation of the characteristics of such systems and how they are managed. This section provides an overview of the essential features of electrical power systems and the wholesale market arrangements that overlay them in Australia.

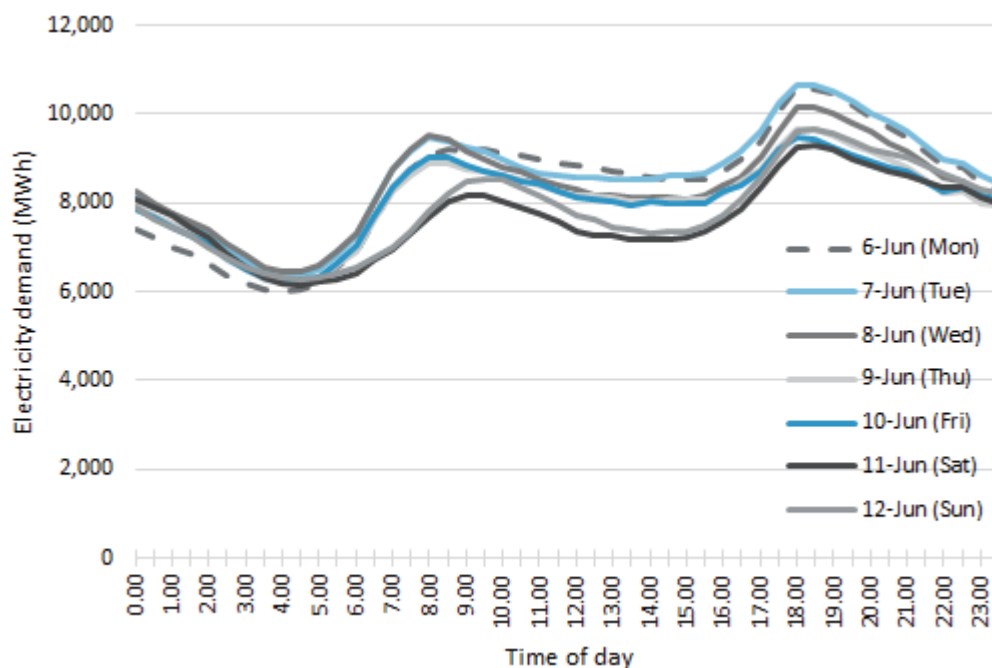
2.1 Balancing demand and supply

Consumers' demand for electricity varies over timescales of seconds, minutes and hours, depending on whether a day is a working day, a weekend day or a holiday, and by season. During the working week, the demand for electricity generally peaks relatively early in the morning, declines somewhat during the day and peaks again in the early evening, and is generally lowest in the early hours of a new day. Figure 2-1 shows a series of such daily demand or 'load' profiles for NSW in early June of this year. It shows daily variations in minimum and maximum demand, as well as the shift in the timing of peaks over different days of the week. Such load profiles are overlaid with temperature-related variability arising from the use of air-conditioning and heating appliances.

Consumer demand profiles are also affected by variability arising from the installation of rooftop photovoltaic (PV) generating installations on the part of households. Rooftop PV installations are installed 'behind the meter'; their electricity output is not directly observable by the system operator. From an aggregate perspective, the existence of rooftop PV installations therefore manifests itself as a reduction in demand at certain times during daylight hours. 'Residual' electricity demand during certain times of the day is therefore reduced.

The power systems that supply consumers with electricity have evolved over many years and are complex. In Australia, the two largest systems operate across Australia's Eastern Seaboard and the South West Interconnected System of Western Australia (SWIS). Power systems comprise a large number of interconnected components, including many different types of network elements and power stations. The operation of a such a system must be administered by a system operator whose role it is to coordinate the operation of all power stations in a very precise way. This coordination task requires that the electricity supplied by power stations exactly equals the electricity that consumers demand by turning on electrical appliances at all times, and that power stations furthermore operate in such a way that the 'technical envelope' of the system is not breached. The corresponding technical constraints require, among other things, that frequency and voltage across the system remain within 'normal' limits and all equipment operates within its technical ratings. In circumstances where electricity demand and supply are not balanced or technical constraints are violated, the operation of a power system is no longer 'secure'. Unless the system operator takes immediate action to address a particular issue or contingency, the power system may collapse and black-outs will result. Black-outs, where some or all parts of an electricity system are no longer supplied with electricity are extremely costly for the affected customers, and represent events that a system operator will try to avoid at a high cost.

Figure 2-1. Electricity load profiles for NSW – 6 to 12 June 2016



Source: AEMO data.

The Australian Energy Market Operator (AEMO) is the system operator for the Eastern Seaboard power system and the SWIS. AEMO maintains these power systems in a secure operating state by ‘dispatching’ (instructing to operate) ‘conventional’ – coal- or gas-fired or hydroelectric – power stations at a defined level of electrical output so that the instantaneous power supplied to the system exactly matches aggregate electricity demand, and that technical constraints are not breached. That task is complicated by the variability in electricity demand and the fact that forward demand projections are inherently uncertain. There is also always the possibility of contingencies arising from unplanned outages and faults, either of a network element or a power station, which can also compromise the security of the power system. Over short timeframes, the secure operation of a power system therefore also requires that AEMO can call on various ‘ancillary services’ that are needed to deal with a range of system events or contingencies, and that a certain quantity of operational reserve is available to be called upon. To date in Australia, these ancillary services are generally provided by conventional power stations, and to a lesser extent by load (customers).

2.2 Power stations and the merit order

The task of matching time-varying electricity demand and supply at all times and in a manner that is least-cost for consumers requires a mix of power stations. Conventional coal-or gas-fired power stations differ according to their operating capabilities and cost characteristics, and play different roles in a power system corresponding to a dispatch hierarchy that depends on the level of

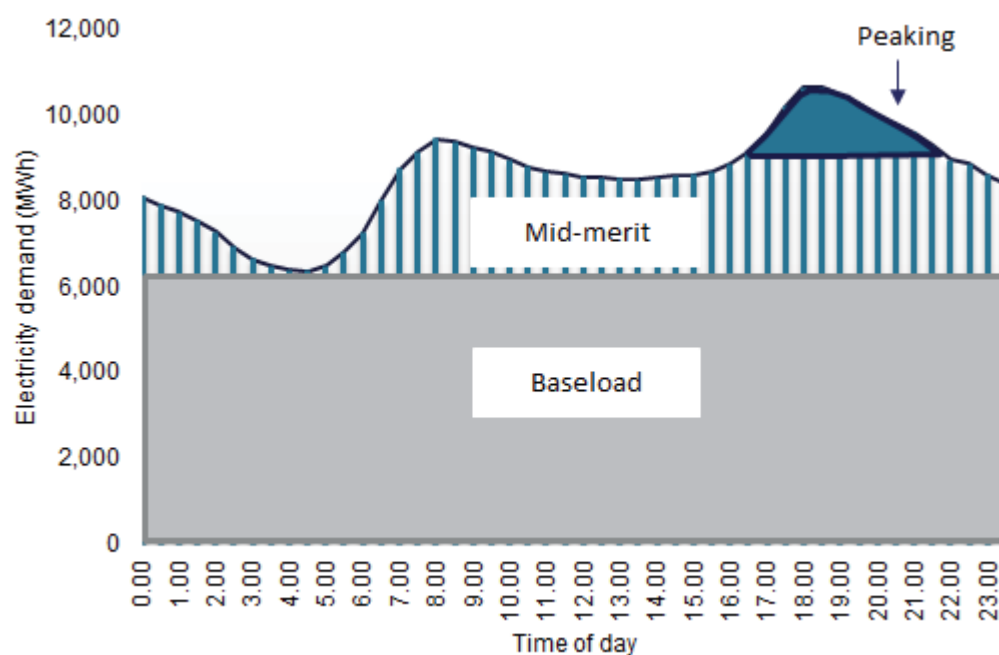
demand:¹

- ‘Baseload’ plants have high capital costs and are relatively inflexible in terms of their ability to vary their output, but are also cheap to run, in terms of their cost of producing an additional unit of electricity (as measured in \$ per megawatt hour of electricity generated (\$/MWh). Baseload plant generally operate 24 hours a day on all days and meets the minimum level of electricity demand. Given that Australia is endowed with substantial, high-quality coal resources, baseload power stations on the Eastern Seaboard are black- or brown coal plants.
- ‘Mid-merit’ or ‘intermediate’ plants additionally operate at times when electricity demand is higher than the daily minimum, sometimes referred to as ‘shoulder’ periods. Such plants are capable of ‘ramping’ their output up or down more quickly than baseload plants to match changing electricity demand, but they also tend to be more costly to operate. Mid-merit power stations can be coal- or gas-fired.
- ‘Peaking’ plants are additionally needed to generate to meet demand when it is at its highest, for instance, when electricity consumption from air-conditioning or heating appliances spikes. Peaking plants are typically gas- or oil-fired, and can change their output very quickly. Although the capital costs of such plants are relatively lower, such plants are very costly to operate. Peaking plants are nevertheless essential for system security. They are, for instance, required to balance electricity demand that is changing rapidly or to compensate for contingencies elsewhere in the power system and thereby prevent the system from collapsing.

In a typical power system, baseload, mid-merit and peaking plants make up the so-called ‘merit order’ of power stations, whereby power stations are ranked in order of their \$/MWh generating costs. Figure 2-2 presents a stylised example of a daily demand curve with three classes of generators serving the load. Around 6,000 MWh can be served from baseload generators that run continuously and offer the lowest \$/MWh cost. As demand increases during the day, higher cost mid-merit generators are dispatched to match the changing load profile. Depending on how flexible these mid-merit plants are, it may also be necessary to dispatch fast-response (peaking) plants. In the example in Figure 2-2, peaking plants are dispatched during the evening peak from 5pm to 10pm.

¹ The following discussion abstracts from hydroelectric generating plant, whose operations differ somewhat from thermal generating plant, but can operate as baseload, mid-merit or peaking plant, depending on the qualities of the underlying water resource.

Figure 2-2. Least-cost generation dispatch



Source: AEMO data.

In principle, and unless there are specific constraints that need to be accommodated, a system operator will always dispatch power stations from least cost to highest cost in order to minimise the cost of meeting consumer demand. The addition of renewable resources such as wind turbines to the generation mix then changes the conventional merit order. Wind turbines incur capital costs to build, but their generating costs are very low and close to zero. When they are available (that is, when the wind is blowing), wind turbines are therefore always located at the bottom of the merit order and have operational priority such that they displace (higher cost) conventional plant.

2.3 Electricity wholesale markets and prices

In most developed countries, including in Australia, the electricity generation sector has been liberalised to enable private sector entities to generate electricity, and wholesale markets have been established where electricity is traded. Thus the National Electricity Market (NEM) operates across the Eastern Seaboard power system, while the Wholesale Electricity Market (WEM) operates across the SWIS. While the designs of the NEM and the WEM differ in important respects, both wholesale markets post a single market-clearing electricity spot price for each half-hour of the day. That spot price reflects the intersection of demand and supply in a given half-hour, so that the incremental cost of producing the electricity in that half-hour equals its value to customers.

Electricity demand varies over short timescales, but wholesale electricity cannot generally be

stored cost-effectively.² This has an important implication for electricity wholesale prices, namely, that these prices have a very significant temporal dimension.³ In the NEM, half-hourly spot prices are typically low during off-peak periods (although they may fall as low as zero or below zero in some instances), but may rise to hundreds of dollars per MWh at high levels of demand, and up to the market price cap of currently \$14,000/MWh. Such price variations reflect the fact that the cost of supplying an additional increment of electricity varies a great deal for different levels of demand, reflecting the type of generation technology that is dispatched and the availability of additional generation capacity. Overnight, for instance, when electricity demand is low and there is ample generation capacity to supply it, a low spot price may reflect the ‘marginal cost’ of the coal-fired baseload plants that are operating. In periods when demand is higher and peaks, spot prices rise as increasingly expensive mid-merit and peaking power stations with higher marginal costs are dispatched to operate. As demand rises, the output of power stations that are available to generate therefore becomes increasingly valuable.

² The exception is hydro-dominated power systems (such as the Tasmanian system) where water stored in reservoirs effectively represents a form of electricity storage (assuming adequate supplies of water are available).

³ The existence of network constraints means that electricity wholesale prices also have a geographical dimension, although these are not necessarily explicitly priced. In the NEM, geographical price differences may emerge across NEM regions, while intra-regional network constraints do not give rise to price differences but are managed via command and control instruments. The WEM does not post geographical price differences.

3 The renewable energy target

In liberalised electricity wholesale markets such as the NEM and the WEM, decisions about the type, timing and location of generation investments are the responsibility of market participants, and occur on the basis of wholesale market price signals.⁴ The objective of these reformed governance arrangements is to enable the private sector to take on the considerable expenditures and associated financial risks of making generation investments. Their implementation reflected a widespread recognition that the hitherto government-owned and -run electricity supply industry was inefficient, and imposed significant unnecessary costs on consumers.

3.1 Government investment mandates

In this market context, government policies such as the RET that mandate the share of wholesale electricity that is to be generated from renewable sources translate into a requirement to build additional (renewable) power stations that is disconnected from whether that additional capacity and generation technology is needed to meet electricity demand, and whether the corresponding expenditures are therefore warranted. Both the NEM and the WEM have, for some years, been characterised by significant surplus generation capacity as growth in electricity consumption has moderated or declined, so that no new generation investment was required to meet consumers' electricity demand. Notwithstanding that excess capacity, as of 2015, government policies to mandate generation investment have resulted in new large-scale wind generation capacity in the NEM of almost 3,500 MW, and in more than 360 MW of mostly wind capacity in the WEM. Wind generation is not commercially viable in either market, and requires substantial subsidies to be deployed at scale. At the same time, the subsidies paid under the SRES have supported the installation of around 2.4 million small-scale facilities (in the main rooftop PV installations) since 2001. The RET therefore represents a form of intervention that has resulted in large amounts of renewable generation capacity being commissioned that is both costly and surplus to requirements. This mandated investment therefore represents a real opportunity cost to the Australian economy.

3.2 Renewable generation subsidies

The subsidies paid to power station developers and households under the RET are recovered from electricity consumers. In the case of the LRET, the subsidies take the form of 'large-scale generation certificates' (LGCs) that are equivalent to 1 MWh of renewable electricity. Renewable generators earn one LGC for each MWh of electricity they generate. The Clean Energy Regulator (CER) calculates an annual 'renewable power percentage' (RPP) that mandates how many LGCs electricity retailers must surrender each year to meet their LRET obligation. Similar arrangements

⁴ In the NEM, for instance, where power stations recover their costs from revenues earned in the wholesale market, rising spot prices generally signal an impending need for new generation capacity and will encourage new entry.

apply for the SRES, whereby CER determines an annual ‘small-scale technology percentage’ and electricity retailers are required to surrender a corresponding number of ‘small-scale technology certificates’ (STCs). Electricity retailers then pass the costs of LGCs and STCs through to consumers who pay these subsidies as a component of their electricity bills.

The design of the LRET and the SRES arrangements implies that while the subsidies directed toward achieving the RET originate from a government mandate, they are paid for by electricity consumers and collected by third parties. These subsidies therefore do not appear in government accounts and their magnitude is not transparent. Estimates of total subsidies must instead be inferred from LGC and STC prices published by proprietary trading platforms, and the limited information provided by CER. In 2016, for example, CER determined that retailers would need to surrender 21.43 million LGCs so as to ensure that 21.43 TWh of electricity would be generated from renewable energy sources. Given that LGCs appear to have traded in the \$80/MWh range over the past six months (and assuming that this will continue to be the case), the current LRET obligation would imply direct subsidies to the large-scale renewable generation sector of around \$1.7 billion in 2016 alone.

4 Wholesale market cost implications of the RET

Electric power systems exist to provide consumers with electricity. Irrespective of how they are organised – in the form of a liberalised market such as the NEM and the WEM, or as a centrally controlled sector – such systems are designed to meet aggregate consumer demand to a given standard of reliability and at least cost. From a public policy (welfare maximising) perspective, what is therefore relevant for assessing the impact of renewable energy mandates such as the RET is their overall effect on the system cost of meeting consumer demand. As set out in the following, the deployment of intermittent renewable generation technologies causes significant so-called ‘integration costs’ in the electric power system.

4.1 Integration costs of intermittent generation technologies

An economic welfare analysis of a power system focuses on minimising total power system costs, which comprise all costs associated with meeting electricity demand, including investment costs and the discounted life-cycle variable cost of all plant, grid infrastructure and storage systems (Ueckerdt et al. 2013). All generation technologies incur different combinations of investment and variable costs over their life-cycle. For any given generation technology, these costs can be aggregated to derive the annualised average discounted life-time cost or ‘levelised cost of electricity’ (LCOE) per MWh of electricity generated. The total system cost of a power system therefore includes the LCOEs of all generation technologies operating in that system.

Whenever a particular generation technology is added to and integrated with the operations of a power system, other generation and network components of that system are affected in some way. As a result, total system costs may increase or decrease. The concept of integration costs of a specific generation technology then captures the effect that deploying that technology causes costs elsewhere in the power system. However, while these costs in principle arise for other types of generation technologies, what distinguishes the integration costs of wind and solar PV technologies is not their existence, but their size (Hirth et al. 2016). Specifically, these technologies interact differently with the power system than is the case for conventional plant that can be dispatched, and are far more difficult to integrate, particularly at high levels of penetration (or shares of generation capacity or demand).

In one way or another, the high integration costs of wind and solar PV technologies derive from the fact that these renewable technologies operate in a manner that is fundamentally different from conventional generation technologies. The electricity output from these technologies is ‘intermittent’; that is, they are not continuously available to generate electricity because of external factors that cannot be controlled (the generator cannot control the strength of the wind or the amount of sunlight). There are therefore significant limitations in the extent to which intermittent technologies can be dispatched by the system operator, and therefore the extent to which they can usefully be deployed to meet demand. When it reaches a certain point, the intermittent production of electricity poses a threat to the security of a power system because supply and demand cannot be balanced using intermittent resources alone. The deployment of intermittent renewable generation (IRG) resources then implies that specific actions need to be taken – and corresponding costs incurred – in the non-intermittent (or ‘residual’) part of the power

system. In this context, integration costs are then defined as all additional costs in the residual part of the power system when IRG resources are deployed (Ueckerdt et al. 2013).

Integration costs depend on the characteristics of IRG technologies, but also on the flexibility of the particular power system into which they are being integrated. Thus integration costs tend to be higher in power systems dominated by less flexible thermal generation resources (as is the case in Australia) than in predominantly hydroelectric systems. These costs also tend to be less in larger and interconnected power systems, than in smaller systems with weak interconnections. Integration costs are therefore system-specific.

Irrespective of their size, however, the existence of integration costs means that a focus on the stand-alone cost of IRG resources understates their opportunity cost when such technologies are added to an existing power system. The concept of a 'system LCOE' of an IRG technology therefore includes the LCOE metric, but additionally includes all other economic costs attributable to that generation technology as it is deployed in a power system (Hirth et al. 2016). Specifically, in the case of IRG technologies such as wind and solar PV, the system LCOE of these technologies is the sum of the stand-alone LCOE of the generation technology and the integration cost per MWh of electricity generated. These costs need to be accounted for when calculating the total system costs of meeting consumers' demand and determining the least-cost mix of generation technologies.

4.2 Intermittency of wind and solar PV generation technologies

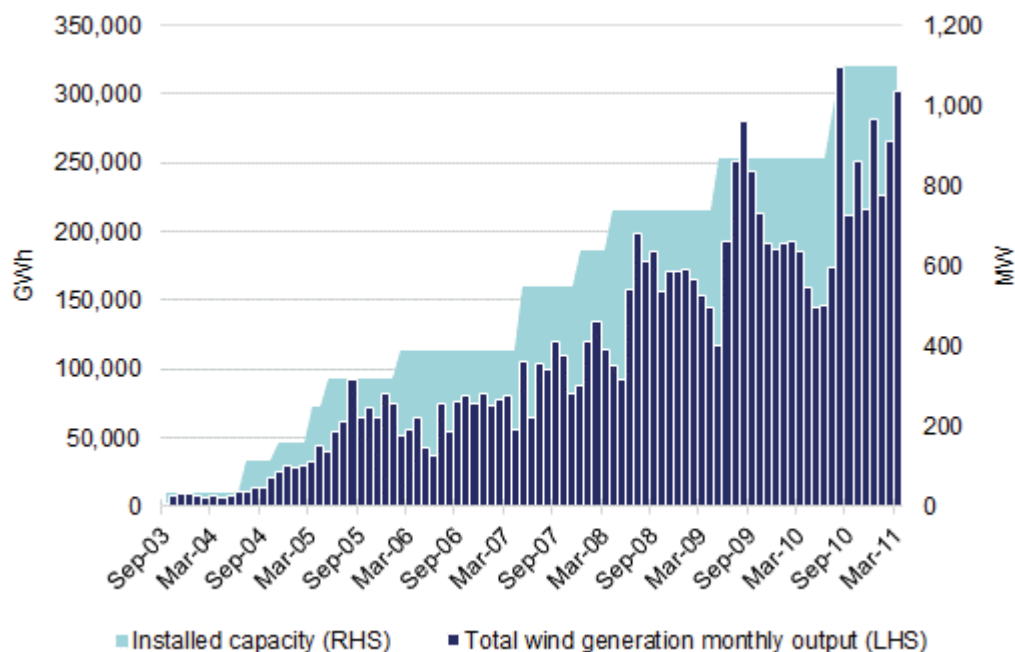
In Australia and in other electricity wholesale markets with renewable energy mandates, new large-scale renewable generation capacity has overwhelmingly taken the form of wind generation, while households have installed large numbers of small-scale solar PV installations. Both wind and solar PV are IRG technologies that give rise to integration costs in the residual power system because of:

- the extent of variability of the supply of electricity from these resources;
- the degree of uncertainty as to how much electricity these resources will supply until realisation; and
- the often distant location of productive renewable energy sites from demand centres and existing infrastructure.

4.2.1 Generation from wind

Whereas conventional generating plant can be dispatched to produce a defined level of electricity, the output of wind turbines varies with fluctuating wind speeds and can only be controlled partially (Wiser et al. 2011). Variations in output can occur over multiple time scales ranging from short-term sub-hourly fluctuations to diurnal, seasonal, and inter-annual fluctuations, and their patterns are highly site- and region-specific. For instance, Figure 4-1 shows total wind generation measured in gigawatt hours (GWh) on the left-hand side (LHS) and in terms of installed capacity on the right-hand side (RHS) in South Australia. There is a seasonal pattern to output, with the highest output generally occurring during winter months, while prominent heatwaves cause a significant decline in monthly output (AEMO 2011a).

Figure 4-1. South Australian total wind generation – September 2003 to March 2011



Source: AEMO 2011a.

The aggregate output of wind farms may change dramatically over multiple hours; very sudden, large drops in output are also possible during high wind conditions when wind turbines cut out. Moreover, and although improvements in forecasting accuracy have been achieved, system operators' ability to predict the output of wind turbines is moderate. In particular, the ability to predict wind power output over forecasting horizons from hours to days is limited.

The characteristics of wind generation can be managed to an extent. The variability of aggregated wind power output diminishes with the geographical dispersion of wind turbines. Control systems at wind turbines can be used to reduce power output fluctuations, albeit at the cost of output reductions or 'spilling' wind. The ability to lower the output of wind generators also gives the system operator a degree of control over their operations in a power system.⁵ Notwithstanding the measures that can be taken to predict and control the output of wind turbines, however, from the perspective of operating a secure and reliable power system, wind power variability and uncertainty pose material challenges, particularly at higher penetrations.

To illustrate these challenges, Figures 4-2, 4-3 and 4-4 show some aspects the intermittency of wind output for the South Australian region of the NEM where the greatest share of wind capacity has been deployed to date. Figure 4-2 shows the percentage of installed wind capacity that was available to generate during the top 10 per cent of demand periods in the summer and winter of

⁵ In the NEM, such plants are classed as 'semi-scheduled': their output can be restricted in some circumstances, but they cannot be dispatched to meet system requirements.

2014-15, respectively. As noted previously, in circumstances where demand is at its highest, most or all power stations in a system are needed to operate to meet demand and maintain the security of the power system. During the summer top demand periods, wind generation never exceeded 81.5 per cent of registered capacity. Fifty per cent of the time, a little more than a quarter (26.2 per cent) of wind capacity was available to generate. About 3 per cent of the time, wind generation was 5 per cent or less of registered capacity. During the winter top demand periods, wind generation never exceeded 91.4 per cent of registered capacity. Fifty per cent of the time wind generation was around a third (33.8 per cent) of registered capacity. About 12 per cent of the time, wind generation was 5 per cent or less of registered capacity.

The significance of these variations in wind output is that the addition of intermittent wind generation capacity does not imply that conventional generation capacity can be retired. The need to balance demand and supply at all times instead means that significant generation capacity must be maintained in the power system to cope with events where wind output is low and the power system would otherwise collapse. This represents a cost to the system because dispatchable capacity of some form (whether it be traditional thermal generators or some form of storage such as pumped hydro or batteries) must be maintained ready for use.⁶

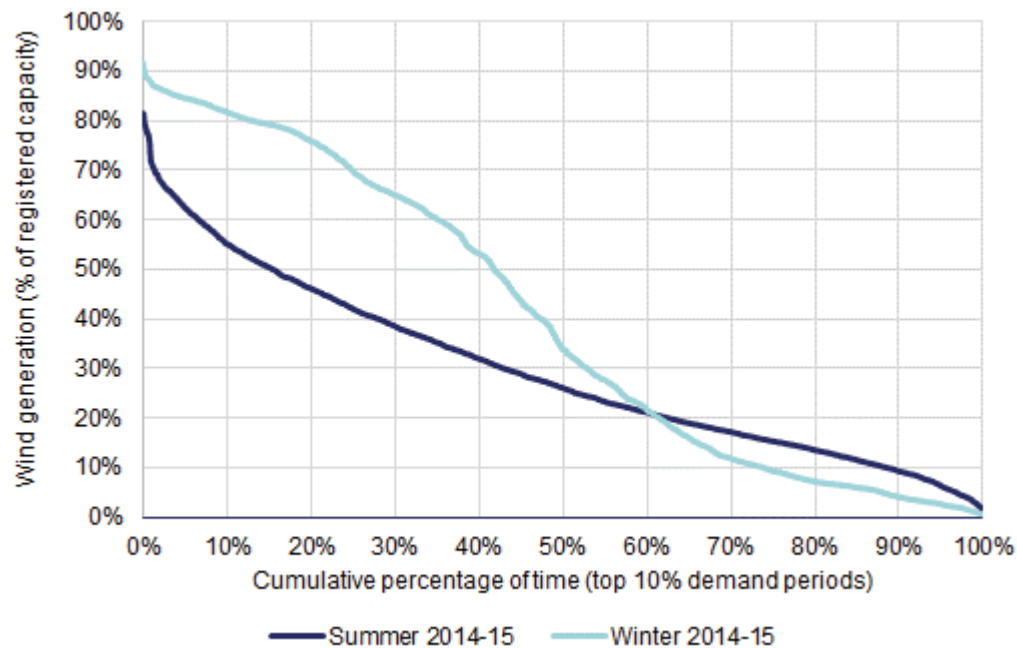
Figures 4-3 and 4-4 illustrate a different aspect of wind variability – the significant rates of change in output over short timeframes. The figures show the maximum changes in wind turbine output that have been recorded in one of three South Australian regions (the Mid-north area, Figure 4-3) and in South Australia as a whole (Figure 4-4) over five-minutes, 30-minutes and 60-minutes. For instance, Figure 4-3 shows that in the Mid-north area in 2014-15, the maximum increase in electricity production from wind turbines within a 5-minute period was 180 MW (20 per cent of installed wind capacity) and the maximum decrease within a 5-minute period was 289 MW (33 per cent of installed capacity). Figure 4-4 shows that in South Australia as a whole, the maximum increase over the same timeframe was also 180 MW (12 per cent of aggregate installed wind capacity), and the maximum decrease was 240 MW (16 per cent of aggregate capacity). A comparison of the regional (Mid-north) and the overall South Australian rates of change shows that:

- variations in realised wind output increase over longer timeframes;
- variations in wind output differ year-on-year even if wind capacity overall remains unchanged; and
- the output variations from wind turbines aggregated across a larger region are lower in absolute terms than variation from individual areas, reflecting the effects of spatial diversification.

Sudden changes in the supply of electricity from wind turbines challenge the ability of the system operator to balance demand and supply, and require additional operating reserves to be deployed at a cost to the overall power system.

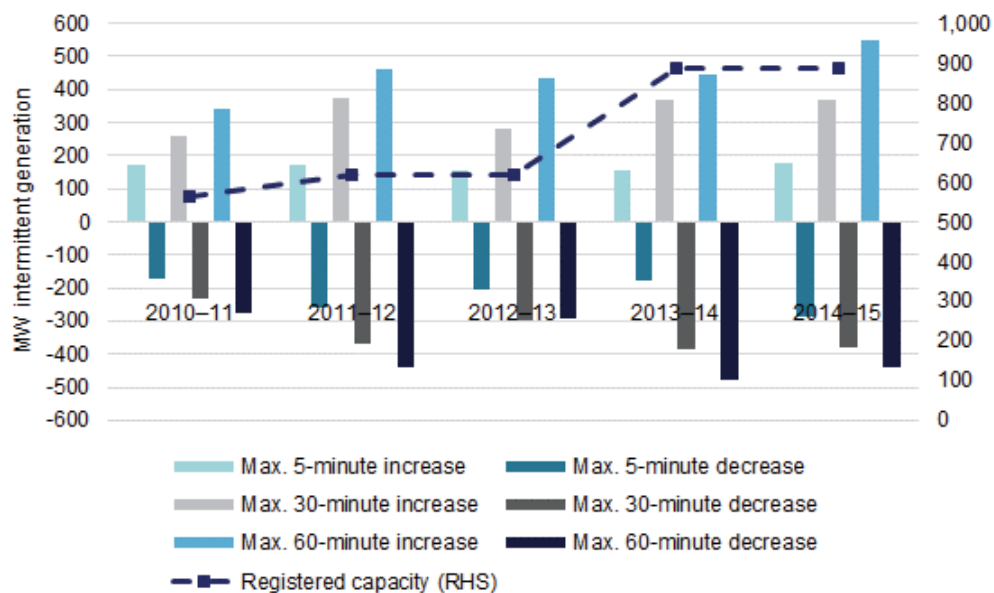
⁶ Alternatively, some form of greater demand side management may be implemented. Such management also has an opportunity cost.

Figure 4-2. South Australian wind generation – Contribution to summer and winter peak demand



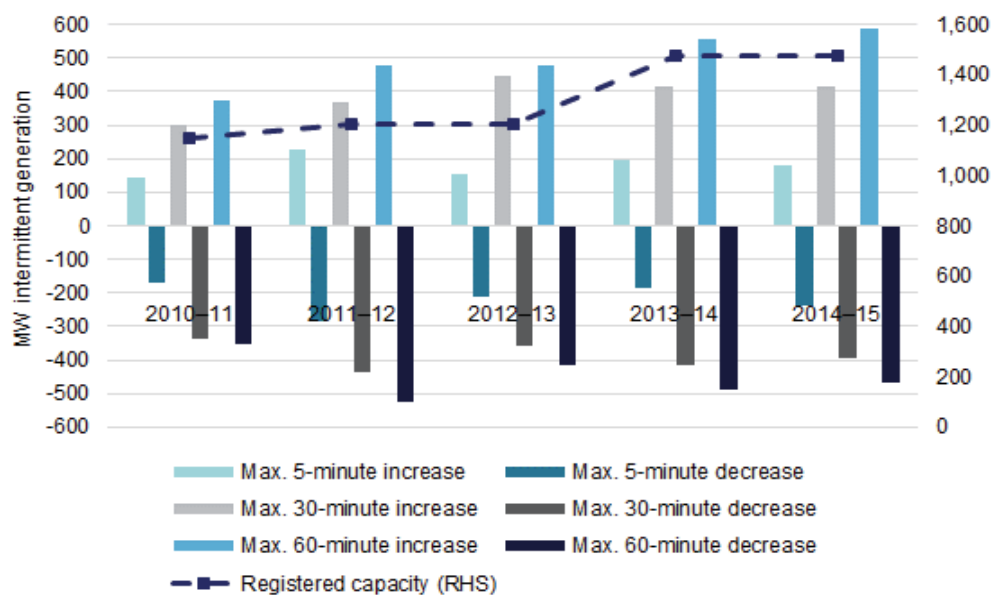
Source: AEMO 2015.

Figure 4-3. South Australian wind generation (Mid-north area) – Registered capacity and maximum output variation (MW)



Source: AEMO 2015.

Figure 4-4. South Australian wind generation (All) – Registered capacity and maximum output variation (MW)



Source: AEMO 2015.

4.2.2 Generation from solar PV installations

Solar PV installations also generate electricity intermittently. Solar PV panels do not produce electricity when the sun is not shining. As is the case for wind, the electrical output of solar PV can change nearly instantaneously and depends, inter alia, on the position of the sun in the sky, cloud cover, and the shadowing effects of obstacles (buildings, trees, etc.), which can vary over time scales as short as seconds (Wiser et al. 2011).

Unlike wind turbines, however, which are generally deployed as large-scale generation technologies, small scale solar PV installations are most often deployed on household rooftops. Their output is generally not ‘visible’ to the system operator, so that the system operator must then balance residual demand with supply. This aspect of solar PV technologies therefore introduces an additional element of operational difficulty in predicting consumers’ (residual) demand, which then consists of an underlying variable demand profile overlaid with the variable output of rooftop PV installations. The accuracy with which output can be predicted to assist in the operation of a power system is also moderate, although spatial diversity can again smooth some of this variability.

5 Integration cost components of intermittent generation technologies

Following on from the particular characteristics of intermittent renewable technologies, the costs of integrating wind and solar PV into electric power systems can be decomposed into three approximately additive components:⁷

- balancing costs, which occur because the supply from IRGs is uncertain until realisation and forecasting errors therefore arise;
- profile costs, which are caused by the variability and particular intertemporal generation profile of IRG technologies; and
- grid costs, which arise from the specific location of IRG resources.

5.1 Balancing costs

Balancing costs arise because of deviations from planned generation schedules, and are essentially the result of forecasting errors. For IRG technologies such as wind and solar PV, forecasting errors come about because their output is uncertain until it is realised. For both types of technologies, the effects of forecasting errors are magnified at greater penetrations in a power system, because the forecast errors for multiple wind turbines or solar PV installations are generally positively correlated. Overall, higher penetrations of IRG technologies make it more difficult to predict and therefore balance supply and demand in a power system. Errors in forecasting the output of IRG technologies have two related consequences:

- they require adjustments to be made to the planned dispatch schedule of conventional power stations; and
- they require additional operating reserves to be held to respond to imbalances within very short timeframes of seconds to minutes.

Adjustments to planned dispatch schedules are costly because they represent a departure from the least-cost configuration of generators. In particular, baseload (and to a lesser extent) mid-merit power stations require time to begin operating and synchronise with the power system, and to make large changes in their level of output. System operators take into account these operational limitations as well as other constraints in the power system in assembling a dispatch schedule that meets expected demand at least-cost over a coming day or week. Forecasting errors that lead to adjustments in the planned dispatch schedule then introduce start-up, operating & maintenance (O&M) and fuel costs because more expensive conventional plant have to be

⁷ The discussion in this section draws on Hirth et al. 2016, Hirth et al. 2015, and Ueckerdt et al. 2013.

dispatched than would have been the case under perfect foresight (Milligan and Kirby 2009). In South Australia, for instance, many high price events arise as a result of low wind output that had not been forecast, and that then require costly, rapid-response peaking plants to operate, while cheaper plants (which take more time to start, ramp up and synchronise) cannot be deployed.

System operators additionally address imbalances by deploying operating reserves that can rapidly respond to deviations between forecast and actual IRG output.⁸ The need to hold additional reserves for balancing to account for greater forecasting errors also constitutes a cost to the power system. Output adjustments (ramping and cycling) increase wear and tear of thermal plants, while ramping constraints require generators to operate part-loaded to provide spinning reserve (so that cheaper generation cannot operate at full capacity).

5.1.1 International estimates of balancing costs

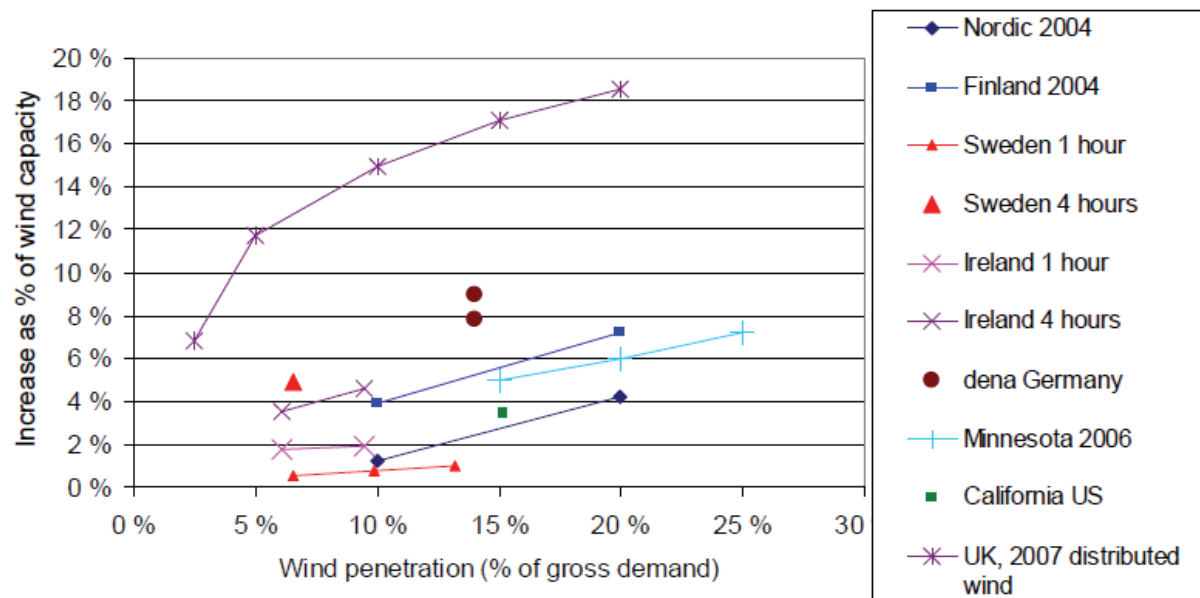
The challenges associated with balancing unexpected variations in the output of IRG technologies increase with the penetration of renewables in a power system, and are greatest within a one- to six-hour timeframe and in small systems. The increases in short-term reserve requirements estimated in recent studies then show a large range, corresponding to 1 to 15 per cent of installed wind power capacity at 10 per cent wind penetration and 4 to 18 per cent of installed wind power capacity at 20 per cent wind penetration (Figure 5-1, Holttinen et al. 2011). When wind forecast errors are combined with demand forecast errors, the reserve requirement is estimated at 15 per cent at 10 per cent penetration rates, and 18 per cent at 20 per cent penetration of gross demand.

Figure 5-2 shows the range of balancing cost estimates for thermal power systems from a recent survey undertaken by Hirth et al. (2015). Most studies summarised in Figure 5-2 focus solely on the balancing costs associated with wind generation; a handful include the effect of solar PV installations as well. Many studies that estimate the balancing costs of IRG technologies focus on one particular aspect of these costs; for instance, by considering only certain types of reserves and not changes to planned dispatch schedules (Gross et al. 2012). Nonetheless, the estimates shown in Figure 5-2 broadly reflect the consensus in the literature that the balancing costs of IRG technologies are relatively small compared to profile costs. Overall, most estimates of balancing costs are below € 6 per MWh (AU\$ 9/MWh) of wind energy generated even at higher wind penetration rates. Hirth et al. (2015) report that a fitted trend line indicates that for each percentage point in penetration, the balancing costs of wind power increase by €0.06/MWh (AU\$ 0.09/MWh), so that balancing costs increase from €2/MWh (AU\$ 3/MWh) to €4/MWh (AU\$ 6/MWh)

⁸ In AC power systems, system frequency is a fundamental indicator of power system health, and provides an immediate indication of the balance between generation and load (Kirby 2007). Frequency drops when load exceeds generation and rises when generation exceeds load. Large frequency deviations result in equipment damage and power system collapse. To control frequency, all power systems therefore maintain 'operating reserves' – generally supplied by conventional generators, but sometimes in the form of responsive load that can be curtailed very rapidly (Ela et al. 2011). Operating reserves can be called upon to provide additional output if demand rises rapidly or if there is an unplanned reduction in supply (upward reserve), or to reduce output if demand falls rapidly or there is an unplanned increase in supply (downward reserve). There are many classifications of operating reserves, many of which are system-specific.

as wind penetration increases from zero to 40 per cent.

Figure 5-1. Increase in reserve requirement as a function of wind penetration



Notes: The studies summarised above apply different timeframes to determine reserve requirements.

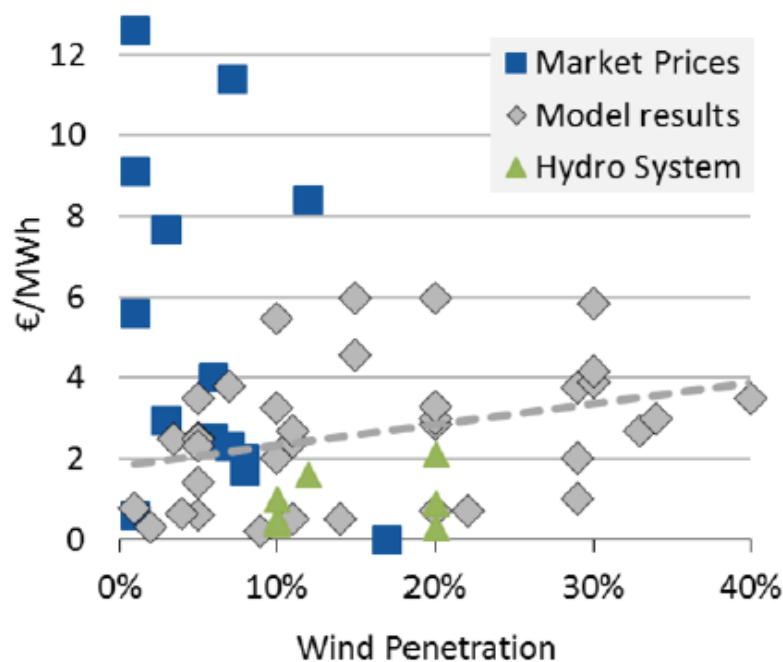
Source: Holttinen et al. 2011.

5.1.2 Australian estimates of balancing costs

In Australia, Riesz et al. (2011) estimated the additional balancing costs in the NEM and the WEM for a 20 per cent RET target (but not the additional costs arising from deviations from planned generation schedules). In the NEM, AEMO calls on Frequency Control Ancillary Services (FCAS) for short-term balancing services, including ‘Regulation Raise’ and ‘Regulation Lower’ services. Regulation services are ‘load following’ services provided by conventional generators that continuously adjust their output to match variations in demand or the output of IRG resources. The corresponding WEM regulation service is called ‘Load Following’.

Riesz et al. (2011) found that in the NEM the Regulation requirement would increase by around 10 per cent of the added wind capacity. In the much smaller SWIS, the Load Following requirement would increase by around 30-40 per cent of the added wind capacity. The high additional reserve requirement in the SWIS reflects the large size of a new wind farm relative to the size of the SWIS, and the fact that the outputs of wind farms in the SWIS are highly correlated, leading to larger ‘disturbances’ relative to the size of the system. While relatively small as a percentage of total system costs, the authors concluded that if the additional load following costs were allocated to wind generators, they would amount to AU\$ 8.30 per MWh of wind energy generated in the NEM, and to \$29.17/MWh of wind energy generated in the WEM.

Figure 5-2. Balancing cost estimates as a function of wind penetration



Notes: Squares denote balancing cost estimates derived from study based on wholesale market price outcomes, diamonds denote estimates derived from power system models, and crosses denote studies that incorporate both wind and solar power (crosses).

Source: Hirth et al. 2016.

5.2 Profile costs

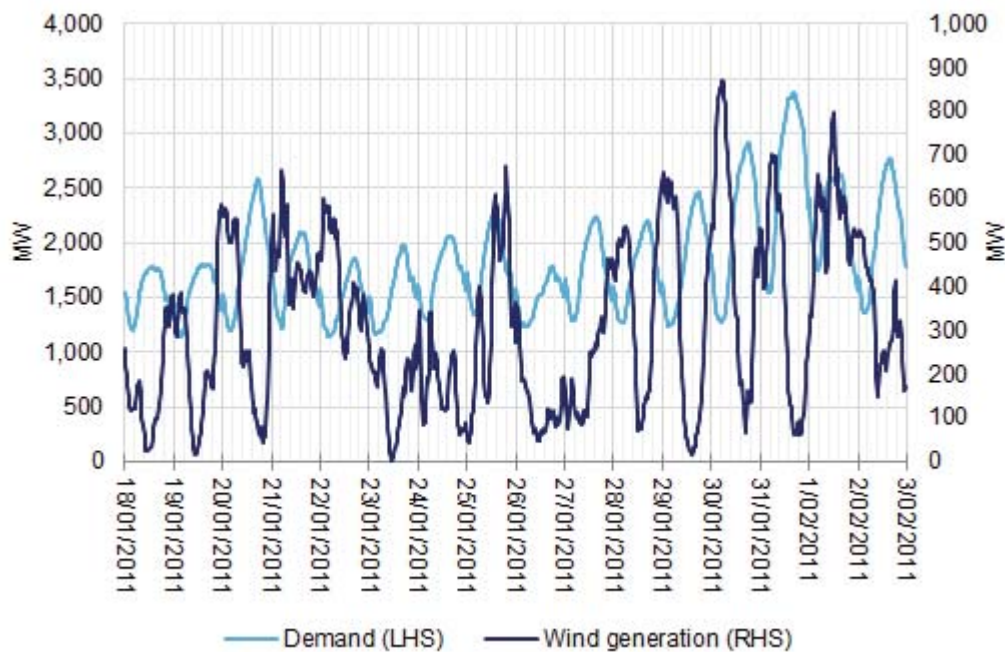
Profile costs arise indirectly from the temporal variation of the electricity output from intermittent generators. Profile costs reflect the empirical observation that the output of IRG technologies is often not well correlated with demand. This generation pattern tends to be quite pronounced for wind turbines, which tend to generate more when demand is low and there is ample available generation capacity, and which tend to generate less when demand is high and generation capacity is scarce. Figure 5-3 illustrates this effect in the South Australian region of the NEM during five high demand days in the summer of 2011. It shows that, over these five days, aggregate generation from wind capacity (drawn in dark blue) fell markedly as demand increased, and tended to be at its lowest when demand was at its highest.

Whereas balancing costs are a consequence of forecasting errors, profile costs occur even if the output of IRG resources could be predicted with certainty. In large part, profile costs arise because while IRG resources contribute some electricity, they hardly reduce the need for the overall capacity that needs to be maintained in a power system (Ueckerdt et al. 2013). Given that generating capacity is very costly, the profile costs of IRG technologies are therefore more material than balancing costs. As discussed in the following, profile costs can be decomposed further into:

- flexibility costs, which arise from specific operational requirements placed on dispatchable generators;
- utilisation or back-up costs, which arise because of the need to maintain significant conventional generation capacity; and

- overproduction costs, because at higher penetration, wind turbines may need to be constrained down or off because they produce more electricity than is demanded by consumers.

Figure 5-3. Wind generation and total South Australian demand from 20 January 2011 to 2 February 2011



Source: AEMO (2011).

5.2.1 Flexibility costs

Flexibility costs arise because the time-varying generation profiles of IRG resources require the output of conventional power stations to be adjusted more frequently, for instance, to compensate for the steep wind output gradients and peaks and troughs shown in Figure 5-3. Frequent ramping (up and down) or cycling whereby conventional power stations adjust their output in response to steep changes in the output of wind turbines or changes in demand (due to increased solar PV penetration) increases wear and tear on capital equipment, and reduces the efficiency of thermal generators.⁹

There are relatively few cost estimates of the flexibility effect (Hirth et al. 2015). Earlier studies report ranges from US\$ 0.2 to US\$ 2 (AU\$ 0.3 to AU\$ \$2.5) per MWh of wind energy generated for the United States. The most recent study examined cycling costs (start-up fuel and variable O&M costs, and ramping costs) for the western US grid (including Canada and Mexico) for up to 33 per

⁹ Flexibility costs refer only to planned ramping and cycling operations, while uncertainty-related ramping and cycling costs are reflected in balancing costs.

cent wind and solar energy penetrations (Lew et al. 2013). For thermal generators, cycling costs increase to around US\$ 0.5 to US\$ 1.2 (AU\$ 0.6 to AU\$ \$1.5) per MWh with increasing penetration of wind and solar PV.

5.2.2 Utilisation costs

Utilisation or capacity costs arise because the production profile of IRG resources generally does not match the demand profile of consumers well. The deployment of IRG technologies in a power system reduces the amount of electricity generated by dispatchable power stations. Wind turbines (which incur no fuel costs) are always ‘dispatched’ before conventional generators, and tend to displace mid-merit plant at lower penetration rates and baseload plant when penetration increases. In contrast, solar PV installations reduce ‘residual’ electricity demand.

Individually and in combination, these trends reduce the utilisation (or capacity factor) of conventional dispatchable power stations. The annual and life-cycle generation per unit of capacity of these plants is reduced, and the average generation costs per MWh in the residual system increases. The key point is that while the utilisation of conventional power stations declines, the capacity (or capability to generate) of these plants remains essential to the secure operation of the power system. The need to carry additional conventional generation capacity (or some type of storage technology) to compensate for the intermittency of IRG resources then represents a significant cost to the power system.

The empirical observation that, in particular, significant quantities of wind capacity hardly reduce the amount of (back-up) capacity that needs to be maintained in a power system is also apparent in Figure 5-4, which shows that very little wind generation was available to meet peak demand during the 2011 heatwave in South Australia. More generally, low wind generation at times of high demand is a relatively common occurrence in South Australia, in other NEM regions, and in overseas jurisdictions where significant amounts of wind capacity have been installed. Table 5.1 shows the share of installed wind generation capacity that was historically available at least 85 per cent of the time during the top 10 per cent of demand periods across the NEM regions. For example, the historic performance of total wind generation in South Australia during the top 10 per cent of summer demand periods is such that wind generation contributed less than 10 per cent of installed wind capacity to meeting peak demand 85 per cent of the time, and less in other regions of the NEM. The implication is that while South Australia has the highest penetration of wind generation in the NEM with an installed capacity of around 1,475 MW, wind generation generally meets less than 10 per cent of demand when consumers require it most.

Table 5-1. 85 percentile wind contribution to operational maximum demand factors

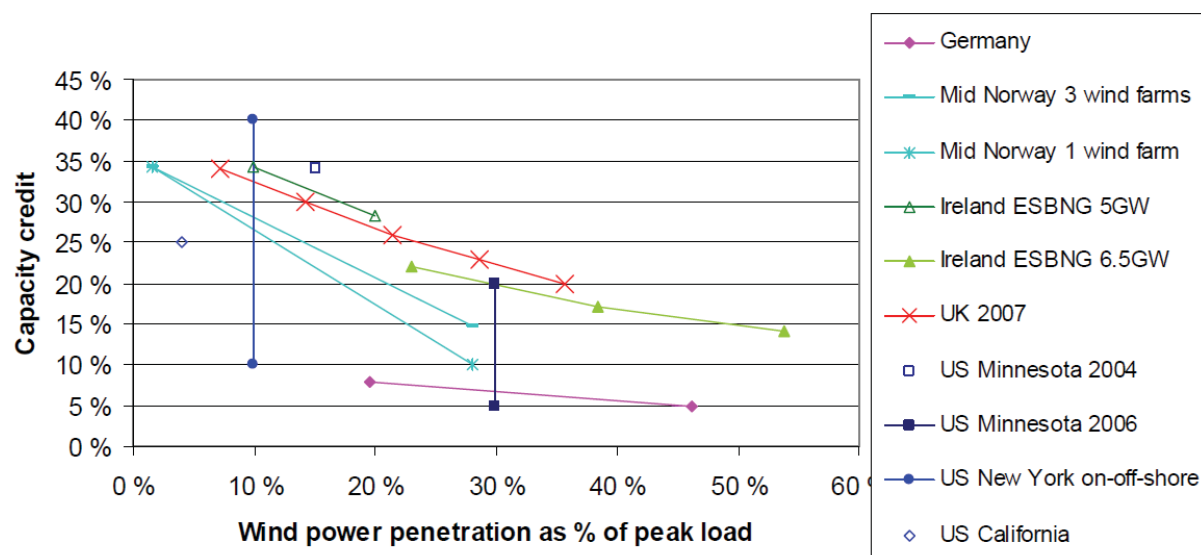
	New South Wales	Victoria	South Australia	Tasmania
Summer average contribution	1.2%	7.0%	9.9%	7.8%
Winter average contribution	3.4%	6.7%	6.9%	3.6%

Source: AEMO 2015. NEM Historical Market Information Report.

Table 4-1 is an example of the low ‘capacity credit’ that is generally assigned to IRG technologies.

Although there are differences across power systems, generation adequacy evaluations are generally used to assess the capability of generation resources to reliably meet electricity demand (Wiser et al. 2011). The capacity credit of a generation resource is the amount of additional demand that can be served if the generator is added to the system while maintaining existing levels of reliability. Wind turbines are typically found to have a capacity credit of 5 to 40 per cent of their nameplate capacity, since their output is often uncorrelated or weakly negatively correlated with periods of high electricity demand. Furthermore, capacity credits for wind energy generally decrease as wind electricity penetration levels rise, because the output of multiple wind turbines is generally positively correlated. For instance, Figure 5-4 shows that for the large UK system, the capacity credit of wind turbines declines from around 34 per cent at less than 10 per cent penetration to around 20 per cent at a penetration of 35 per cent. In the small Irish power system, the capacity credit declines to 15 per cent at higher penetrations.

Figure 5-4. Capacity credit of wind power



Notes: The estimates shown above depend on how generation adequacy is assessed, the correlation of wind power output to electricity demand, the geographic distribution of wind turbines, and the level of wind electricity penetration.

Source: Holttinen et al. 2011.

The low average capacity credit of wind turbines (compared to dispatchable generators) means that systems with large amounts of wind energy will need to hold significantly more generation capacity in reserve to meet the same peak electricity demand than will electric systems without large amounts of wind energy. Much of this generation capacity will operate only infrequently, but its costs must still be incurred by the system and therefore consumers.

Where solar PV installations are concerned, the general finding in the literature is also that the economic value of PV systems is reduced at increasing levels of system penetration due to the high variability of PV, although geographical diversity can smooth out some of these effects (Arvizu et al. 2011). The capacity credit of these installations is highly dependent on the extent to which solar PV generation is correlated with demand. In the mainland regions of the NEM, rooftop PV installations have historically not reduced summer peak demand, which typically occurs in the late afternoon when rooftop PV generation is declining from its midday peak (AEMO 2012). AEMO

(2016) projects that solar PV installations will moderate summer peak demand (but not winter peaks), so that there may be some (small) reduction in the amount of seasonal thermal back-up capacity needed.

5.2.3 Overproduction

Overproduction costs arise at high levels of IRG penetration. When large amounts of intermittent wind and solar PV capacity are installed, the incidents when these technologies produce more electricity than is demanded by consumers rises, and the output of these technologies either has to be curtailed or ‘spilled’. Hence, the effective capacity factor of renewable generation decreases and specific \$ per MWh costs increase.

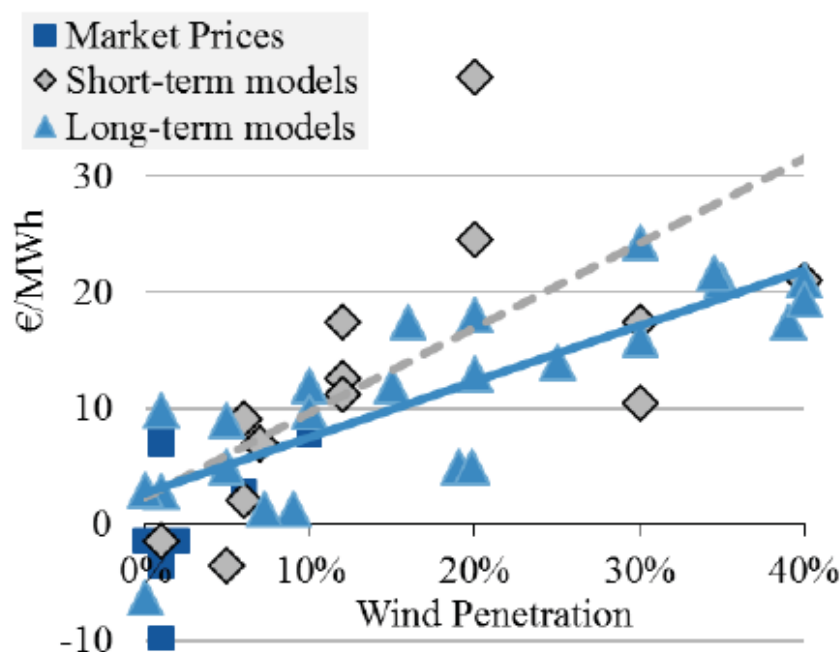
The frequency and magnitude of negative spot price outcomes that are often observed in electricity wholesale markets with significant wind penetration can be interpreted as an indication of overproduction (Baldick 2012). Unlike conventional generators who are not dispatched and not paid when their output is not required, the subsidy arrangements around wind turbines are often such that these plants earn revenues whenever they generate electricity (irrespective of system requirements or spot prices). Negative price outcomes that arise because wind turbines receive additional LGC payments in addition to the revenues earned from NEM operations have mostly occurred in South Australia. In that NEM region, negative prices were posted for 154 (half-hourly) trading intervals in 2014-15, mostly during periods of high wind generation combined with low demand and limits on interconnector flows restricting exports from South Australia to Victoria (AEMO 2015).

5.2.4 Aggregate profile costs

Figure 5-5 summarises aggregate wind profile cost estimates from some 30 publications, as reported in Hirth et al. (2015).¹⁰ If it is assumed that changes are made to the capacity mix by retiring existing plant and investing in more flexible generation capacity (the blue line), wind profile costs are estimated to be zero or slightly negative at low penetration rates, and to be around €15 to €25 (AU\$ 22.50 to \$37.5) per MWh at penetration rates in the 30 to 40 per cent range. A fitted trend line indicates that even in such a long-term investment scenario, the profile cost of wind power increase by €0.5 (AU\$ 0.75) per MWh generated for each percentage point increase in wind penetration. In contrast, if it is assumed that the generation mix remains unchanged, profile costs are 50 per cent higher, as shown by the gradient of the grey line.

¹⁰ Many of the studies cited only report estimates of the utilisation effect. As such these estimates are likely to underestimate total profile costs.

Figure 5-5. Profile cost estimates as a function of wind penetration



Notes: Squares denote profile cost estimates derived from study of wholesale market price outcomes, diamonds denote estimates derived from power system models, and triangles denote studies of long-term dispatch and investment outcomes.

Source: Hirth et al. 2016.

5.3 Grid-related costs

The grid-related costs of IRG technologies arise because their supply is often location-specific, in the sense that the primary ‘energy carrier’ (wind or sun) cannot be transported in the same way as fossil or nuclear fuels (Hirth et al. 2015). Integration costs then occur because electricity transmission infrastructure is costly. Two aspects of grid-related costs are cited in the integration cost literature:

- costs that arise if additional network investment is necessary to accommodate IRG resources, for instance if high quality IRG sites are located far from demand centres; and
- additional transmission losses and congestion costs, for instance, if the additional output from renewable generators constrains existing transmission infrastructure.

The majority of estimates of grid-related costs for IRG technologies come from wind integration studies (Weiser et al. 2011). The integration of additional wind resources into an existing power system commonly requires additional grid infrastructure both within a particular region and to interconnect with neighbouring regions. At the same time, grid reinforcement and congestion costs depend on where wind turbines are located relative to load and grid infrastructure, and therefore vary by type of system, grid infrastructure and country. It is also the case that large-scale transmission investments can have broader system benefits, so that estimating grid-related costs requires decisions to be made about the share of costs that should be allocated to IRG resources.

The impact of increasing rooftop PV deployment on grid-related costs is less clear. AEMO (2015d)

reports that more rooftop PV typically reduces transmission congestion, as it reduces operational demand, but note that very high levels of rooftop PV in a particular location may cause congestion in the distribution network. Overseas studies also note that a high penetration of rooftop PV installations can present significant challenges to operating distribution networks (McDonald et al. 2013, EPRI 2005). A certain amount of distributed generation can generally be accommodated without making changes to protective devices or operating procedures. However, beyond a certain point, negative effects appear that relate to difficulties in regulating local voltages, other issues with power quality which may interfere with the operation of equipment and shorten equipment life, and raised fault levels.

5.3.1 International estimates of grid-related costs

Given the many factors that play a role in determining grid-related costs, the range of estimates in the overseas literature is large:

- Mills et al. (2009) reviewed 40 detailed transmission studies undertaken in the United States between 2001 and 2008 that estimated the cost of integrating wind power. The median cost grid cost was found to be US\$ 15/MWh (AU\$ 18.8/MWh).
- More recent European studies suggest that grid reinforcement costs are about €3.75 /MWh (AU\$ 5.6/MWh) at wind shares of 15 to 20 per cent, and about €7.5/MWh (AU\$ 11.3/MWh) at 40 per cent wind penetration (Ueckerdt et al. 2013).

Overall, Ueckerdt et al. (2013) estimate that the increase in grid costs with increasing shares of IRG up to 7.5 €/MWh on average (AU\$ 11.3/MWh) or about 13 €/MWh in (AU\$ 19.5/MWh) in marginal terms.

5.3.2 Outcomes in Australia

In Australia, augmentation of the Heywood Interconnector between Victoria and South Australia at a cost of around \$108 million was, to a significant extent, driven by increased IRG penetration in South Australia. The rapid and substantial deployment of wind and rooftop PV generation in that NEM region has resulted in the withdrawal of more than 1,500 MW of coal- and gas-fired generation capacity, so that South Australia is reliant on inter-regional imports to meet demand at critical times (AEMO 2015a). The increase in interconnector transfer capacity from 460 MW to 650 MW was then justified on the basis of reliability benefits that would accrue to South Australian consumers, the ability to export surplus renewable generation to other NEM region and, relatedly, reduced transmission network congestion.

AEMO's 2013 assessment of a '100 Per Cent Renewables' study provides an indication of the scale of transmission investment that would be required to accommodate a high share of renewables in the NEM. AEMO (2013) noted that many renewable resources are in locations that are remote from the current transmission system, and identified a number of high-level transmission options that would need to be developed. AEMO's cost estimates for an 'optimised' (100 per cent renewables) electricity system that would minimise combined generation and transmission costs then range from \$27 to \$30 billion in 2030, and \$34 to \$39 billion in 2050.

5.4 Broader system challenges

The integration costs discussed above relate to impacts on power systems that are relatively well-understood, in the sense that they can be quantified on the basis of how systems are currently operated. However, the combination of a rising share of IRG technologies and the withdrawal of conventional (steam turbine) power stations that is apparent in the NEM creates new challenges to power system operations. Broader questions then arise about the types of ancillary services that will be required in the future, and how they should be provided and paid for.

Conventional generators – particularly large coal-fired plants – have certain inherent characteristics that contribute to the stability of the grid, but are currently not explicitly priced in the NEM. When such generators operate they provide ‘inertia’; that is, they are synchronised to the frequency of the grid, and thus contribute to the ability of the power system to ‘ride through’ fault events and limit system frequency excursions.¹¹ As conventional generators are displaced by non-synchronous (wind and solar) generation technologies,¹² the overall reduction in inertia tends to increase the frequency and magnitude of power system disturbances, so that the power system becomes more vulnerable to fault events.

The 2015 NTNDP accordingly identifies a number of other emerging challenges that are directly related to the increasing penetration of IRG resources and the withdrawal of thermal power stations (AEMO 2015e). The reduced availability of dispatchable generation will make it increasingly difficult to forecast demand, supply and the behaviour of the power system; balance demand and supply in real time; and control network flows to remain within secure limits. In addition, and as more thermal synchronous generators withdraw from the NEM, there may be insufficient inertia and network support services available to be shared across all regions, and a loss of voltage support and larger voltage fluctuations during network faults.

A number of these challenges are already apparent in South Australia, and are expected to arise in the remainder of the NEM and the Western Australian WEM at higher levels of IRG penetration. In South Australia these challenges relate to AEMO’s ability to balance the system either during or following the loss of the Heywood Interconnector, which makes the power system more susceptible to frequency deviations and limits AEMO’s ability to acquire FCAS services (AEMO and ElectraNet 2016). In these circumstances South Australia would become ‘islanded’, and the risk of load shedding in South Australia, as occurred in November 2015, would increase.¹³

¹¹ Power system inertia is a measure of the energy stored in the rotating masses of generators synchronised to the power system (as measured in units of megawatt seconds, MW.s). The amount of inertia a given generator provides is a constant value, and depends on the generator’s design and size. Larger/more massively built generation units contribute more inertia.

¹² Some wind turbine designs can provide inertia to the system. However, in the NEM the contribution to inertia of wind turbines is small and is ignored in real-time operations.

¹³ The load shedding event on 1 November 2015 occurred when one Heywood Interconnector line tripped while the second line was out of service. The South Australian power system was islanded and 160 MW of demand remained unserved for more than 1.5 hours.

5.5 Aggregate integration costs

The components that constitute the integration costs of IRG resources – balancing, profile and grid costs - are not constant parameters, but are functions of many system properties (Hirth et al. 2016). A review of the literature nevertheless reveals a number of important trends that apply across predominantly thermal power systems. The most important of these is that integration costs increase with the penetration of IRG resources:

- At low levels of penetration, the integration costs of intermittent renewables may be low or even negative. In these circumstances, the additional balancing and profile costs are outweighed by the fuel cost savings from wind and solar PV resources. Overall, integration costs are considered to be relatively small at penetration levels of up to 10 per cent.
- Even allowing for adaptation in the generation mix to account for the uncertainty and variability of intermittent renewables, the integration costs of IRG technologies can become very high at high penetration rates. When wind penetration reaches 30 to 40 per cent, balancing costs are estimated to be AU\$ 6 per MWh of renewable energy generated, while profile costs are in the range of AU\$ 30 per MWh of renewable energy generated. Profile costs – which arise from the need to maintain additional costly generation capacity in the system to manage the significant output variability of intermittent resources – are significantly higher than balancing costs.

Overall, and allowing for long-term changes in the generation mix, integration costs are estimated to be in the range of AU\$ 37.50 to AU\$ 52.5 per MWh when wind penetration reaches 30 to 40 per cent.

6 Minimising the total costs of a power system

A power system operates as an interdependent portfolio of power stations that are deployed jointly to meet consumer demand. A long-term economic assessment of the optimal generation mix (including the share of renewables) that minimises the cost of supplying consumers with electricity cannot therefore consider only the stand-alone LCOE of a technology, but must also take into account the increase in total system costs as a result of integration costs. If these interdependencies are accounted for, a formal evaluation of the optimal generation mix leads to two optimality conditions that offer important insights about the deployment of IRG technologies (Hirth et al. 2016):

- any welfare or competitiveness analysis of IRG technologies must account for the effect of intermittency on the value of these technologies in a power system; and
- the effect of intermittency is that IRG technologies produce the least-value electricity, and that value is increasingly reduced at higher shares within a power system.

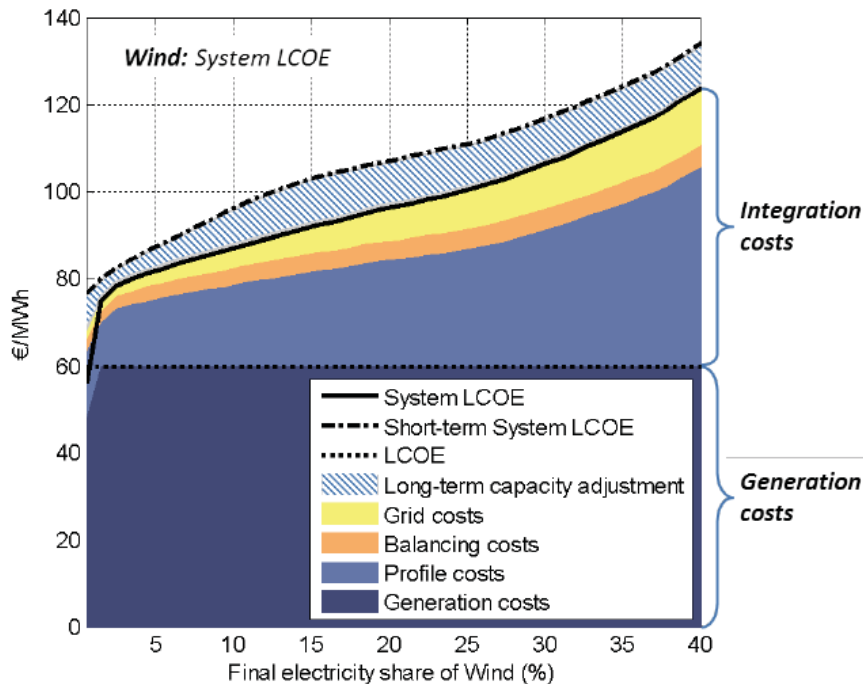
6.1 System versus stand-alone costs of intermittent renewables

The balancing, profile and grid-related costs that are incurred when intermittent generation technologies such as wind or solar PV are integrated into a power system cause costs in the residual power system to increase with rising shares of these technologies. In effect, the stand-alone LCOE of an IRG technology understates the full economic cost of that technology. That economic cost is instead captured by the ‘system’ LCOE of a technology, which comprises its stand-alone LCOE and integration costs at a system level.

Figure 6-1 shows the system LCOE of wind as a function of increasing wind penetration for a typical European thermal power system. At a low market share, integration costs are slightly negative (since wind generation reduces fuel cost), but integration costs increase steeply with further deployment. At moderate shares the system LCOE cost curve is concave; at shares above 25 per cent it becomes convex. The short-term system LCOE of wind is larger than the long-term LCOE, since the latter assumes that the generation mix in the residual power system is adjusted to accommodate wind generation.

The implications of rising integration costs of IRG resources is that these costs may potentially outweigh any cost reductions that IRG resources may achieve in future. That is, irrespective of the stand-alone LCOE of IRG technologies, the system LCOE of these technologies is such that the total cost of the power system increases disproportionately with their deployment. There are therefore material economic barriers to large-scale deployment of IRG technologies.

Figure 6-1. Marginal system LCOE of wind generation



Notes: The LCOE of wind is assumed to be €60/MWh (AU\$ 90/MWh).

Source: Ueckerdt et al. 2013.

6.2 Value versus stand-alone cost of intermittent renewables

In a power system with an optimal generation mix, the marginal *stand-alone* LCOE of a specific generation technology (excluding subsidies) equals its marginal value to consumers. In a market context, the marginal value of a generation technology is consumers' average willingness to pay for that technology's output: the weighted-average spot price which it earns from selling its output over a given timeframe, say a year (Hirth et al. 2016). For a given coal-fired power station, for example, the marginal value of that plant is the weighted-average \$ per MWh spot price it earns in each trading interval over a year when it generates electricity, p_{coal} . For a given wind turbine, the marginal value of that turbine is the annual weighted-average \$ per MWh spot price it earns when it generates electricity, p_{wind} .

The first implication of this general result is that the optimality condition is distinct for each generation technology. Differing generating technologies operate to meet demand at different times and therefore have different temporal production patterns. Given that the price of electricity varies a great deal over time, ranging from lowest at off-peak times to highest at peak times, the marginal value of different generation technologies also does not coincide. The optimal deployment for each generation technology therefore also varies, depending on its value in the power system. Government policies that set a targeted level of IRG output as part of a renewable energy mandate without considering the value of the electricity produced by that technology are therefore almost certainly inefficient, and will increase costs to consumers at higher levels of IRG technology penetration.

Second, unlike what is commonly claimed by proponents of renewable energy mandates, it is not

the case that IRG technologies will invariably become ‘competitive’ as the LCOE of these technologies continues to fall. LCOE comparisons between IRG and other generation technologies are misleading because they fail to consider the value of IRG resources within a power system (IEA 2016). From a social welfare or competitiveness perspective, it is irrelevant whether or not the LCOE of wind or solar technologies is below or above that of other generation technologies; what matters instead is a given technology’s cost relative to its value. Thus, the electricity that can be supplied by a wind generator at a low levelised cost is not ‘cheap’, if the output is mostly available at night when demand is low, supply is plentiful, and the value of electricity is also low. Conversely, the electricity that can be supplied by a gas turbine at a very high levelised cost is not ‘expensive’, if it can be called upon to generate during peak demand periods when the system is stretched to capacity and the value of electricity is very high. Simplistic levelised cost comparisons between different generation technologies are then meaningless because they implicitly assume that the electricity generated from different sources has the same value in the power system.

6.3 Value versus price of intermittent renewables

One of the key findings in the integration literature is that the intermittent properties of IRG technologies reduce their market value (the weighted-average price they earn) as their market share in a power system increases (Hirth et al. 2015). In efficient wholesale power markets, the relatively low value of IRG technologies, as measured by the weighted-average spot price reflects the opportunity cost of intermittency or integration costs.¹⁴

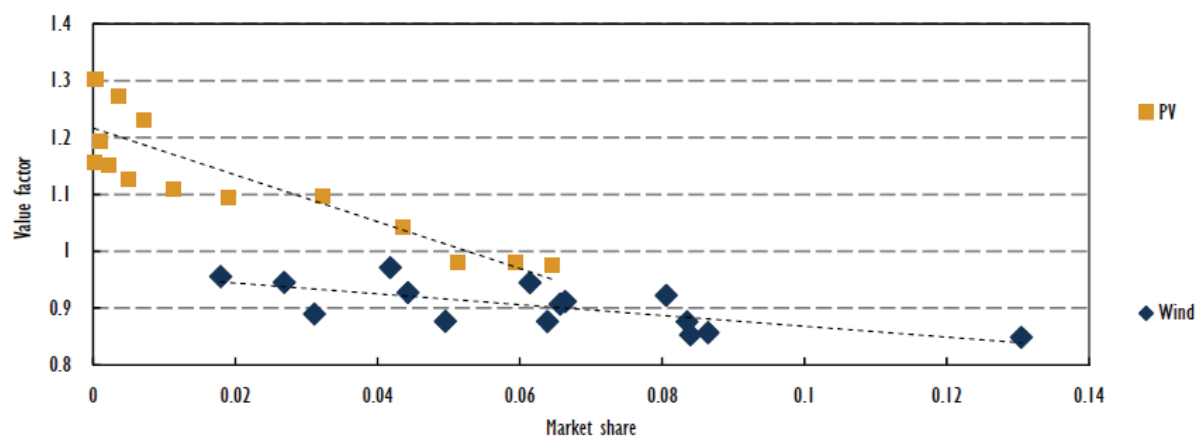
The duality between prices and costs implies that the integration costs of IRG technologies can be inferred from the relatively lower prices these technologies earn in wholesale markets (Hirth et al. 2016, IEA 2016). The difference between the weighted-average wholesale market price for a power system over a year p_{System} and the technology-specific weighted-average spot price, say p_{wind} , is interpreted as a ‘value gap’ between the value of electricity that consumers demand and the value of electricity that a particular technology supplies.

Figure 6-2 illustrates this concept for a case study of wind and solar integration in the German power system. The ‘value factor’ is the ratio between the weighted-average system price p_{System} and the weighted-average price for a specific technology p_{wind} so that a value factor of less than unity indicates a value gap. Figure 6-2 shows how a rising share of wind and solar capacity progressively reduces the value factor of these technologies, consistent with the finding that the integration costs of IRG technologies rise with increasing penetration. At the onset of deployment, solar PV installations generate at times of fairly high demand (when wholesale electricity prices are high) so that the value factor is above unity for a penetration of around 4 per cent. At greater penetrations of solar PV, the value factor drops rapidly below one, because solar power is concentrated in a few hours of the day. In contrast, the value factor of wind generation is never

¹⁴ The finding that integration costs are reflected in weighted-average wholesale prices requires wholesale markets to be ‘perfect’ and ‘complete’ in an economic sense. These are strong assumptions. For instance, electricity wholesale markets may not price all costs (such as locational price differences arising from congestion), as is the case in the NEM and the WEM. The exercise of generator market power may also mean that prices are not efficient in some trading intervals.

greater than unity, and declines to a level of around 0.85 at a penetration of around 13 per cent. More generally, virtually all studies that quantify the market value of solar power find value factors above unity at penetrations of 2 to 5 per cent, but value factors of 0.7 to 0.9 at 10 per cent penetration and around 0.4 to 0.7 at 30 per cent penetration (Hirth 2015). Even accounting for the long-term adaptation of the thermal capacity mix, the value of solar PV generation drops by 3.3 to 3.5 per cent, per percentage point increase in market share.

Figure 6-2. Market value factor of wind and solar PV as a function of their market share in Germany (2001-15)



Notes: Each point corresponds to one year; the value factor is defined as the ratio between the electricity market revenue of the average wind/solar generator and the average electricity price.

Source: IEA 2016.

The observation that the value factor of IRG technologies strictly declines as their share in a power system increases is referred to as the ‘self-cannibalisation effect’. It arises because renewable technologies tend to produce disproportionately during times when the electricity price is low, and because their output is correlated. As more capacity is added to the system, IRG technologies will tend to generate at similar times, so that there is increasingly an abundance of electricity at these times, which in turn leads to lower prices, a lower system value, and a lower value factor.

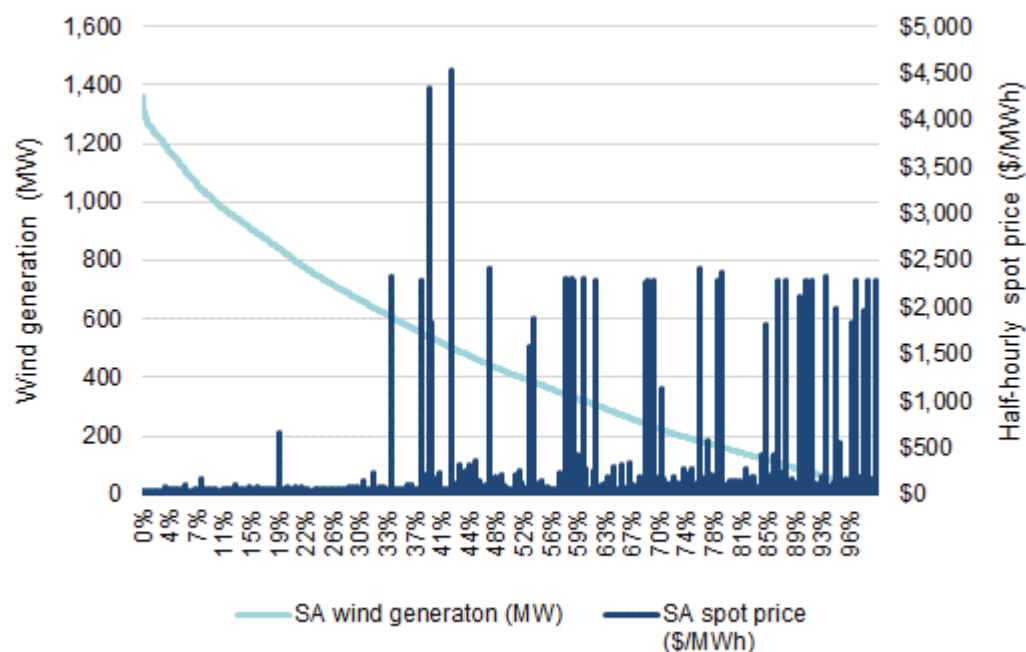
The exact magnitude of the value decline of IRG resources is system-specific. However, the studies that have been undertaken commonly find that in predominantly thermal power systems, at high penetration rates (such as 20+ per cent for wind or 10+ per cent for solar, intermittent technologies produce the least-value electricity (Hirth et al. 2016). At such penetrations, integration costs play an increasing and material role. Thus intermittency increasingly reduces the market value of renewable generation such that, on average, one MWh from wind power is worth increasingly less than one MWh from a conventional power station. The implication is that the greater the share of renewables in a power system, the lower its value, and the higher the subsidies required to support it.

7 Intermittent generation and price volatility

One of the effects of increasing the share of IRG technologies in a power system, notably the share of wind, is an increase in the volatility of wholesale prices. Fundamentally, greater price volatility is a reflection of the significant variation in the output that wind turbines are able to generate at any point in time and the positive correlation of output from wind turbines, as well as the potentially rapid rate of change in wind output. For instance, when the wind is blowing, multiple wind turbines will generate electricity, and greater output from wind generators will depress wholesale prices as low as zero or even result in negative prices. Conversely, when the wind is not blowing across a wide area, few or no wind turbines will generate electricity, so that wholesale prices are disproportionately determined by conventional generators. Furthermore, and as an increasing share of conventional generation is withdrawn from the system with a greater penetration of renewables, fewer conventional generators are available to operate when wind generation is low. Wholesale prices during conditions when wind generation is low are therefore elevated.

In South Australia, for instance, the high reliance on wind generation has led to the closure of Northern and Playford B power stations, corresponding to 786 MW (or 15 per cent) of generation capacity. This situation has led to a recurring pattern of price spikes in circumstances where wind output was very low (often in combination with limits on interconnector flows) and where the remaining conventional power stations could command very high prices for their output. Figure 7-1 accordingly illustrates that the incidence of price spikes predominantly occurs when wind generation is low.

Figure 7-1. Wind output and high price events – South Australia (2014-15)



Source: AEMO 2015.

The volatility of South Australian wholesale prices has implications for electricity derivative

markets and the ability of market participants to hedge against price risks (Deloitte Access Economics 2015). Derivatives such as base swaps or caps enable retailers and large users to either fix or cap the price they pay for a given volume of electricity, and are typically sold by baseload and mid-merit plant. As these types of generators exit the market as a result of the increasing penetration of renewables, the supply of derivatives is also reduced so that it becomes increasingly difficult to manage price risks.

8 Integrating an increasing share of renewable generation into Australia's electricity markets

There are a number of studies that suggest that high shares of renewable generation are technically feasible in the Australian electricity market. For example, the study by AEMO (2013) mentioned earlier suggests that a 100 per cent renewable share is technically feasible at costs that are high but 'appear manageable'. Similar conclusions have been reached by Elliston, MacGill and Diesendorf (2013) and Wright and Hearps (2010). However, few such studies consider the market context in which electricity markets operate and whether, given current market structures, financing models exist that will allow the necessary investment in increasing renewable capacity, network infrastructure, and also in the energy storage necessary to ensure that system reliability is maintained.¹⁵

The electricity market reforms that led to the establishment of the NEM in the 1990s were aimed at improving pricing efficiency and capital allocation. The NEM is an energy only market where generators are expected to be ready to dispatch electricity when requested to ensure that the power system remains reliable but are paid only for the energy they produce. With increasing shares of renewable generation with zero fuel costs and therefore close to zero short run marginal costs, dispatchable generators must rely on periods of high electricity prices, increasingly caused by the lack of correlation between peak demand and the times that renewable generators are able to supply electricity. In South Australia for example, it is estimated that only around 10 per cent of wind capacity and 31 per cent of solar capacity can be relied on during times of peak summer demand (AER 2015, pp.30-1). The extent to which price volatility can be relied on to justify new investment in an energy only market will depend, among other factors, on the price cap (currently \$14,000/MWh in the NEM) and the ability of investors to write long term forward contracts with electricity retailers for purchase.

High price volatility is likely to be a challenge for both consumers and governments. Riesz, Gilmore and MacGill (2016, p.122) estimate that a market price cap of \$60,000 to \$80,000/MWh would be required to recover average system costs and to compensate for median prices close to zero in the case of a 100 per cent renewables scenario in the NEM. While this scenario has no practical importance today it does illustrate the potential challenges being faced in re-designing the NEM to cope with increasing shares of renewables.

At a practical level, the recent South Australian experience with lack of security of electricity supply illustrates the challenges that will need to be faced as the share of renewables rises. Currently in South Australia wind provides about 33 per cent of electricity load, and about 25 per cent of households have installed solar PV generation, while total grid based electricity demand has fallen since 2011. In these circumstances, a number of conventional generators are no longer

¹⁵ For a recent review of energy storage technologies see USDOE 2015.

commercially viable and have withdrawn from the market. Nelson and Orton (2016) set out in detail the recent experience in the South Australian electricity market and conclude that a ‘root-and-branch review of energy market design and governance is required – to consider how best to decarbonize Australia’s electricity supply across the generation, transmission, distribution, and retail components of the supply chain while maintaining supply security, efficient pricing, and appropriate risk allocation.’ Such a review seems essential if Australia’s political parties continue to support further increasing the RET, and given that substantial new investment in the power system overall will be required to achieve such a target.

References

- AEMO (2011). NEM Background Information for WP4a, Version: 1.2; 10 November.
- AEMO (2011a). 2011 South Australian Supply and Demand Outlook.
- AEMO (2012). Rooftop PV Information Paper.
- AEMO (2013). 100 Per Cent Renewables Study – Modelling Outcomes, July.
- AEMO (2015). South Australian Wind Study Report, October.
- AEMO (2015a). The Heywood Interconnector: Overview of the Upgrade and Current Status, August.
- AEMO (2015b). Electricity Statement of Opportunities for the National Electricity Market, August.
- AEMO (2015c). Update, Electricity Statement of Opportunities for the National Electricity Market, October.
- AEMO (2015d). National Electricity Forecasting Report for the National Electricity Market, November.
- AEMO (2015e). National Transmission Network Development Plan for the National Electricity Market, November.
- AEMO (2016). National Electricity Forecasting Report for the National Electricity Market, June.
- AEMO and ElectraNet (2014). Renewable Energy Integration in South Australia, October.
- AEMO and ElectraNet (2016). Update to Renewable Energy Integration in South Australia, February.
- Arvizu, D., Balaya, P., Cabeza, L., Hollands, T., Jäger-Waldau, A., Kondo, M., Konseibo, C., Meleshko, V., Stein, W., Tamaura, Y., Xu, H., Zilles, R. (2011). Direct Solar Energy. In Edenhofer, O., Pichs-Madruga, R., Sokona, Y., Seyboth, K., Matschoss, P., Kadner, S., Zwickel, T., Eickemeier, P., Hansen, G., Schlömer, S., and von Stechow, C. (eds), *IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation*, Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
- Baldick, R. (2012). ‘Wind and energy markets: A case study of Texas’, *IEEE Systems Journal*, 6(1), 27-34.
- Deloitte Access Economics (2015). Energy markets and the implications of renewables, South Australian case study, 26 November.
- Ela, E., Milligan, M. and Kirby B. (2011). Operating reserves and variable generation. National Renewable Energy Research Laboratory, Technical Report NREL/TP-5500-51978, August.
- Elliston, B., MacGill, I. and Diesendorf, M. (2013). Least cost 100% renewable electricity scenarios in the Australian national electricity market. *Energy Policy*, 59, 270-82.
- EPRI (2009). Report to NIST on the smart grid’s interoperability standards roadmap.

Gross, R., Heptonstall, P., Leach, M., Skea, J., Anderson, D. and Green, T. (2012). The UK Energy Research Centre Review of the Costs and Impacts of Intermittency. Renewable Electricity and the Grid: The Challenge of Variability, p.73.

International Energy Agency (2016). *Next Generation Wind and Solar Power, From Cost to Value*.

Lew, D., Brinkman, G., Ibanez, E., Florita, A., Heaney, M., Hodge, B.-M., Hummon, M., Stark, G., King, J., Lefton, S.A., Kumar, N. and Agan, D. (2013). The Western Wind and Solar Integration Study Phase 2. National Renewable Energy Research Laboratory, Technical Report NREL/TP-5500-55588, September.

Hirth, L., Ueckerdt, F. and Edenhofer, O. (2016). Why wind is not coal: on the economics of electricity generation, *The Energy Journal*, 37(3).

Hirth, L., Ueckerdt, F. and Edenhofer, O. (2015). Integration costs revisited—An economic framework for wind and solar variability, *Renewable Energy* 74.

Hirth, L. (2015). Market value of solar power: Is photovoltaics cost-competitive?, *Renewable Power Generation*, IET 9.1.

Hirth, L. and Ziegenhagen, I. (2015). Balancing power and variable renewables: three links, *Renewable & Sustainable Energy Reviews* 50.

Hirth, L. and Müller, S. (2016). System-friendly wind power: How advanced wind turbine design can increase the economic value of electricity generated through wind power, *Energy Economics* 56, 51-63.

Holttinen, H., Meibom, P., Orths, A., van Hulle, F., Lange, B., Tiedemann, A., O'Malley, M., Perik, J., Ummels, B., Tande, J.O., Estanqueiro, A., Matos, M., Gomez, E., Soder, L., Strbac, G., Shakoob, A., Smith, J.C. and Milligan M. (2009). Design and Operation of Power Systems with Large Amounts of Wind Power: Phase One 2006-2008. VTT Technical Research Centre of Finland, Espoo, Finland.

Kirby, B. (2007). Ancillary Services: Technical and Commercial Insights. Institute of Electrical and Electronics Engineers, Washington DC, July.

McDonald, J.D., Wojszczyk, B., Flynn, B. and Voloh, I. (2013). Distribution Systems, Substations, and Integration of Distributed Generation. In Begovic, M.M. (Ed.) *Electrical Transmission Systems and Smart Grids*, Springer, New York, pp.7-68.

Milligan, M.R. and Kirby, B. (2009). Calculating wind integration costs: separating wind energy value from integration cost impacts. Golden: National Renewable Energy Laboratory.

Mills, A.D. (2009). The cost of transmission for wind energy: A review of transmission planning studies. Lawrence Berkeley National Laboratory.

Nelson, T. and Orton, F. (2016). Climate and electricity policy integration: is the South Australian electricity market the canary in the coalmine?, *The Electricity Journal* 29, 1-7.

Riesz, J., Shiao, F., Gilmore, J., Yeowart, D., Turley, A., and Rose, I. (2011). Frequency Control Ancillary Service Requirements with Wind Generation – Australian Projections, Roam Consulting.

Reisz, J., Gilmore, J. and MacGill, I. (2016). Assessing the viability of energy-only markets with 100% renewables: an Australian national electricity market case study, *Economics of Energy & Environmental Policy* 5(1), 105-130.

Sims, R., Mercado P., Krewitt W., Bhuyan G., Flynn D., Holttinen H., Jannuzzi G., Khennas S., Liu Y., Nilsson L.J. and Ogden J. (2011). Integration of renewable energy into present and future energy systems. In Edenhofer, O., Pichs-Madruga, R., Sokona, Y., Seyboth, K., Matschoss, P., Kadner, S., Zwickel, T., Eickemeier, P., Hansen, G., Schlömer, S., and von Stechow, C. (eds), *IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation*, Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Ueckerdt, F., Hirth, L., Luderer, G. and Edenhofer, O. (2013). System LCOE: What are the costs of variable renewables? *Energy*, 63, 61-75.

USDOE (United States Department of Energy) (2008). 20 percent Wind Energy by 2020: Increasing Wind Energy's Contribution to U.S. Electricity Supply. DOE/GO-102008-2567. Office of Energy Efficiency and Renewable Energy, US Department of Energy, Washington, DC. July.

USDOE (2015). *Quadrennial Technology Review 2015: An Assessment of Energy Technologies and Research Opportunities*, Technical Assessments, 'Electric Energy Storage', Washington DC, September.

Wiser, R., Yang, Z., Hand, M., Hohmeyer, O., Infield, D., Jensen, P.H., Nikolaev, V., O'Malley, M., Sinden, G. and Zervos, A. (2011). Wind Energy. In Edenhofer, O., Pichs-Madruga, R., Sokona, Y., Seyboth, K., Matschoss, P., Kadner, S., Zwickel, T., Eickemeier, P., Hansen, G., Schlömer, S., and von Stechow, C. (eds), *IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation*, Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Woo CK, Horowitz I, Moore J, Pacheco A. (2011). The impact of wind generation on the electricity spot-market price level and variance: The Texas experience, *Energy Policy* 39(7), 3939-3944.

Wright, M. and Hearps, P. (2010). *Australian Sustainable Energy – Zero Carbon Australia Stationary Energy Plan*. Beyond Zero Emissions, University of Melbourne Energy Research Institute, Melbourne.

Caleb Ball

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:35 AM
To: DPE PS Wind Energy Mailbox
Subject: Submission on the New Wind Energy Planning Framework

Categories: Purple Category

Dear Sir/Madam,

Thank you for the opportunity to comment on the New Wind Energy Planning Framework. I generally support a new Framework that provides greater certainty and guidance on the assessment of wind energy projects in NSW.

With increasing CO2 levels causing warming of the Earth's atmosphere and oceans, the breakup of ice sheets, glacial retreat, sea level rise, and ocean acidification, it is clear that we urgently need improved action in NSW to transition away from fossil fuels and increase our investment in renewable energy.

Wind energy will play an important role in that transition, so it is important that the New Wind Energy Planning Framework encourages investors to develop wind energy projects in NSW.

There are a number of positive aspects to the new Framework including an increased emphasis on community engagement and consultation; a shift away from arbitrary, strict buffer zones; and confirmation that wind turbines do not cause adverse impacts on health.

However I am concerned that the new Framework puts too high an emphasis on the visual impacts of wind turbines. I do not agree that the visual impacts of wind energy projects are that much more significant than other major projects, such as open cut coal mines or high-rise residential buildings, that they warrant a more stringent assessment. This could act as a deterrent for investors in NSW.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, Verge Colpo 2034

Caleb Ball

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:35 AM
To: DPE PS Wind Energy Mailbox
Subject: Submission on the New Wind Energy Planning Framework

Categories: Red Category

Dear Sir/Madam,

Thank you for the opportunity to comment on the New Wind Energy Planning Framework. I generally support a new Framework that provides greater certainty and guidance on the assessment of wind energy projects in NSW.

With increasing CO2 levels causing warming of the Earth's atmosphere and oceans, the breakup of ice sheets, glacial retreat, sea level rise, and ocean acidification, it is clear that we urgently need improved action in NSW to transition away from fossil fuels and increase our investment in renewable energy.

Wind energy will play an important role in that transition, so it is important that the New Wind Energy Planning Framework encourages investors to develop wind energy projects in NSW.

There are a number of positive aspects to the new Framework including an increased emphasis on community engagement and consultation; a shift away from arbitrary, strict buffer zones; and confirmation that wind turbines do not cause adverse impacts on health.

However I am concerned that the new Framework puts too high an emphasis on the visual impacts of wind turbines. I do not agree that the visual impacts of wind energy projects are that much more significant than other major projects, such as open cut coal mines or high-rise residential buildings, that they warrant a more stringent assessment. This could act as a deterrent for investors in NSW.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, Meagan Brown 4224

Max Chipchase

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:40 AM
To: DPE PS Wind Energy Mailbox
Subject: KARL PETERS

Dear Sir/Madam,

Thank you for the opportunity to comment on the New Wind Energy Planning Framework. I generally support a new Framework that provides greater certainty and guidance on the assessment of wind energy projects in NSW.

With increasing CO2 levels causing warming of the Earth's atmosphere and oceans, the breakup of ice sheets, glacial retreat, sea level rise, and ocean acidification, it is clear that we urgently need improved action in NSW to transition away from fossil fuels and increase our investment in renewable energy.

Wind energy will play an important role in that transition, so it is important that the New Wind Energy Planning Framework encourages investors to develop wind energy projects in NSW.

There are a number of positive aspects to the new Framework including an increased emphasis on community engagement and consultation; a shift away from arbitrary, strict buffer zones; and confirmation that wind turbines do not cause adverse impacts on health.

However I am concerned that the new Framework puts too high an emphasis on the visual impacts of wind turbines. I do not agree that the visual impacts of wind energy projects are that much more significant than other major projects, such as open cut coal mines or high-rise residential buildings, that they warrant a more stringent assessment. This could act as a deterrent for investors in NSW.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, KARL PETERS N3 3H

Max Chipchase

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:39 AM
To: DPE PS Wind Energy Mailbox
Subject: Submission on the New Wind Energy Planning Framework

Dear Sir/Madam,

Thank you for the opportunity to comment on the New Wind Energy Planning Framework. I generally support a new Framework that provides greater certainty and guidance on the assessment of wind energy projects in NSW.

With increasing CO2 levels causing warming of the Earth's atmosphere and oceans, the breakup of ice sheets, glacial retreat, sea level rise, and ocean acidification, it is clear that we urgently need improved action in NSW to transition away from fossil fuels and increase our investment in renewable energy.

Wind energy will play an important role in that transition, so it is important that the New Wind Energy Planning Framework encourages investors to develop wind energy projects in NSW.

There are a number of positive aspects to the new Framework including an increased emphasis on community engagement and consultation; a shift away from arbitrary, strict buffer zones; and confirmation that wind turbines do not cause adverse impacts on health.

However I am concerned that the new Framework puts too high an emphasis on the visual impacts of wind turbines. I do not agree that the visual impacts of wind energy projects are that much more significant than other major projects, such as open cut coal mines or high-rise residential buildings, that they warrant a more stringent assessment. This could act as a deterrent for investors in NSW.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, Jan Roberts 2650

Max Chipchase

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:39 AM
To: DPE PS Wind Energy Mailbox
Subject: Submission on the New Wind Energy Planning Framework

Dear Sir/Madam,

Thank you for the opportunity to comment on the New Wind Energy Planning Framework. I generally support a new Framework that provides greater certainty and guidance on the assessment of wind energy projects in NSW.

With increasing CO2 levels causing warming of the Earth's atmosphere and oceans, the breakup of ice sheets, glacial retreat, sea level rise, and ocean acidification, it is clear that we urgently need improved action in NSW to transition away from fossil fuels and increase our investment in renewable energy.

Wind energy will play an important role in that transition, so it is important that the New Wind Energy Planning Framework encourages investors to develop wind energy projects in NSW.

There are a number of positive aspects to the new Framework including an increased emphasis on community engagement and consultation; a shift away from arbitrary, strict buffer zones; and confirmation that wind turbines do not cause adverse impacts on health.

However I am concerned that the new Framework puts too high an emphasis on the visual impacts of wind turbines. I do not agree that the visual impacts of wind energy projects are that much more significant than other major projects, such as open cut coal mines or high-rise residential buildings, that they warrant a more stringent assessment. This could act as a deterrent for investors in NSW.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, Dorina Garbayo 2528

Max Chipchase

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:39 AM
To: DPE PS Wind Energy Mailbox
Subject: Curren Submission on the New Wind Energy Planning Framework

Dear Sir/Madam,

Thanks for the opportunity to comment on the New Wind Energy Planning Framework. I generally support a new Framework that provides greater certainty and guidance on the assessment of wind energy projects in NSW.

With increasing CO2 levels causing warming of the Earth's atmosphere and oceans, the breakup of ice sheets, glacial retreat, sea level rise, and ocean acidification, it is clear that we urgently need improved action in NSW to transition away from fossil fuels and increase our investment in renewable energy.

Wind energy will play an important role in that transition, so it is important that the New Wind Energy Planning Framework encourages investors to develop wind energy projects in NSW.

There are a number of positive aspects to the new Framework including an increased emphasis on community engagement and consultation; a shift away from arbitrary, strict buffer zones; and confirmation that wind turbines do not cause adverse impacts on health.

However I am concerned that the new Framework puts too high an emphasis on the visual impacts of wind turbines. I do not agree that the visual impacts of wind energy projects are that much more significant than other major projects, such as open cut coal mines or high-rise residential buildings, that they warrant a more stringent assessment. This could act as a deterrent for investors in NSW.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, Nick Dooley 3892

Max Chipchase

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:39 AM
To: DPE PS Wind Energy Mailbox
Subject: Please Vote For Windpower or Solar Powere...

Dear Sir/Madam,

Thank you for the opportunity to comment on the New Wind Energy Planning Framework. I generally support a new Framework that provides greater certainty and guidance on the assessment of wind energy projects in NSW.

With increasing CO2 levels causing warming of the Earth's atmosphere and oceans, the breakup of ice sheets, glacial retreat, sea level rise, and ocean acidification, it is clear that we urgently need improved action in NSW to transition away from fossil fuels and increase our investment in renewable energy.

Wind energy will play an important role in that transition, so it is important that the New Wind Energy Planning Framework encourages investors to develop wind energy projects in NSW.

There are a number of positive aspects to the new Framework including an increased emphasis on community engagement and consultation; a shift away from arbitrary, strict buffer zones; and confirmation that wind turbines do not cause adverse impacts on health.

However I am concerned that the new Framework puts too high an emphasis on the visual impacts of wind turbines. I do not agree that the visual impacts of wind energy projects are that much more significant than other major projects, such as open cut coal mines or high-rise residential buildings, that they warrant a more stringent assessment. This could act as a deterrent for investors in NSW.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, Sheila Di 99999

Max Chipchase

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:39 AM
To: DPE PS Wind Energy Mailbox
Subject: Stephen Bloomfield

Dear Sir/Madam,

Thank you for the opportunity to comment on the New Wind Energy Planning Framework. I generally support a new Framework that provides greater certainty and guidance on the assessment of wind energy projects in NSW.

With increasing CO2 levels causing warming of the Earth's atmosphere and oceans, the breakup of ice sheets, glacial retreat, sea level rise, and ocean acidification, it is clear that we urgently need improved action in NSW to transition away from fossil fuels and increase our investment in renewable energy.

Wind energy will play an important role in that transition, so it is important that the New Wind Energy Planning Framework encourages investors to develop wind energy projects in NSW.

There are a number of positive aspects to the new Framework including an increased emphasis on community engagement and consultation; a shift away from arbitrary, strict buffer zones; and confirmation that wind turbines do not cause adverse impacts on health.

However I am concerned that the new Framework puts too high an emphasis on the visual impacts of wind turbines. I do not agree that the visual impacts of wind energy projects are that much more significant than other major projects, such as open cut coal mines or high-rise residential buildings, that they warrant a more stringent assessment. This could act as a deterrent for investors in NSW.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, Stephen Bloomfield 2115

Max Chipchase

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:39 AM
To: DPE PS Wind Energy Mailbox
Subject: Guarantee a future for wind power!

Dear Sir/Madam,

Thank you for the opportunity to comment on the New Wind Energy Planning Framework. I generally support a new Framework that provides greater certainty and guidance on the assessment of wind energy projects in NSW.

With increasing CO2 levels causing warming of the Earth's atmosphere and oceans, the breakup of ice sheets, glacial retreat, sea level rise, and ocean acidification, it is clear that we urgently need improved action in NSW to transition away from fossil fuels and increase our investment in renewable energy.

Wind energy will play an important role in that transition, so it is important that the New Wind Energy Planning Framework encourages investors to develop wind energy projects in NSW.

There are a number of positive aspects to the new Framework including an increased emphasis on community engagement and consultation; a shift away from arbitrary, strict buffer zones; and confirmation that wind turbines do not cause adverse impacts on health.

However I am concerned that the new Framework puts too high an emphasis on the visual impacts of wind turbines. I do not agree that the visual impacts of wind energy projects are that much more significant than other major projects, such as open cut coal mines or high-rise residential buildings, that they warrant a more stringent assessment. This could act as a deterrent for investors in NSW.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, Kresimir Bozic 2160

Max Chipchase

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:39 AM
To: DPE PS Wind Energy Mailbox
Subject: Submission on the New Wind Energy Planning Framework

Dear Sir/Madam,

Thank you for the opportunity to comment on the New Wind Energy Planning Framework. I generally support a new Framework that provides greater certainty and guidance on the assessment of wind energy projects in NSW.

With increasing CO2 levels causing warming of the Earth's atmosphere and oceans, the breakup of ice sheets, glacial retreat, sea level rise, and ocean acidification, it is clear that we urgently need improved action in NSW to transition away from fossil fuels and increase our investment in renewable energy.

Wind energy will play an important role in that transition, so it is important that the New Wind Energy Planning Framework encourages investors to develop wind energy projects in NSW.

There are a number of positive aspects to the new Framework including an increased emphasis on community engagement and consultation; a shift away from arbitrary, strict buffer zones; and confirmation that wind turbines do not cause adverse impacts on health.

However I am concerned that the new Framework puts too high an emphasis on the visual impacts of wind turbines. I do not agree that the visual impacts of wind energy projects are that much more significant than other major projects, such as open cut coal mines or high-rise residential buildings, that they warrant a more stringent assessment. This could act as a deterrent for investors in NSW.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, Jan Burton 2780

Max Chipchase

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:39 AM
To: DPE PS Wind Energy Mailbox
Subject: Tom Flood

Dear Sir/Madam,

Thank you for the opportunity to comment on the New Wind Energy Planning Framework. I generally support a new Framework that provides greater certainty and guidance on the assessment of wind energy projects in NSW.

With increasing CO2 levels causing warming of the Earth's atmosphere and oceans, the breakup of ice sheets, glacial retreat, sea level rise, and ocean acidification, it is clear that we urgently need improved action in NSW to transition away from fossil fuels and increase our investment in renewable energy.

Wind energy will play an important role in that transition, so it is important that the New Wind Energy Planning Framework encourages investors to develop wind energy projects in NSW.

There are a number of positive aspects to the new Framework including an increased emphasis on community engagement and consultation; a shift away from arbitrary, strict buffer zones; and confirmation that wind turbines do not cause adverse impacts on health.

However I am concerned that the new Framework puts too high an emphasis on the visual impacts of wind turbines. I do not agree that the visual impacts of wind energy projects are that much more significant than other major projects, such as open cut coal mines or high-rise residential buildings, that they warrant a more stringent assessment. This could act as a deterrent for investors in NSW.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, Tom Flood 2250

Max Chipchase

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:39 AM
To: DPE PS Wind Energy Mailbox
Subject: Let's save the planet and encourage wind generation!

Dear Sir/Madam,

Thank you for the opportunity to comment on the New Wind Energy Planning Framework. I generally support a new Framework that provides greater certainty and guidance on the assessment of wind energy projects in NSW.

With increasing CO2 levels causing warming of the Earth's atmosphere and oceans, the breakup of ice sheets, glacial retreat, sea level rise, and ocean acidification, it is clear that we urgently need improved action in NSW to transition away from fossil fuels and increase our investment in renewable energy.

Wind energy will play an important role in that transition, so it is important that the New Wind Energy Planning Framework encourages investors to develop wind energy projects in NSW.

There are a number of positive aspects to the new Framework including an increased emphasis on community engagement and consultation; a shift away from arbitrary, strict buffer zones; and confirmation that wind turbines do not cause adverse impacts on health.

However I am concerned that the new Framework puts too high an emphasis on the visual impacts of wind turbines. I do not agree that the visual impacts of wind energy projects are that much more significant than other major projects, such as open cut coal mines or high-rise residential buildings, that they warrant a more stringent assessment. This could act as a deterrent for investors in NSW.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, Geoffrey Colwill 2484

Max Chipchase

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:39 AM
To: DPE PS Wind Energy Mailbox
Subject: Sue Moran

Dear Sir/Madam,

Thank you for the opportunity to comment on the New Wind Energy Planning Framework. I generally support a new Framework that provides greater certainty and guidance on the assessment of wind energy projects in NSW.

With increasing CO2 levels causing warming of the Earth's atmosphere and oceans, the breakup of ice sheets, glacial retreat, sea level rise, and ocean acidification, it is clear that we urgently need improved action in NSW to transition away from fossil fuels and increase our investment in renewable energy.

Wind energy will play an important role in that transition, so it is important that the New Wind Energy Planning Framework encourages investors to develop wind energy projects in NSW.

There are a number of positive aspects to the new Framework including an increased emphasis on community engagement and consultation; a shift away from arbitrary, strict buffer zones; and confirmation that wind turbines do not cause adverse impacts on health.

However I am concerned that the new Framework puts too high an emphasis on the visual impacts of wind turbines. I do not agree that the visual impacts of wind energy projects are that much more significant than other major projects, such as open cut coal mines or high-rise residential buildings, that they warrant a more stringent assessment. This could act as a deterrent for investors in NSW.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, Sue Moran 2529

Max Chipchase

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:39 AM
To: DPE PS Wind Energy Mailbox
Subject: Submission on the New Wind Energy Planning Framework

Dear Sir/Madam,

Thank you for the opportunity to comment on the New Wind Energy Planning Framework. I generally support a new Framework that provides greater certainty and guidance on the assessment of wind energy projects in NSW.

With increasing CO2 levels causing warming of the Earth's atmosphere and oceans, the breakup of ice sheets, glacial retreat, sea level rise, and ocean acidification, it is clear that we urgently need improved action in NSW to transition away from fossil fuels and increase our investment in renewable energy.

Wind energy will play an important role in that transition, so it is important that the New Wind Energy Planning Framework encourages investors to develop wind energy projects in NSW.

There are a number of positive aspects to the new Framework including an increased emphasis on community engagement and consultation; a shift away from arbitrary, strict buffer zones; and confirmation that wind turbines do not cause adverse impacts on health.

However I am concerned that the new Framework puts too high an emphasis on the visual impacts of wind turbines. I do not agree that the visual impacts of wind energy projects are that much more significant than other major projects, such as open cut coal mines or high-rise residential buildings, that they warrant a more stringent assessment. This could act as a deterrent for investors in NSW.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, Elizabeth O'Hara 2350

Max Chipchase

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:39 AM
To: DPE PS Wind Energy Mailbox
Subject: Guarantee a future for wind power!

Dear Sir/Madam,

Thank you for the opportunity to comment on the New Wind Energy Planning Framework. I generally support a new Framework that provides greater certainty and guidance on the assessment of wind energy projects in NSW.

With increasing CO2 levels causing warming of the Earth's atmosphere and oceans, the breakup of ice sheets, glacial retreat, sea level rise, and ocean acidification, it is clear that we urgently need improved action in NSW to transition away from fossil fuels and increase our investment in renewable energy.

Wind energy will play an important role in that transition, so it is important that the New Wind Energy Planning Framework encourages investors to develop wind energy projects in NSW.

There are a number of positive aspects to the new Framework including an increased emphasis on community engagement and consultation; a shift away from arbitrary, strict buffer zones; and confirmation that wind turbines do not cause adverse impacts on health.

However I am concerned that the new Framework puts too high an emphasis on the visual impacts of wind turbines. I do not agree that the visual impacts of wind energy projects are that much more significant than other major projects, such as open cut coal mines or high-rise residential buildings, that they warrant a more stringent assessment. This could act as a deterrent for investors in NSW.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, Andjelka Bozic 2160

Max Chipchase

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:38 AM
To: DPE PS Wind Energy Mailbox
Subject: Submission on the New Wind Energy Planning Framework

Dear Sir/Madam,

Thank you for the opportunity to comment on the New Wind Energy Planning Framework. I generally support a new Framework that provides greater certainty and guidance on the assessment of wind energy projects in NSW.

With increasing CO2 levels causing warming of the Earth's atmosphere and oceans, the breakup of ice sheets, glacial retreat, sea level rise, and ocean acidification, it is clear that we urgently need improved action in NSW to transition away from fossil fuels and increase our investment in renewable energy.

Wind energy will play an important role in that transition, so it is important that the New Wind Energy Planning Framework encourages investors to develop wind energy projects in NSW.

There are a number of positive aspects to the new Framework including an increased emphasis on community engagement and consultation; a shift away from arbitrary, strict buffer zones; and confirmation that wind turbines do not cause adverse impacts on health.

However I am concerned that the new Framework puts too high an emphasis on the visual impacts of wind turbines. I do not agree that the visual impacts of wind energy projects are that much more significant than other major projects, such as open cut coal mines or high-rise residential buildings, that they warrant a more stringent assessment. This could act as a deterrent for investors in NSW.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, John Mester 2483

Max Chipchase

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:38 AM
To: DPE PS Wind Energy Mailbox
Subject: Submission on the New Wind Energy Planning Framework

Dear Sir/Madam,

Thank you for the opportunity to comment on the New Wind Energy Planning Framework. I generally support a new Framework that provides greater certainty and guidance on the assessment of wind energy projects in NSW.

With increasing CO2 levels causing warming of the Earth's atmosphere and oceans, the breakup of ice sheets, glacial retreat, sea level rise, and ocean acidification, it is clear that we urgently need improved action in NSW to transition away from fossil fuels and increase our investment in renewable energy.

Wind energy will play an important role in that transition, so it is important that the New Wind Energy Planning Framework encourages investors to develop wind energy projects in NSW.

There are a number of positive aspects to the new Framework including an increased emphasis on community engagement and consultation; a shift away from arbitrary, strict buffer zones; and confirmation that wind turbines do not cause adverse impacts on health.

However I am concerned that the new Framework puts too high an emphasis on the visual impacts of wind turbines. I do not agree that the visual impacts of wind energy projects are that much more significant than other major projects, such as open cut coal mines or high-rise residential buildings, that they warrant a more stringent assessment. This could act as a deterrent for investors in NSW.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, Vanessa Smith 2205

Max Chipchase

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:38 AM
To: DPE PS Wind Energy Mailbox
Subject: Catch up with the rest of the world

Dear Sir/Madam,

I think it is embarrassing that Australia has less alternative power generation than third world countries. With our resources we should be leaders in renewable energy!!!

Thank you for the opportunity to comment on the New Wind Energy Planning Framework. I generally support a new Framework that provides greater certainty and guidance on the assessment of wind energy projects in NSW.

With increasing CO2 levels causing warming of the Earth's atmosphere and oceans, the breakup of ice sheets, glacial retreat, sea level rise, and ocean acidification, it is clear that we urgently need improved action in NSW to transition away from fossil fuels and increase our investment in renewable energy.

Wind energy will play an important role in that transition, so it is important that the New Wind Energy Planning Framework encourages investors to develop wind energy projects in NSW.

There are a number of positive aspects to the new Framework including an increased emphasis on community engagement and consultation; a shift away from arbitrary, strict buffer zones; and confirmation that wind turbines do not cause adverse impacts on health.

However I am concerned that the new Framework puts too high an emphasis on the visual impacts of wind turbines. I do not agree that the visual impacts of wind energy projects are that much more significant than other major projects, such as open cut coal mines or high-rise residential buildings, that they warrant a more stringent assessment. This could act as a deterrent for investors in NSW.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, Debbie Davis 4213

Max Chipchase

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:38 AM
To: DPE PS Wind Energy Mailbox
Subject: Submission on the New Wind Energy Planning Framework

Dear Sir/Madam,

Thank you for the opportunity to comment on the New Wind Energy Planning Framework. I generally support a new Framework that provides greater certainty and guidance on the assessment of wind energy projects in NSW.

With increasing CO2 levels causing warming of the Earth's atmosphere and oceans, the breakup of ice sheets, glacial retreat, sea level rise, and ocean acidification, it is clear that we urgently need improved action in NSW to transition away from fossil fuels and increase our investment in renewable energy.

Wind energy will play an important role in that transition, so it is important that the New Wind Energy Planning Framework encourages investors to develop wind energy projects in NSW.

There are a number of positive aspects to the new Framework including an increased emphasis on community engagement and consultation; a shift away from arbitrary, strict buffer zones; and confirmation that wind turbines do not cause adverse impacts on health.

However I am concerned that the new Framework puts too high an emphasis on the visual impacts of wind turbines. I do not agree that the visual impacts of wind energy projects are that much more significant than other major projects, such as open cut coal mines or high-rise residential buildings, that they warrant a more stringent assessment. This could act as a deterrent for investors in NSW.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, Hannah Donaldson 2107

Max Chipchase

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:38 AM
To: DPE PS Wind Energy Mailbox
Subject: Submission on the New Wind Energy Planning Framework

Dear Sir/Madam,

Thank you for the opportunity to comment on the New Wind Energy Planning Framework. I generally support a new Framework that provides greater certainty and guidance on the assessment of wind energy projects in NSW.

With increasing CO2 levels causing warming of the Earth's atmosphere and oceans, the breakup of ice sheets, glacial retreat, sea level rise, and ocean acidification, it is clear that we urgently need improved action in NSW to transition away from fossil fuels and increase our investment in renewable energy.

Wind energy will play an important role in that transition, so it is important that the New Wind Energy Planning Framework encourages investors to develop wind energy projects in NSW.

There are a number of positive aspects to the new Framework including an increased emphasis on community engagement and consultation; a shift away from arbitrary, strict buffer zones; and confirmation that wind turbines do not cause adverse impacts on health.

However I am concerned that the new Framework puts too high an emphasis on the visual impacts of wind turbines. I do not agree that the visual impacts of wind energy projects are that much more significant than other major projects, such as open cut coal mines or high-rise residential buildings, that they warrant a more stringent assessment. This could act as a deterrent for investors in NSW.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, shawn Buchan 2111

Max Chipchase

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:38 AM
To: DPE PS Wind Energy Mailbox
Subject: Submission on the New Wind Energy Planning Framework

Dear Sir/Madam,

Thank you for the opportunity to comment on the New Wind Energy Planning Framework. I generally support a new Framework that provides greater certainty and guidance on the assessment of wind energy projects in NSW.

With increasing CO2 levels causing warming of the Earth's atmosphere and oceans, the breakup of ice sheets, glacial retreat, sea level rise, and ocean acidification, it is clear that we urgently need improved action in NSW to transition away from fossil fuels and increase our investment in renewable energy.

Wind energy will play an important role in that transition, so it is important that the New Wind Energy Planning Framework encourages investors to develop wind energy projects in NSW.

There are a number of positive aspects to the new Framework including an increased emphasis on community engagement and consultation; a shift away from arbitrary, strict buffer zones; and confirmation that wind turbines do not cause adverse impacts on health.

However I am concerned that the new Framework puts too high an emphasis on the visual impacts of wind turbines. I do not agree that the visual impacts of wind energy projects are that much more significant than other major projects, such as open cut coal mines or high-rise residential buildings, that they warrant a more stringent assessment. This could act as a deterrent for investors in NSW.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, michael azzopardi 2210

Max Chipchase

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:38 AM
To: DPE PS Wind Energy Mailbox
Subject: Dear Sir/Madam,

Dear Sir/Madam,

Thank you for the opportunity to comment on the New Wind Energy Planning Framework. I generally support a new Framework that provides greater certainty and guidance on the assessment of wind energy projects in NSW.

With increasing CO2 levels causing warming of the Earth's atmosphere and oceans, the breakup of ice sheets, glacial retreat, sea level rise, and ocean acidification, it is clear that we urgently need improved action in NSW to transition away from fossil fuels and increase our investment in renewable energy.

Wind energy will play an important role in that transition, so it is important that the New Wind Energy Planning Framework encourages investors to develop wind energy projects in NSW.

There are a number of positive aspects to the new Framework including an increased emphasis on community engagement and consultation; a shift away from arbitrary, strict buffer zones; and confirmation that wind turbines do not cause adverse impacts on health.

However I am concerned that the new Framework puts too high an emphasis on the visual impacts of wind turbines. I do not agree that the visual impacts of wind energy projects are that much more significant than other major projects, such as open cut coal mines or high-rise residential buildings, that they warrant a more stringent assessment. This could act as a deterrent for investors in NSW.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, Jessica McKenzie 2763

Max Chipchase

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:38 AM
To: DPE PS Wind Energy Mailbox
Subject: Submission on the New Wind Energy Planning Framework

Dear Sir/Madam,

Thank you for the opportunity to comment on the New Wind Energy Planning Framework. I generally support a new Framework that provides greater certainty and guidance on the assessment of wind energy projects in NSW.

With increasing CO2 levels causing warming of the Earth's atmosphere and oceans, the breakup of ice sheets, glacial retreat, sea level rise, and ocean acidification, it is clear that we urgently need improved action in NSW to transition away from fossil fuels and increase our investment in renewable energy.

Wind energy will play an important role in that transition, so it is important that the New Wind Energy Planning Framework encourages investors to develop wind energy projects in NSW.

There are a number of positive aspects to the new Framework including an increased emphasis on community engagement and consultation; a shift away from arbitrary, strict buffer zones; and confirmation that wind turbines do not cause adverse impacts on health.

However I am concerned that the new Framework puts too high an emphasis on the visual impacts of wind turbines. I do not agree that the visual impacts of wind energy projects are that much more significant than other major projects, such as open cut coal mines or high-rise residential buildings, that they warrant a more stringent assessment. This could act as a deterrent for investors in NSW.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, Julie Tomlin 2204

Max Chipchase

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:38 AM
To: DPE PS Wind Energy Mailbox
Subject: Guarantee a future for wind power!

Dear Sir/Madam,

Thank you for the opportunity to comment on the New Wind Energy Planning Framework. I generally support a new Framework that provides greater certainty and guidance on the assessment of wind energy projects in NSW.

With increasing CO2 levels causing warming of the Earth's atmosphere and oceans, the breakup of ice sheets, glacial retreat, sea level rise, and ocean acidification, it is clear that we urgently need improved action in NSW to transition away from fossil fuels and increase our investment in renewable energy.

Wind energy will play an important role in that transition, so it is important that the New Wind Energy Planning Framework encourages investors to develop wind energy projects in NSW.

There are a number of positive aspects to the new Framework including an increased emphasis on community engagement and consultation; a shift away from arbitrary, strict buffer zones; and confirmation that wind turbines do not cause adverse impacts on health.

However I am concerned that the new Framework puts too high an emphasis on the visual impacts of wind turbines. I do not agree that the visual impacts of wind energy projects are that much more significant than other major projects, such as open cut coal mines or high-rise residential buildings, that they warrant a more stringent assessment. This could act as a deterrent for investors in NSW.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, Karlo Bozic 2880

Max Chipchase

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:38 AM
To: DPE PS Wind Energy Mailbox
Subject: Wind energy must be part of the energy mix for NSW

How is it that in the face of too many environmental crises this state is going backwards on something that makes economic, social and environmental sense?

The electorate want renewable energy.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, Claudette Rechterik 2040

Max Chipchase

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:37 AM
To: DPE PS Wind Energy Mailbox
Subject: Submission on the New Wind Energy Planning Framework

Dear Sir/Madam,

Thank you for the opportunity to comment on the New Wind Energy Planning Framework. I generally support a new Framework that provides greater certainty and guidance on the assessment of wind energy projects in NSW.

With increasing CO2 levels causing warming of the Earth's atmosphere and oceans, the breakup of ice sheets, glacial retreat, sea level rise, and ocean acidification, it is clear that we urgently need improved action in NSW to transition away from fossil fuels and increase our investment in renewable energy.

Wind energy will play an important role in that transition, so it is important that the New Wind Energy Planning Framework encourages investors to develop wind energy projects in NSW.

There are a number of positive aspects to the new Framework including an increased emphasis on community engagement and consultation; a shift away from arbitrary, strict buffer zones; and confirmation that wind turbines do not cause adverse impacts on health.

However I am concerned that the new Framework puts too high an emphasis on the visual impacts of wind turbines. I do not agree that the visual impacts of wind energy projects are that much more significant than other major projects, such as open cut coal mines or high-rise residential buildings, that they warrant a more stringent assessment. This could act as a deterrent for investors in NSW.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, Simon Fox 2779

Max Chipchase

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:37 AM
To: DPE PS Wind Energy Mailbox
Subject: Peter Kuestler

Dear Sir/Madam,

Thank you for the opportunity to comment on the New Wind Energy Planning Framework. I generally support a new Framework that provides greater certainty and guidance on the assessment of wind energy projects in NSW.

With increasing CO2 levels causing warming of the Earth's atmosphere and oceans, the breakup of ice sheets, glacial retreat, sea level rise, and ocean acidification, it is clear that we urgently need improved action in NSW to transition away from fossil fuels and increase our investment in renewable energy.

Wind energy will play an important role in that transition, so it is important that the New Wind Energy Planning Framework encourages investors to develop wind energy projects in NSW.

There are a number of positive aspects to the new Framework including an increased emphasis on community engagement and consultation; a shift away from arbitrary, strict buffer zones; and confirmation that wind turbines do not cause adverse impacts on health.

However I am concerned that the new Framework puts too high an emphasis on the visual impacts of wind turbines. I do not agree that the visual impacts of wind energy projects are that much more significant than other major projects, such as open cut coal mines or high-rise residential buildings, that they warrant a more stringent assessment. This could act as a deterrent for investors in NSW.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, Peter Kuestler 4120

Max Chipchase

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:37 AM
To: DPE PS Wind Energy Mailbox
Subject: Submission on the New Wind Energy Planning Framework

Dear Sir/Madam,

Thank you for the opportunity to comment on the New Wind Energy Planning Framework. I generally support a new Framework that provides greater certainty and guidance on the assessment of wind energy projects in NSW.

With increasing CO2 levels causing warming of the Earth's atmosphere and oceans, the breakup of ice sheets, glacial retreat, sea level rise, and ocean acidification, it is clear that we urgently need improved action in NSW to transition away from fossil fuels and increase our investment in renewable energy.

Wind energy will play an important role in that transition, so it is important that the New Wind Energy Planning Framework encourages investors to develop wind energy projects in NSW.

There are a number of positive aspects to the new Framework including an increased emphasis on community engagement and consultation; a shift away from arbitrary, strict buffer zones; and confirmation that wind turbines do not cause adverse impacts on health.

However I am concerned that the new Framework puts too high an emphasis on the visual impacts of wind turbines. I do not agree that the visual impacts of wind energy projects are that much more significant than other major projects, such as open cut coal mines or high-rise residential buildings, that they warrant a more stringent assessment. This could act as a deterrent for investors in NSW.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, Alicia Lloyd 2096

Max Chipchase

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:37 AM
To: DPE PS Wind Energy Mailbox
Subject: Support wind farms

Dear Sir/Madam,

Thank you for the opportunity to comment on the New Wind Energy Planning Framework. I generally support a new Framework that provides greater certainty and guidance on the assessment of wind energy projects in NSW.

With increasing CO2 levels causing warming of the Earth's atmosphere and oceans, the breakup of ice sheets, glacial retreat, sea level rise, and ocean acidification, it is clear that we urgently need improved action in NSW to transition away from fossil fuels and increase our investment in renewable energy.

Wind energy will play an important role in that transition, so it is important that the New Wind Energy Planning Framework encourages investors to develop wind energy projects in NSW.

There are a number of positive aspects to the new Framework including an increased emphasis on community engagement and consultation; a shift away from arbitrary, strict buffer zones; and confirmation that wind turbines do not cause adverse impacts on health.

However I am concerned that the new Framework puts too high an emphasis on the visual impacts of wind turbines. I do not agree that the visual impacts of wind energy projects are that much more significant than other major projects, such as open cut coal mines or high-rise residential buildings, that they warrant a more stringent assessment. This could act as a deterrent for investors in NSW.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, Roy Burton 27 80

Max Chipchase

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:37 AM
To: DPE PS Wind Energy Mailbox
Subject: Submission on the New Wind Energy Planning Framework

Dear Sir/Madam,

Thank you for the opportunity to comment on the New Wind Energy Planning Framework. I generally support a new Framework that provides greater certainty and guidance on the assessment of wind energy projects in NSW.

With increasing CO2 levels causing warming of the Earth's atmosphere and oceans, the breakup of ice sheets, glacial retreat, sea level rise, and ocean acidification, it is clear that we urgently need improved action in NSW to transition away from fossil fuels and increase our investment in renewable energy.

Wind energy will play an important role in that transition, so it is important that the New Wind Energy Planning Framework encourages investors to develop wind energy projects in NSW.

There are a number of positive aspects to the new Framework including an increased emphasis on community engagement and consultation; a shift away from arbitrary, strict buffer zones; and confirmation that wind turbines do not cause adverse impacts on health.

However I am concerned that the new Framework puts too high an emphasis on the visual impacts of wind turbines. I do not agree that the visual impacts of wind energy projects are that much more significant than other major projects, such as open cut coal mines or high-rise residential buildings, that they warrant a more stringent assessment. This could act as a deterrent for investors in NSW.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, Gillian Houghton 2760

Max Chipchase

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:37 AM
To: DPE PS Wind Energy Mailbox
Subject: Looking to a cleaner future

Dear Sir/Madam,

Thank you for the opportunity to comment on the New Wind Energy Planning Framework. I generally support a new Framework that provides greater certainty and guidance on the assessment of wind energy projects in NSW.

With increasing CO2 levels causing warming of the Earth's atmosphere and oceans, the breakup of ice sheets, glacial retreat, sea level rise, and ocean acidification, it is clear that we urgently need improved action in NSW to transition away from fossil fuels and increase our investment in renewable energy.

Wind energy will play an important role in that transition, so it is important that the New Wind Energy Planning Framework encourages investors to develop wind energy projects in NSW.

There are a number of positive aspects to the new Framework including an increased emphasis on community engagement and consultation; a shift away from arbitrary, strict buffer zones; and confirmation that wind turbines do not cause adverse impacts on health.

However I am concerned that the new Framework puts too high an emphasis on the visual impacts of wind turbines. I do not agree that the visual impacts of wind energy projects are that much more significant than other major projects, such as open cut coal mines or high-rise residential buildings, that they warrant a more stringent assessment. This could act as a deterrent for investors in NSW.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, Ian Willis 2780

Max Chipchase

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:37 AM
To: DPE PS Wind Energy Mailbox
Subject: Submission on the New Wind Energy Planning Framework

Dear Sir/Madam,

Thank you for the opportunity to comment on the New Wind Energy Planning Framework. I generally support a new Framework that provides greater certainty and guidance on the assessment of wind energy projects in NSW.

With increasing CO2 levels causing warming of the Earth's atmosphere and oceans, the breakup of ice sheets, glacial retreat, sea level rise, and ocean acidification, it is clear that we urgently need improved action in NSW to transition away from fossil fuels and increase our investment in renewable energy.

Wind energy will play an important role in that transition, so it is important that the New Wind Energy Planning Framework encourages investors to develop wind energy projects in NSW.

There are a number of positive aspects to the new Framework including an increased emphasis on community engagement and consultation; a shift away from arbitrary, strict buffer zones; and confirmation that wind turbines do not cause adverse impacts on health.

However I am concerned that the new Framework puts too high an emphasis on the visual impacts of wind turbines. I do not agree that the visual impacts of wind energy projects are that much more significant than other major projects, such as open cut coal mines or high-rise residential buildings, that they warrant a more stringent assessment. This could act as a deterrent for investors in NSW.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, Pieter Heine Heemstra 2101

Max Chipchase

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:37 AM
To: DPE PS Wind Energy Mailbox
Subject: Elizabeth Conway

Dear Sir/Madam,

Thank you for the opportunity to comment on the New Wind Energy Planning Framework. I generally support a new Framework that provides greater certainty and guidance on the assessment of wind energy projects in NSW.

With increasing CO2 levels causing warming of the Earth's atmosphere and oceans, the breakup of ice sheets, glacial retreat, sea level rise, and ocean acidification, it is clear that we urgently need improved action in NSW to transition away from fossil fuels and increase our investment in renewable energy.

Wind energy will play an important role in that transition, so it is important that the New Wind Energy Planning Framework encourages investors to develop wind energy projects in NSW.

There are a number of positive aspects to the new Framework including an increased emphasis on community engagement and consultation; a shift away from arbitrary, strict buffer zones; and confirmation that wind turbines do not cause adverse impacts on health.

However I am concerned that the new Framework puts too high an emphasis on the visual impacts of wind turbines. I do not agree that the visual impacts of wind energy projects are that much more significant than other major projects, such as open cut coal mines or high-rise residential buildings, that they warrant a more stringent assessment. This could act as a deterrent for investors in NSW.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, Elizabeth Conway 2600 Elizabeth Conway 2600

Max Chipchase

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:36 AM
To: DPE PS Wind Energy Mailbox
Subject: [REDACTED]

Dear Sir/Madam,

Thank you for the opportunity to comment on the New Wind Energy Planning Framework. I generally support a new Framework that provides greater certainty and guidance on the assessment of wind energy projects in NSW.

With increasing CO2 levels causing warming of the Earth's atmosphere and oceans, the breakup of ice sheets, glacial retreat, sea level rise, and ocean acidification, it is clear that we urgently need improved action in NSW to transition away from fossil fuels and increase our investment in renewable energy.

Wind energy will play an important role in that transition, so it is important that the New Wind Energy Planning Framework encourages investors to develop wind energy projects in NSW.

There are a number of positive aspects to the new Framework including an increased emphasis on community engagement and consultation; a shift away from arbitrary, strict buffer zones; and confirmation that wind turbines do not cause adverse impacts on health.

However I am concerned that the new Framework puts too high an emphasis on the visual impacts of wind turbines. I do not agree that the visual impacts of wind energy projects are that much more significant than other major projects, such as open cut coal mines or high-rise residential buildings, that they warrant a more stringent assessment. This could act as a deterrent for investors in NSW.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, Robert Gordon 6162

Max Chipchase

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:36 AM
To: DPE PS Wind Energy Mailbox
Subject: Submission on the New Wind Energy Planning Framework

Dear Sir/Madam,

Thank you for the opportunity to comment on the New Wind Energy Planning Framework. I generally support a new Framework that provides greater certainty and guidance on the assessment of wind energy projects in NSW.

With increasing CO2 levels causing warming of the Earth's atmosphere and oceans, the breakup of ice sheets, glacial retreat, sea level rise, and ocean acidification, it is clear that we urgently need improved action in NSW to transition away from fossil fuels and increase our investment in renewable energy.

Wind energy will play an important role in that transition, so it is important that the New Wind Energy Planning Framework encourages investors to develop wind energy projects in NSW.

There are a number of positive aspects to the new Framework including an increased emphasis on community engagement and consultation; a shift away from arbitrary, strict buffer zones; and confirmation that wind turbines do not cause adverse impacts on health.

However I am concerned that the new Framework puts too high an emphasis on the visual impacts of wind turbines. I do not agree that the visual impacts of wind energy projects are that much more significant than other major projects, such as open cut coal mines or high-rise residential buildings, that they warrant a more stringent assessment. This could act as a deterrent for investors in NSW.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, irene tims 2489

Max Chipchase

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:36 AM
To: DPE PS Wind Energy Mailbox
Subject: Wind Power

Dear Sir/Madam,

Thank you for the opportunity to comment on the New Wind Energy Planning Framework. I generally support a new Framework that provides greater certainty and guidance on the assessment of wind energy projects in NSW.

With increasing CO2 levels causing warming of the Earth's atmosphere and oceans, the breakup of ice sheets, glacial retreat, sea level rise, and ocean acidification, it is clear that we urgently need improved action in NSW to transition away from fossil fuels and increase our investment in renewable energy.

Wind energy will play an important role in that transition, so it is important that the New Wind Energy Planning Framework encourages investors to develop wind energy projects in NSW.

There are a number of positive aspects to the new Framework including an increased emphasis on community engagement and consultation; a shift away from arbitrary, strict buffer zones; and confirmation that wind turbines do not cause adverse impacts on health.

However I am concerned that the new Framework puts too high an emphasis on the visual impacts of wind turbines. I do not agree that the visual impacts of wind energy projects are that much more significant than other major projects, such as open cut coal mines or high-rise residential buildings, that they warrant a more stringent assessment. This could act as a deterrent for investors in NSW.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, Katie Covington 2095

Max Chipchase

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:36 AM
To: DPE PS Wind Energy Mailbox
Subject: strong future for wind energy

Dear Sir/Madam,

Thank you for the opportunity to comment on the New Wind Energy Planning Framework. I generally support a new Framework that provides greater certainty and guidance on the assessment of wind energy projects in NSW.

With increasing CO2 levels causing warming of the Earth's atmosphere and oceans, the breakup of ice sheets, glacial retreat, sea level rise, and ocean acidification, it is clear that we urgently need improved action in NSW to transition away from fossil fuels and increase our investment in renewable energy.

Wind energy will play an important role in that transition, so it is important that the New Wind Energy Planning Framework encourages investors to develop wind energy projects in NSW.

There are a number of positive aspects to the new Framework including an increased emphasis on community engagement and consultation; a shift away from arbitrary, strict buffer zones; and confirmation that wind turbines do not cause adverse impacts on health.

However I am concerned that the new Framework puts too high an emphasis on the visual impacts of wind turbines. I do not agree that the visual impacts of wind energy projects are that much more significant than other major projects, such as open cut coal mines or high-rise residential buildings, that they warrant a more stringent assessment. This could act as a deterrent for investors in NSW.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, Russell Weisz 95060

Max Chipchase

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:36 AM
To: DPE PS Wind Energy Mailbox
Subject: Submission on the New Wind Energy Planning Framework

Dear Sir/Madam,

Thank you for the opportunity to comment on the New Wind Energy Planning Framework. I generally support a new Framework that provides greater certainty and guidance on the assessment of wind energy projects in NSW.

With increasing CO2 levels causing warming of the Earth's atmosphere and oceans, the breakup of ice sheets, glacial retreat, sea level rise, and ocean acidification, it is clear that we urgently need improved action in NSW to transition away from fossil fuels and increase our investment in renewable energy.

Wind energy will play an important role in that transition, so it is important that the New Wind Energy Planning Framework encourages investors to develop wind energy projects in NSW.

There are a number of positive aspects to the new Framework including an increased emphasis on community engagement and consultation; a shift away from arbitrary, strict buffer zones; and confirmation that wind turbines do not cause adverse impacts on health.

However I am concerned that the new Framework puts too high an emphasis on the visual impacts of wind turbines. I do not agree that the visual impacts of wind energy projects are that much more significant than other major projects, such as open cut coal mines or high-rise residential buildings, that they warrant a more stringent assessment. This could act as a deterrent for investors in NSW.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, Jeffrey Gardner 2615

Max Chipchase

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:35 AM
To: DPE PS Wind Energy Mailbox
Subject: Submission on the New Wind Energy Planning Framework

Dear Sir/Madam,

Thank you for the opportunity to comment on the New Wind Energy Planning Framework. I generally support a new Framework that provides greater certainty and guidance on the assessment of wind energy projects in NSW.

With increasing CO2 levels causing warming of the Earth's atmosphere and oceans, the breakup of ice sheets, glacial retreat, sea level rise, and ocean acidification, it is clear that we urgently need improved action in NSW to transition away from fossil fuels and increase our investment in renewable energy.

Wind energy will play an important role in that transition, so it is important that the New Wind Energy Planning Framework encourages investors to develop wind energy projects in NSW.

There are a number of positive aspects to the new Framework including an increased emphasis on community engagement and consultation; a shift away from arbitrary, strict buffer zones; and confirmation that wind turbines do not cause adverse impacts on health.

However I am concerned that the new Framework puts too high an emphasis on the visual impacts of wind turbines. I do not agree that the visual impacts of wind energy projects are that much more significant than other major projects, such as open cut coal mines or high-rise residential buildings, that they warrant a more stringent assessment. This could act as a deterrent for investors in NSW.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, Cris Terry 2500

Max Chipchase

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:35 AM
To: DPE PS Wind Energy Mailbox
Subject: Submission on the New Wind Energy Planning Framework

Dear Sir/Madam,

Thank you for the opportunity to comment on the New Wind Energy Planning Framework. I generally support a new Framework that provides greater certainty and guidance on the assessment of wind energy projects in NSW.

With increasing CO2 levels causing warming of the Earth's atmosphere and oceans, the breakup of ice sheets, glacial retreat, sea level rise, and ocean acidification, it is clear that we urgently need improved action in NSW to transition away from fossil fuels and increase our investment in renewable energy.

Wind energy will play an important role in that transition, so it is important that the New Wind Energy Planning Framework encourages investors to develop wind energy projects in NSW.

There are a number of positive aspects to the new Framework including an increased emphasis on community engagement and consultation; a shift away from arbitrary, strict buffer zones; and confirmation that wind turbines do not cause adverse impacts on health.

However I am concerned that the new Framework puts too high an emphasis on the visual impacts of wind turbines. I do not agree that the visual impacts of wind energy projects are much more significant than other major projects, such as open cut coal mines or high-rise residential buildings, that they warrant a more stringent assessment. This could act as a deterrent for investors in NSW.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, Martin Oliver 2480

Max Chipchase

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:35 AM
To: DPE PS Wind Energy Mailbox
Subject: Submission on the New Wind Energy Planning Framework

Dear Sir/Madam,

Thank you for the opportunity to comment on the New Wind Energy Planning Framework. I generally support a new Framework that provides greater certainty and guidance on the assessment of wind energy projects in NSW.

With increasing CO2 levels causing warming of the Earth's atmosphere and oceans, the breakup of ice sheets, glacial retreat, sea level rise, and ocean acidification, it is clear that we urgently need improved action in NSW to transition away from fossil fuels and increase our investment in renewable energy.

Wind energy will play an important role in that transition, so it is important that the New Wind Energy Planning Framework encourages investors to develop wind energy projects in NSW.

There are a number of positive aspects to the new Framework including an increased emphasis on community engagement and consultation; a shift away from arbitrary, strict buffer zones; and confirmation that wind turbines do not cause adverse impacts on health.

However I am concerned that the new Framework puts too high an emphasis on the visual impacts of wind turbines. I do not agree that the visual impacts of wind energy projects are that much more significant than other major projects, such as open cut coal mines or high-rise residential buildings, that they warrant a more stringent assessment. This could act as a deterrent for investors in NSW.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, Pilar Muschietti Piana 5061

Max Chipchase

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:35 AM
To: DPE PS Wind Energy Mailbox
Subject: Josh Rust

Dear Sir/Madam,

Thank you for the opportunity to comment on the New Wind Energy Planning Framework. I generally support a new Framework that provides greater certainty and guidance on the assessment of wind energy projects in NSW.

With increasing CO2 levels causing warming of the Earth's atmosphere and oceans, the breakup of ice sheets, glacial retreat, sea level rise, and ocean acidification, it is clear that we urgently need improved action in NSW to transition away from fossil fuels and increase our investment in renewable energy.

Wind energy will play an important role in that transition, so it is important that the New Wind Energy Planning Framework encourages investors to develop wind energy projects in NSW.

There are a number of positive aspects to the new Framework including an increased emphasis on community engagement and consultation; a shift away from arbitrary, strict buffer zones; and confirmation that wind turbines do not cause adverse impacts on health.

However I am concerned that the new Framework puts too high an emphasis on the visual impacts of wind turbines. I do not agree that the visual impacts of wind energy projects are that much more significant than other major projects, such as open cut coal mines or high-rise residential buildings, that they warrant a more stringent assessment. This could act as a deterrent for investors in NSW.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, Josh Rust 2477

Max Chipchase

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:54 AM
To: DPE PS Wind Energy Mailbox
Subject: Renewable Energy is vital

Dear Sir/Madam,

Thank you for the opportunity to comment on the New Wind Energy Planning Framework. I generally support a new Framework that provides greater certainty and guidance on the assessment of wind energy projects in NSW.

With increasing CO2 levels causing warming of the Earth's atmosphere and oceans, the breakup of ice sheets, glacial retreat, sea level rise, and ocean acidification, it is clear that we urgently need improved action in NSW to transition away from fossil fuels and increase our investment in renewable energy.

Wind energy will play an important role in that transition, so it is important that the New Wind Energy Planning Framework encourages investors to develop wind energy projects in NSW.

There are a number of positive aspects to the new Framework including an increased emphasis on community engagement and consultation; a shift away from arbitrary, strict buffer zones; and confirmation that wind turbines do not cause adverse impacts on health.

However I am concerned that the new Framework puts too high an emphasis on the visual impacts of wind turbines. I do not agree that the visual impacts of wind energy projects are that much more significant than other major projects, such as open cut coal mines or high-rise residential buildings, that they warrant a more stringent assessment. This could act as a deterrent for investors in NSW.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, Niclas Witton 2112

Max Chipchase

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:54 AM
To: DPE PS Wind Energy Mailbox
Subject: Submission on the New Wind Energy Planning Framework

Dear Sir/Madam,

Thank you for the opportunity to comment on the New Wind Energy Planning Framework. I generally support a new Framework that provides greater certainty and guidance on the assessment of wind energy projects in NSW.

With increasing CO2 levels causing warming of the Earth's atmosphere and oceans, the breakup of ice sheets, glacial retreat, sea level rise, and ocean acidification, it is clear that we urgently need improved action in NSW to transition away from fossil fuels and increase our investment in renewable energy.

Wind energy will play an important role in that transition, so it is important that the New Wind Energy Planning Framework encourages investors to develop wind energy projects in NSW.

There are a number of positive aspects to the new Framework including an increased emphasis on community engagement and consultation; a shift away from arbitrary, strict buffer zones; and confirmation that wind turbines do not cause adverse impacts on health.

However I am concerned that the new Framework puts too high an emphasis on the visual impacts of wind turbines. I do not agree that the visual impacts of wind energy projects are that much more significant than other major projects, such as open cut coal mines or high-rise residential buildings, that they warrant a more stringent assessment. This could act as a deterrent for investors in NSW.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, Alynn Pratt 2071

Max Chipchase

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:52 AM
To: DPE PS Wind Energy Mailbox
Subject: Submission on the New Wind Energy Planning Framework

Dear Sir/Madam,

Thank you for the opportunity to comment on the New Wind Energy Planning Framework. I generally support a new Framework that provides greater certainty and guidance on the assessment of wind energy projects in NSW.

With increasing CO2 levels causing warming of the Earth's atmosphere and oceans, the breakup of ice sheets, glacial retreat, sea level rise, and ocean acidification, it is clear that we urgently need improved action in NSW to transition away from fossil fuels and increase our investment in renewable energy.

Wind energy will play an important role in that transition, so it is important that the New Wind Energy Planning Framework encourages investors to develop wind energy projects in NSW.

There are a number of positive aspects to the new Framework including an increased emphasis on community engagement and consultation; a shift away from arbitrary, strict buffer zones; and confirmation that wind turbines do not cause adverse impacts on health.

However I am concerned that the new Framework puts too high an emphasis on the visual impacts of wind turbines. I do not agree that the visual impacts of wind energy projects are that much more significant than other major projects, such as open cut coal mines or high-rise residential buildings, that they warrant a more stringent assessment. This could act as a deterrent for investors in NSW.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, vicki johnson 4575

Max Chipchase

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:53 AM
To: DPE PS Wind Energy Mailbox
Subject: Submission on the New Wind Energy Planning Framework

Dear Sir/Madam,

Thank you for the opportunity to comment on the New Wind Energy Planning Framework. I generally support a new Framework that provides greater certainty and guidance on the assessment of wind energy projects in NSW.

With increasing CO2 levels causing warming of the Earth's atmosphere and oceans, the breakup of ice sheets, glacial retreat, sea level rise, and ocean acidification, it is clear that we urgently need improved action in NSW to transition away from fossil fuels and increase our investment in renewable energy.

Wind energy will play an important role in that transition, so it is important that the New Wind Energy Planning Framework encourages investors to develop wind energy projects in NSW.

There are a number of positive aspects to the new Framework including an increased emphasis on community engagement and consultation; a shift away from arbitrary, strict buffer zones; and confirmation that wind turbines do not cause adverse impacts on health.

However I am concerned that the new Framework puts too high an emphasis on the visual impacts of wind turbines. I do not agree that the visual impacts of wind energy projects are that much more significant than other major projects, such as open cut coal mines or high-rise residential buildings, that they warrant a more stringent assessment. This could act as a deterrent for investors in NSW.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, Kerry Firkin 2315

Max Chipchase

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:50 AM
To: DPE PS Wind Energy Mailbox
Subject: Submission on the New Wind Energy Planning Framework

Dear Sir/Madam,

Thank you for the opportunity to comment on the New Wind Energy Planning Framework. I generally support a new Framework that provides greater certainty and guidance on the assessment of wind energy projects in NSW.

With increasing CO2 levels causing warming of the Earth's atmosphere and oceans, the breakup of ice sheets, glacial retreat, sea level rise, and ocean acidification, it is clear that we urgently need improved action in NSW to transition away from fossil fuels and increase our investment in renewable energy.

Wind energy will play an important role in that transition, so it is important that the New Wind Energy Planning Framework encourages investors to develop wind energy projects in NSW.

There are a number of positive aspects to the new Framework including an increased emphasis on community engagement and consultation; a shift away from arbitrary, strict buffer zones; and confirmation that wind turbines do not cause adverse impacts on health.

However I am concerned that the new Framework puts too high an emphasis on the visual impacts of wind turbines. I do not agree that the visual impacts of wind energy projects are that much more significant than other major projects, such as open cut coal mines or high-rise residential buildings, that they warrant a more stringent assessment. This could act as a deterrent for investors in NSW.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, Jeanette Mcalpine 2251

Max Chipchase

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:54 AM
To: DPE PS Wind Energy Mailbox
Subject: Submission on the New Wind Energy Planning Framework

Dear Sir/Madam,

Thank you for the opportunity to comment on the New Wind Energy Planning Framework. I generally support a new Framework that provides greater certainty and guidance on the assessment of wind energy projects in NSW.

With increasing CO2 levels causing warming of the Earth's atmosphere and oceans, the breakup of ice sheets, glacial retreat, sea level rise, and ocean acidification, it is clear that we urgently need improved action in NSW to transition away from fossil fuels and increase our investment in renewable energy.

Wind energy will play an important role in that transition, so it is important that the New Wind Energy Planning Framework encourages investors to develop wind energy projects in NSW.

There are a number of positive aspects to the new Framework including an increased emphasis on community engagement and consultation; a shift away from arbitrary, strict buffer zones; and confirmation that wind turbines do not cause adverse impacts on health.

However I am concerned that the new Framework puts too high an emphasis on the visual impacts of wind turbines. I do not agree that the visual impacts of wind energy projects are that much more significant than other major projects, such as open cut coal mines or high-rise residential buildings, that they warrant a more stringent assessment. This could act as a deterrent for investors in NSW.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, Raymond Martin 2871

Max Chipchase

From: [REDACTED]
Sent: Wednesday, 14 September 2016 10:50 AM
To: DPE PS Wind Energy Mailbox
Subject: Submission on the New Wind Energy Planning Framework

Dear Sir/Madam,

Thank you for the opportunity to comment on the New Wind Energy Planning Framework. I generally support a new Framework that provides greater certainty and guidance on the assessment of wind energy projects in NSW.

With increasing CO2 levels causing warming of the Earth's atmosphere and oceans, the breakup of ice sheets, glacial retreat, sea level rise, and ocean acidification, it is clear that we urgently need improved action in NSW to transition away from fossil fuels and increase our investment in renewable energy.

Wind energy will play an important role in that transition, so it is important that the New Wind Energy Planning Framework encourages investors to develop wind energy projects in NSW.

There are a number of positive aspects to the new Framework including an increased emphasis on community engagement and consultation; a shift away from arbitrary, strict buffer zones; and confirmation that wind turbines do not cause adverse impacts on health.

However I am concerned that the new Framework puts too high an emphasis on the visual impacts of wind turbines. I do not agree that the visual impacts of wind energy projects are that much more significant than other major projects, such as open cut coal mines or high-rise residential buildings, that they warrant a more stringent assessment. This could act as a deterrent for investors in NSW.

Wind energy has significant benefits to the people of NSW and I urge the NSW government to ensure its new Framework promotes investment in wind energy here in NSW and is finalised in a timely manner.

Yours faithfully, Les Ayers 2747