Supplementary Submission No 81a

# INQUIRY INTO RURAL WIND FARMS

**Name:** Dr David Burraston and Ms Sarah Last

**Date received:** 27/10/2009

# Inquiry into rural wind farms

# Supplementary Submission to the Legislative Council General Purpose Standing Committee No 5

# by


# Dr David Burraston and Ms Sarah Last


Based on our research and the testimonies given at the Public Inquiry there are an alarming number of negative impacts and urgent research requirements related to industrial scale wind power stations. We request that this committee recommend :

- Moratorium on further construction of "wind farms" and industrial scale wind electricity generation in rural areas
- Environmental assessments / impact statements be revisited, independently assessed and revised
- Independent investigation into decommissioning (bonds, costs, management plans, process)
- Salvage/scrap value to be excluded from decommissioning costs as is now happening in the USA
- Comprehensive scientific research report that extends and updates America's 2007 National Research Council of the National Academies study "*Environmental Impacts of Wind-Energy Projects*". Such research should be conducted at both state and national levels
- Independent investigation into negative health effects of industrial wind power stations

With particular reference to NSW environmental assessments / impact statements we have found that the sections on Noise Assessment use a flawed methodology. Research demonstrating these flaws is presented in Kamperman & James (2008), and also in James' Statement of Evidence in 2008 regarding the development at Mills Creek, NZ. Both are listed in the bibliography below. Kamperman and James examined a number of noise assessments in Europe, Canada and USA which had received noise complaints after construction. Some important excerpts from their Noise-Con 2008 conference paper :

*"After reviewing the materials in the tables; we have arrived at our current understanding of wind turbine noise and its impact on the host community and its residents. The review showed that some residents living as far as 3 km (two (2) miles) from a wind farm complain of sleep disturbance from the noise. Many residents living one-tenth this distance (300 m. or 1000 feet) from a wind farm are experiencing major sleep disruption and other serious medical problems from nighttime wind turbine noise. The peculiar acoustic characteristics of wind turbine noise immissions cause the sounds heard at the receiving properties to be more annoying and troublesome than the more familiar noise*

*from traffic and industrial factories. Limits used for these other community noise sources do not appear to be appropriate for siting industrial wind turbines."*

*"The common method used for establishing the background sound level at a proposed wind farm used in many of the studies in Table 1 was to use unattended noise monitors to record hundreds often (10) minute measurements to obtain a statistically significant sample over varying wind conditions or a period of weeks. The measured results for daytime and nighttime are combined to determine the statically average wind noise as a function of wind velocity measured at a height of ten (10) meters. This provides an enormous amount of data but the results have little relationship to the wind turbine sound immission or turbine noise impact in nearby residents. The purpose of this exhaustive exercise often only demonstrates how much noise is generated by the wind. In some cases it appears that the data is used to 'prove' that the wind noise masks the turbine's sound immissions."*

*The most glaring fault with this argument is shown during the frequent nighttime conditions with a stable atmosphere when the wind turbines generate the maximum electricity and noise while the wind at ground level is calm and the background noise level is low. This is the condition of maximum turbine noise impact on nearby residents. It is the condition which most directly causes chronic sleep disruption. Furthermore, this methodology is usually faulty, as much of the wind noise measured by unattended sound monitors is the wind noise generated at the microphone windscreen resulting in totally erroneous results."*

An example of this flawed methodology in a noise assessment is evident in the NSW Government approved Conroy's Gap development. The monitoring campaign summary by noise consultants Heggies Australia on page 25 of Epuron's environmental assessments details numerous problems with data gathering, due to flat logger batteries, damaged microphones, non-functional wind monitoring, logger failure etc. In fact out of 25 monitoring periods only 1 produced a full period. This Noise Assessment is Attachment 7 of Epuron's Environmental Assessment available on line at :

http://www.epuron.com.au/desktopdefault.aspx/tabid-786/

Of further concern for environmental assessments is the repetition and "cut and paste" that appears. Such techniques demonstrate low professional standards. Error and repetition is seen in the case of Gullen Range, the Traffic Impact Study still has "Conroys Gap" as the header on pages 4, 24 and 25. The Traffic Impact Study is Attachment 3.8 of Epuron's Environmental Assessment available on line at :

http://www.epuron.com.au/desktopdefault.aspx/tabid-787/

Noise levels are certified by the wind turbine manufacturer assuming optimal operating conditions; a perfect linear intersection velocity with the surface area of the blade. Once the blade incorporates turbulence (from either a sudden increase in gradient - also known as shear, tall tree plantations, inadequate spacing or atmospheric turbulence), then extreme variances in pressure over the surface area of the blade are created. This results in vibration and therefore operating inefficiencies, the potential for blade damage and noise issues. Noise level certification becomes invalid when operating conditions are breached.

The Vestas V90 wind turbine specification document (Vestas 2008) recommends that turbines not be placed on slopes greater than 10 degrees within 100m of a turbine (see Section 1.3 Terrain Conditions). A spacing of 5 rotor diameters is recommended at Section 1.4 Climatic Conditions. At Section 2.1 Wind Climate, it also mentions that the turbulence % maximum is 20%. The wind speed data for the Victorian Government's recently approved Winchelsea Wind Farm, one of the few sites at which wind speed data was ordered to be released by VCAT, showed a night time turbulence pattern of over 20% for 75% of the time over a 12 month period and slopes greater than 10 degrees. Other industrial wind power stations have been built on slopes greater than 10 degrees and spacing issues are very much apparent. Basic manufacturer specifications are not taken into consideration during the planning process and noise standards deliberately exclude low frequency noise. This problem of turbulence is well known and is discussed in the CSIRO publication on wind resource assessment, Coppin, Ayotte and Steggel (2003).

We also wish to register our disagreement that installation of industrial scale wind turbines will "drought proof" farms. As demonstrated in some of the energy policy papers mentioned below that refer to industrial scale wind energy and its financing; the future of the wind industry and its returns are highly uncertain, irrespective of the numerous other potential problems for landholders, the community and the environment. Put simply, there are too many unanswered questions by the developers and scientifically proven negative impacts.

**Industrial wind energy development is not a sustainable landscape management practice and does not meet these principles.** Sustainable landscape management is presented in the CSIRO publication McIntyre, McIvor and Heard (2002), and this text also has a specific focus on endangered grassy woodland ecoregions. The most recent research on an 800,000-ha section of an internationally recognised NSW endangered ecoregion is presented in (Fischer et al 2009). These two references provide key information on biodiversity and endangered species with calls for new policy supporting sustainable farming practices to turn the region from *"ecological decline to ecological recovery"*. We believe that industrial wind energy developments will negatively effect any conservation efforts by individual farmers, community groups, and state and federal governments.

We conclude that industrial scale wind energy development is not a viable long term option for any farming or mixed farming enterprise. Big company bullying and poor government planning is putting regional and farming communities at risk.

We also would like to draw your attention to a recent announcement (attached) of a health investigation by Department of Human Services and Environmental Protection Authority in Western Victoria regarding possible health effects of wind farm generators.

We thank the committee for their attention during the Parliamentary Inquiry and allowing us time to make this supplementary submission. Annotated notes/references relating to our research and supporting documents are attached.

Sarah Last and David Burraston

## ANNOTATED NOTES/REFERENCES RELATING TO OUR SUPPORTING DOCUMENTS

The majority of the research references we have enclosed for the committee are published work from the last 5 years. This list is completely up to date and current, and refers to the current industrial wind turbine technology. In some cases research results were published as this inquiry was taking place. We are both trained academic researchers and have obtained information from a variety of sources such as peer reviewed journals, peer reviewed reports and peer reviewed conferences, court rulings, government testimonies and high quality independent web resources. Our research is ongoing and we will continue to make our results available to our neighbours and any other interested parties. This list of references represents only a partial list of our research to date, but we feel this is a comprehensive selection of the issues we have presented in our submission and our appearance at the Parliamentary Inquiry.

**GREENHOUSE GAS EMISSIONS ISSUES / VARIABILITY / INTERMITTENCY**

* Apt, J (2009) *"Testimony of Dr. Jay Apt"* Testimony to U.S. House of Representatives Committee on Energy and Commerce Subcommittee on Energy and Environment's Hearing on The American Clean Energy Security Act of 2009 "Panel on Low Carbon Electricity, Carbon Capture and Storage, Renewables and Grid Modernization" available online from the U.S. House of Representatives Committee on Energy and Commerce :

http://energycommerce.house.gov/Press_111/20090423/testimony_apt.pdf

Prof Jay Apt's testimony covers the poor emissions reduction of wind and in particular his groups research which shows that **natural gas back-up for wind energy produces more CO2 and much more NOx than they do when run steadily. He also reports on wind farms affecting climate downwind and reducing precipitation**

* Katzenstein, W & Apt, J, *"Air Emissions Due To Wind and Solar Power", Environmental Science & Technology* (2009) Vol 43 No 2 pages 253-258

The most recent (2009) research paper in the scientific journal *Environmental Science & Technology* which goes into great detail on the poor greenhouse gas reduction capability of wind power, and also presents research results showing increases in NOx emissions due to wind.

* Katzenstein, W & Apt, J, *"Incorporating Wind into a Natural-gas Turbine BaseloadPower System Increases NOx and CO2 Emissions from the Gas Turbines"*, (2008), Fifth Annual Carnegie Mellon Conference on the Electricity Industry, Future Energy Systems: Efficiency, Security, Control available on line at :

http://www.ece.cmu.edu/~electriconf/2008/PDFs/6-2%20Katzenstein%20and%20Apt.pdf

This presentation is an overview of their work detailed in the previous paper and makes particular note that :

- **1MWh of wind energy does not eliminate 1MWh of emissions**
- **Amount of emissions displaced by wind are overestimated**
- **Life Cycle Analyses does not account for wind's effect of decreasing the emission efficiencies of conventional fossil fuel generators**
- **Significant penetration of wind power will make it harder for Clean Air Interstate Rule (CAIR) to achieve emission reduction goals**

* Adams. T & Cadieux. F, (2009) *"Wind Power In Ontario: Quantifying The Benefits Of Geographic Diversity"* presented at the 2nd Climate Change Technology Conference, May 12-15 2009 which specifically looks at the aggregated output of multiple industrial wind power stations. Discusses poor smoothing of geographically dispersed wind. Available online at :

http://tomadamsenergy.com/?attachment_id=43

* Adams, T (2009) *"Transforming Ontario's Electricity Paradigm: Lessons Arising from Wind Power Integration"* Keynote Address for the Professional Engineers of Ontario Annual General Meeting May 9, 2009

Discusses grid failures due to wind, poor smoothing of geographically dispersed wind and higher volatile output swings due to wind. Available online at :

http://tomadamsenergy.com/wp-content/uploads/2009/05/keynote-for-peo-may-2009-transforming-ontario_s-power-system.pdf

* Lave, L, (2009) *"Testimony of Dr. Lester B Lave"*, Testimony to U.S. Senate Committee on Energy and Natural Resources February 10. 2009 available online from the Carnegie Mellon University Electricity Industry Center at :

http://wpweb2.tepper.cmu.edu/ceic/pdfs_other/Senate_testimony_Lave.pdf

Prof Lester B Lave's testimony covers the problems of Renewable Portfolio Standards. He points out that because people oppose both transmission lines and wind turbines, the role out of large scale wind energy will likely face delays of up to 10 years, particularly for transmission. He states that attempting to integrate more than 15% wind will be costly and compromise reliability. Wind is generally not available when demand is highest, and intermittency poses a challenge to grid stability when it is above 5% of total generation and requires fossil fuel backup. He gives an example of a study in Texas that showed wind farms producing almost no power in the windiest months. **He also reports on wind farms affecting climate downwind and reducing precipitation**

* Apt, J, Lave, L & Pattahariyankool, S (2008) *"A National Renewable Portfolio Standard? Not Practical"* Issues in Science & Technology 25, pages 53-59. Published by the National Academy of Sciences

Details the reasons that the Renewable Portfolio Standard (RPS) is bad idea because there are several other practical and less expensive ways to generate electricity with low CO2 emissions. In addition renewable resources such as wind are far from demand centers requiring unpopular and expensive transmission lines, doubling the cost of delivered power, increasing the time for development by several years, and casting doubt on the feasibility of building such extensive transmission lines. They also point out that there is already an 18 month waiting list for wind turbines, and **manufactures of wind turbines are now reducing their warranties from 5 years to 2 years.** Also discussed are the poor greenhouse gas emission reductions from wind energy due to fossil fuel back up requirements, variability, grid problems due to wind energy and the lack of any energy storage systems for wind. **Problems with local climate effects are also mentioned such as drying of soil and increase in temperatures.**

* Dobesova, K, Apt, J & Lave, L (2005) *"Are Renewables Portfolio Standards Cost-Effective Emission Abatement Policy?"*, Environmental Science & Technology 39, pages 8578-8583.

Discusses the problems of RPS with some particular references to the problems of wind energy. For example in the Texas grid the rapid build of wind energy has caused grid congestion. This resulted in the Electric Reliability Council of Texas (ERCOT) to request wind producers to "curtail" (i.e. dump and not use) the electricity generated by wind turbines. They give the example of 2002 where ERCOT requested curtailment of 380,000 MWh, 13% of wind generated electricity. **ERCOT then had to compensate wind producers with payments of US$9.1million for "the value of lost tax credits and renewable energy credits" and these costs were passed on to consumers.** All

this for electricity that was never even used and failed to deliver on its green promises. Consumers also paid extra costs due to new transmission lines to relieve congestion, as well as RPS administration. The curtailment fund was fully expended in both 2002 and 2003, and was fully expended in 2003 by April 2003.

* Liik, O, Oidram, R & Keel, M (2003) "*Estimation of real emissions reduction caused by wind generators*", International Energy Workshop 24-26 June 2003, IIASA, Laxenburg, Austria

Research paper investigating fuel economy and emissions reductions in power systems consisting of wind and thermal plant. Two notable quotes from the conclusions of the research :

*"Participation of thermal power plants in keeping the reserve capacity for wind turbines and in compensation of the fluctuations of wind power increases the fuel consumption and emissions substantially."*

*"Estonian case study shows that the integration of considerable capacity of wind turbines would increase the fuel consumption and emissions of thermal stations about 8-10%, which will reduce the environmental effect of windmills substantially. There can be situations where probably no environmental gain can be achieved at all."*

* White, D. (2004) "*Reduction In Carbon Dioxide Emissions: Estimating The Potential Contribution From Wind-Power*", Renewable Energy Foundation Report

http://www.ref.org.uk/PublicationDetails/27

Extensive report on the poor emissions reduction capability of wind energy commissioned by the Renewable Energy Foundation

* Oswald, J., Raine, M. and Hezlin, A., "*Will British weather provide reliable electricity?*" *Energy Policy* 36(8), August 2008, pages 3212-3225 available at : www.windaction.org/documents/18480

This recent paper by Oswald et al into the effectiveness and reliability of industrial wind turbine power demonstrates the poor ability of wind to produce reliable electricity, poor smoothing of wind output due to geographic diversity, highly volatile output energy swings, and the need for better carbon cost calculations for wind due to fossil backup emissions.

* Oswald Consulting (2006) *"25GW of Distributed Wind on the UK Electricity System"* Engineering assessment carried out for Renewable Energy Foundation and overview of results presented in the Oswald et al 2008 paper mentioned above. Available on line at :

www.ref.org.uk/Files/ref.wind.smoothing.08.12.06.pdf

* REF (2007) "Renewable Energy Data Technology Analyses: Wind 2006" Renewable Energy Foundation. Available on line at :

http://www.ref.org.uk/Files/wind.overview.2007.(ii).pdf

* REF (2008) "Renewable Energy Data Technology Analyses: Wind 2007" Renewable Energy Foundation. Available on line at :

http://www.ref.org.uk/Files/wind.overview.2008.pdf

The Renewable Energy Foundation publishes an analyses of the UK wind energy production on a yearly basis. These are comprehensive reports for 2006/7 containing all data in an easily digestible form, with good overviews of wind technology in their introductions.

* National Research Council of the National Academies. (2007) *Environmental Impacts of Wind-Energy Projects*; The National Academies Press: Washington, DC. Available on line at :

http://www.nap.edu/catalog.php?record_id=11935

It is important to note also that since this National Research Council report was published in 2007 there have been a number of important papers published on the further negative environmental impacts of wind energy. The report also does not cover human health effects in depth. However, it is a comprehensive and wide ranging report to 2007. One of the National Research Council authors, Rick Webb, has made the pre-publication version of this important report available for free on line at :

http://www.vawind.org/Assets/NRC/NRC_Wind.htm

Webb has also summarized his personal concerns regarding lack of emissions reductions in SO2 and NOx, and the cumulative impacts to wildlife, available on line :

http://www.vawind.org/Assets/Docs/Perspective/Key_Points_About_Wind_Development.pdf

and

http://www.vawind.org/Assets/Docs/Wishful-Thinking.pdf

* Poyry (2009) *"Impact of Intermittency: How wind intermittency could shape the electricity markets"* Summary Report, Poyry Energy Consulting.

This landmark study by Poyry Consulting has revealed for the first time how the electricity markets will be profoundly affected by the growth of wind energy and how ***"future markets with large amounts of wind will become completely dominated by the vagaries of the weather"***. It provides a unique insight into how the electricity sector in the UK and Republic of Ireland could look by 2030. The report findings have been presented to government organisations including the Department of Environment and Climate Change (DECC) as well as a number of high profile energy companies. Steering Committee members: Centrica, DONG Energy, EirGrid, ESBI, National Grid and RES. Data from the Meteorological Office and Met Eirann. The summary report is available on line at :

http://www.poyry.com/index_cases/index_cases_12.html

* Sharman, H (2009) "*Wind Energy: The case of Denmark*" CEPOS - Center for Politiske Studier

In depth study of wind energy in Denmark examining the real state-of-play, hidden costs and its effect on employment. The report shows that Denmark's special circumstances mean that its experience of wind energy is of little use in other countries. Denmark exports on average 57% of its wind generated electricity and their electricity is the most expensive in the European Union. The wind power exported saves neither fossil fuel consumption nor CO2 emissions. Substantial subsidies have resulted in a shift from more productive employment in other sectors to less productive employment in the wind industry. Available on line at :

http://www.cepos.dk/fileadmin/user_upload/Arkiv/PDF/Wind_energy_-_the_case_of_Denmark.pdf

* Hewson, T & Pressman, D (2009) *"Calculating wind power's environmental benefits"* Power Engineering, July 2009. Available on line at :

http://www.evainc.com/Publications/windpowerbenefit.pdf

* Hewson, T & Pressman, D (2009) "*Evaluation of Wind Power Avoided Emissions Benefits"* Energy Ventures Analysis, Inc. Available on line at :

http://www.northnet.org/brvmug/WindPower/Hewson.pdf

The above papers by Hewson and Pressman discuss lack of emissions reduction by wind energy.

* Lang, P, (2009) "*Cost and Quantity of Greenhouse Gas Emissions Avoided by Wind Generation"* available from Professor Barry Brook's site :

http://bravenewclimate.files.wordpress.com/2009/08/peter-lang-wind-power.pdf

Lang's paper is an analysis of the poor emissions reduction capability of wind energy.

* Miskelly, A and Quirk, T (2009) "*Wind Farming in South East Australia*" available on line at :

http://marvellousmelbourne.org/drupal/sites/default/files/Wind%20Farming%20in%20South%20East%20Australia.pdf
and the page presenting this paper is at :

http://marvellousmelbourne.org/drupal/?q=node/884

Miskelly and Quirk's preliminary study in Australia on existing industrial wind power stations shows that intermittency is happening in Australia. Their analysis is based on 11 industrial wind power stations spread across 900km in South Australia, New South Wales, Victoria and Tasmania for the month June 2009. The data is obtained from the publically available *Non-Scheduled Generation Data* at the AEMO

**DECOMMISSIONING**

* Hewson, T & Stamberg, J, (2008), *"Beech Ridge Energy LLC Financial Assurance Needs"*, Energy Ventures Analysis, Inc. Available on line at :

http://www.windaction.org/documents/23450

This document us the full Energy Ventures Analysis (EVA) decommissioning report on the **USD$10million** underestimate for the 124 turbine Beech Ridge development in the USA. All NSW developers are claiming that decommissioning is covered by scrap value, this report shows that this is not the case and a serious underestimation of the realities of decommissioning/site restoration. Cost estimates per turbine for decommissioning were **US$100,000** and ultimately the landholder is liable should funds not be available by the wind energy company. (Please refer to section 6 of our submission) The summary from EVA :

*"Tom Hewson of Energy Ventures Analysis, Inc. ("EVA") was hired by the citizen's group, Mountain Communities for Responsible Energy, to evaluate a Decommissioning Cost Report prepared for the Beech Ridge Energy Project - a 124-turbine project proposed for Greenbrier County, West Virginia.*

*The project wind developer, Invenergy, had argued that the scrap value of the wind turbines would far exceed the cost to decommission the wind project and thus, bonding only $2,500 per turbine that would slowly escalate to $25,000/turbine by year 16 would be more than adequate.*

*The applicant's consultant estimated that its salvage value credit would reach $12.64 million ($101,900/turbine) in their decommissioning fund study based upon application of general scrap factors and prices. This scrap value credit would more than offset their estimated demo costs ($8.68 million: $70,000/turbine).*

*EVA completed an independent assessment of the salvage value of the Beech Ridge Wind turbines by first contacting the major regional scrap yards directly and obtaining current scrap prices for steel, copper and transport. From these data, EVA developed a Beech Ridge project-specific salvage credit estimate of only $2.63 million, i.e., $10.01 million less than the original applicant study. They also uncovered several major flaws in the applicant study methodology and pricing. The developer not only used old scrap prices but failed to take into account costs related to transporting scrap to a yard. In addition, to obtain the posted scrap price, they would need to break down the tower into 3-4 ft length pieces else the quoted price would be significantly less. In addition, the copper materials must also have their insulation stripped and/or copper pieces separated to obtain their posted copper price. If not, their scrap value would be far less than the common posted price. Given the large drop in scrap prices in recent years (>40%), EVA found that scrap value would no longer cover decommissioning costs.*

*EVA also compared the estimated demolition costs to another decommissioning report for another wind project developer that had contained detailed cost breakdowns. The other study estimated demo costs of $97K/turbine vs. $70K/turbine by Beech Ridge. Using the demolition costs from the other wind turbine project decommissioning study would translate to a Beech Ridge demo cost of $12.03 million, i.e., $3.35 million more the applicant's $8.68 million estimate. (Note: In another very recent project EVA*

*had reviewed, the decommissioning costs were again severely underestimated by more than 50% by not taking into account recent crane rental rates, assuming extremely low earth moving costs, and assuming high productivity rates (6 turbines/wk).)*

*The bottom line is that even if the permitting agency allows the salvage credit, the total net cost of decommissioning the Beech Ridge project today would be $10.4 million ($83,900/turbine). EVA's analysis quantified the large scrap price and demo cost escalation risk being assumed by the local community. To protect the community, the permitting agency should require a bond of a minimum $100K/turbine ($12.4 million) to capture demolition cost escalation risk. If the wind developer can convince the bonding company of the high salvage value, then they should be able to negotiate a lower rate for the bond. If they were right, there would be very little price difference for a larger $12+ million bond. EVA encourages shifting the risk to the bonding company. The developer and bonding company should assume the price risk and not the community."*

* Brown, R (2009) "*Appeal of Maine final order, Record Hill Wind LLC*", State of Maine Board of Environmental Protection re : Record Hill Wind Project. Available on line at :

http://www.windaction.org/documents/23278

Appeal filed by the Concerned Citizens to Save Roxbury ("CCSR") regarding the 22 industrial scale turbine proposal in Roxbury, Maine. The full appeal includes testimony filed by sound expert, Richard James. Also includes objections to the **Decommissioning Plan** and makes note of the fact the fact the **Deerfield** ruling disallowed a deduction for scrap value, see pages 31 to 33 in part 2 of the PDF documents.

* Comfrey Wind Energy, LLC, (2007) "*Docket Number: IP6630/WS-07-318 Decommissioning - Estimated Cost and Funding Analysis for Comfrey Wind Energy – REVISED, page 31a*", Minnesota Dept. of Commerce. Energy Facility Permitting, Siting and Routing

This decommissioning report submitted on 1st August 2007 is the estimated costs by Comfrey Wind Energy for fifteen Suzlon S88 2.1MW wind turbines, hub height 80m and rotor diameter 88m. Total estimated cost to dismantle & remove turbine per unit without scrap value is **US$154,000.** No other infrastructure dismantling costs were submitted in this report.

* State Of Vermont Public Service Board (2009) *"Docket No. 7250, Section VI Decommissioning Fund"*, pages 91-96. Available on line from Government of Vermont website at :

http://www.state.vt.us/psb/orders/2009/files/7250finalorder.pdf

Some excerpts from the ruling relating to decommissioning:

Finding 331. *"The establishment of a fund to decommission the Project is necessary in the event the Project does not succeed, or to ensure its timely and permanent removal at the end of its useful life."*

Finding 331. *"Salvage value for scrap is vulnerable to market price volatility and thus should not be considered a reliable funding source for decommissioning the Project. The amount placed in the decommissioning fund should represent the full estimated costs of decommissioning without netting out estimated salvage value."*

**HEALTH PROBLEMS**

* Health Canada (2009) "*Health Canada's response to the Digby Wind Power Project Addendum, Digby, Nova Scotia*", Safe Environments Program, Regions and Programs Branch, Health Canada. Available on line at :

http://www.wind-watch.org/documents/health-canada's-response-to-the-digby-wind-power-project-addendum-digby-nova-scotia/

Document requested by Nova Scotia Department of Environment for Health Canada to review the project with respect to human health. Health Canada reviewed the project report and commented on noise and health issues, and highlighted misleading statements by the developer. In particular regarding health effects they specifically remark :

*"The final sentence in Appendix B states that "there is no peer-reviewed scientific evidence indicating that wind turbines have an adverse impact on human health". In fact, there are peer-reviewed scientific articles indicating that wind turbines may have an adverse impact on human health. For example, Keith et. al. (2008), identified annoyance as an adverse impact on human health that can be related to high levels of wind turbine noise. In addition, there are several articles by Pedersen (and others) related to wind turbine annoyance (as referenced below). The relationship between noise annoyance and adverse effects on human health is also further investigated in the manuscript by Michaud et. al (2008).*

- *Health Canada advises that this statement be revised to indicate that there are peer-reviewed scientific articles indicating that wind turbines may have an adverse impact on human health.*

*References:*

*Howe Gastmeier Chapnik Limited (HCG Engineering). 2006. Environmental Noise Assessment Pubnico Point Wind Farm, Nova Scotia. Natural Resources Canada Contract NRCAN-06-00046.*

*Keith, S. E., D. S. Michaud, and S. H. P. Bly. 2008. A proposal for evaluating the potential health effects of wind turbine noise for projects under the Canadian Environmental Assessment Act. Journal of Low Frequency Noise, Vibration and Active Control, 27 (4): 253-265.*

*Michaud, D., S. H. P. Bly, and S. E. Keith. 2008. Using a change in percentage highly annoyed with noise as a potential health effect measure for projects under the Canadian Environmental Assessment Act. Canadian Acoustics, 36(2): 13-28.*

*Pedersen, E., and Halmstad, H. I. 2003. Noise annoyance from wind turbines – a review. Swedish Environmental Protection Agency, Report 5308.*

*Pedersen, E. and Persson Waye, K. 2008. Wind turbines – low level noise sources interfering with restoration? Environmental Research Letters, 3: 1-5.*

*Pedersen, E., and Persson Waye, K. 2007. Wind turbine noise, annoyance and selfreported health and wellbeing in different living environments. Occup. Environ. Med. 64: 480-486.*

*Pedersen E. and Persson Waye, K. 2004. Perception and annoyance due to wind turbine noise – a dose-response relationship. J. Accoust. Soc. Am. 116: 3460-3470.*

*World Health Organization (WHO). 1999. Guidelines for Community Noise. Eds. B. Berglund, T. Lindvall, D. H. Schwela. WHO: Geneva.*

*Van den Berg, F., Pedersen E., Bouma, J., and R. Bakker. 2008. Project WINDFARMperception. Visual and acoustic impact of wind turbine farms on residents. FP6-2005-Science-and-Society-20 Project no. 044628: 1-99*

* Pedersen, E, (2007) "*Human response to wind turbine noise - perception, annoyance and moderating factors*", Doctoral Thesis (Medicine) Inst of Medicine. Dept of Public Health and Community Medicine, Göteborg University. Sahlgrenska Academy, Sweden. Available on line at :

http://gupea.ub.gu.se/dspace/handle/2077/4431

The PhD thesis of Dr. Pedersen is a culmination of a number of papers including those cited above by Health Canada and reports key findings on negative health risks of industrial wind turbine noise.

* Minnesota Department of Health Environmental Health Division (2009) "*Public Health Impacts of Wind Turbines*" Report requested by Minnesota Department of Commerce Office of Energy Security May 22, 2009. Available on line at :

http://www.windaction.org/documents/21436

Health report "white paper" evaluating possible health effects associated with low frequency vibrations and sound arising from large wind energy conversion systems (LWECS).

* McMurtry et.al. (2009) "*Community-based health survey, Ontario*" Report for Wind Concerns Ontario. Available on line at :

http://www.windaction.org/documents/22261

*"This community based surveillance activity was conducted under the guidance of Dr. Robert McMurtry, the Former Dean of Medicine at the University of Western Ontario. The health survey revealed that out of 76 respondents, 53 people now living near different wind power facilities in Ontario reported that industrial wind turbines were having a significant negative impact on their lives. The adverse effects range from headaches and sleep disturbance to tinnitus (ringing in the ear) and depression."*

Some excerpts from the abstract of the report gives a summary of the responses to the survey :

*"It is now emerging that whenever industrial wind turbines have been located near peoples' homes, family members are reporting adverse health effects. Some of these families have been forced to abandon their homes in order to protect their health. This phenomenon is occurring world wide, not just in Canada."*

*"Researchers and victims have reported altered living conditions, loss of enjoyment of homes and property, and ill health as a result of industrial wind turbines. The adverse health reports are consistent globally and across 3 continents."*

*"Major wind turbine projects were launched in 2006 in Ontario and within a short time, reports about ill health started to appear. In January, 2009, Wind Concerns Ontario solicited volunteers to conduct a health survey. Distribution of the community-based self reporting health survey started in March 2009.*

*The findings of the health survey were presented on April 22, by Dr. Robert McMurtry, former Dean of Medicine at the University of Western Ontario, to the Ontario Government's Standing Committee while it was examining Bill 150, the Green Energy Act. With the efforts of volunteers and a nominal budget from donations, the health survey revealed that out of 76 respondents, 53 reported at least one adverse health effect they suspect is related to industrial wind turbine exposure. The average number of symptoms per individual reported was 5.*

*The health survey is ongoing and as result the number of 53 victims has since risen to 86 as responses continue to be submitted.*

*Sleep disturbance was the most common complaint. Other health complaints include inner ear problems, mood disturbances, cardiac arrhythmias, and headaches. Several suffered acute hypertensive episodes which are most serious and worrisome.*

*Comments provided by respondents are both revealing and disturbing. No authority or compassionate member of our society can ignore the moving descriptions of the victims' experiences. They describe disturbed living conditions, loss of quality of life and enjoyment of their home and property, financial loss and the negative impact to the health of their families, including children. These comments are included in this report.*

*This community-based self reporting survey fills a void regarding the lack of a Canadian vigilance and surveillance program for industrial wind turbines. The willingness of the victims to participate in the survey serves to reinforce the critical need for a robust vigilance program which encourages victims to self report suspected adverse health effects from these industrial wind turbines. In addition, long term surveillance is required. There are unanswered questions about infants, children, and the unborn whose mothers are exposed, family members and workers such as farmers and technicians who live and work in close proximity to the wind turbines.*

*When uncertainty exists and the health and well-being of people are potentially at risk, it is appropriate to invoke the precautionary principle. Until these authoritative guidelines are put in place based on the best available evidence, the Province of Ontario ought not to proceed with any further development of industrial wind turbines.*

*The development of these guidelines must be based on a rigorous epidemiological evaluation of the adverse health effects of industrial wind turbines."*

* Pierpont, N, (2006) "*Wind Turbine Syndrome*" Testimony before the New York State Legislature Energy Committee March 7, 2006. Nina Pierpont MD, PhD has done extensive research into the health effects of industrial scale wind turbines. This work has received world wide attention. Available on line with numerous other papers / reports and a draft of her forthcoming book :

http://www.windturbinesyndrome.com

* Nissenbaum, M (2009) *"Affidavit of Michael A. Nissenbaum, M.D."* State of Maine Board of Environmental Protection re : Record Hill Wind Project. Available on line at :

http://www.windaction.org/documents/23332

Affidavit by Dr. Michael Nissenbaum submitted in support of an appeal filed with Maine's Board of Environmental Protection against a proposed project that will include 22 industrial scale turbines sited in Roxbury, Maine. Dr. Nissenbaum asserts that industrial wind turbines can cause adverse effects on human health.

* Northern Maine Medical Center (2009) "*Health Concerns and the Need for Careful Siting of Wind Turbines*" Press Release March 4, 2009

Medical Staff of Northern Maine Medical Center unanimously approved this press release and requested a moratorium on "wind farm" developments. Three excerpts from this press release :

*"We echo the concerns of the Medical Staff of Rumford Community Hospital as regards an increasing body of literature and reports from Canada, the USA, and particularly from Europe suggesting that the deployment of industrial wind facilities in close proximity to places where people live, work or attend schools results in negative health effects, including and especially sleep deprivation and stress."*

*"These effects arise not only from audible noise frequencies but also from persistent inaudible low frequency noise waves of a cyclical nature which are felt, but not heard. There are a growing number of scientific observations and studies suggesting that people living up to 2 miles away from these industrial wind farms may be affected."*

*"In light of these growing, serious medical concerns, we propose a moratorium on the building of any such "wind farms" until more research is done on the health impact that such facilities will have on the communities surrounding such technology. These communities and the Maine DEP and Health Services must be allowed time to study and learn from the European and Canadian experiences, as well as from the many affected families in Mars Hill, Maine, and put into place appropriate regulations and ordinances, prior to expanding the wind industry in the State of Maine."*

* Hanning, C, (2009) "*Sleep Disturbance and Wind Turbine Noise*" Self published (June 2009) available on line at :

http://www.windaction.org/documents/22602

Hanning's is one of the most recent health reports pertaining to sleep disturbance from industrial wind turbines. Dr Christopher Hanning MD founded, and until retirement, ran the Leicester Sleep Disorders Service, one of the longest standing and largest services in the United Kingdom, and has 30 years of experience in the field.

* Phipps, R (2007) *"Evidence of Dr Robyn Phipps in the matter of the Moturimu wind farm application*", Testimony before the Joint Commissioners in the Matter of the Moturimu Wind Farm Application, New Zealand. Available on line at :

http://www.windaction.org/documents/14619

Extensive testimony by Dr Robyn Phipps and evidence presented of a **peer reviewed** survey of visual and noise effects experienced by residents living near the Taraua and Ruahine ranges wind farms. **Of the households surveyed in the analysis 80% considered that the wind turbines were intrusive and 73% thought that they were unattractive. Over 52% of households located between 2 to 2.5km and 5 to 9.5km heard wind turbine noise, and 25% could hear wind turbine noise greater than 10km from the wind farm.** There are many more disturbing findings in this survey.

* Harding, G, Harding, P and Wilkins, A (2008) "*Wind turbines, flicker, and photosensitive epilepsy: Characterizing the flashing that may precipitate seizures and optimizing guidelines to prevent them*" Epilepsia 49(6) pages 1095-1098

* Castelo Branco NAA, Alves-Pereira M. (2007) "*In-Home Wind Turbine Noise Is Conducive to Vibroacoustic Disease*", Second International Conference on Wind Turbine Noise, Lyon, France.

The definitive paper on Vibroacoustic Disease (VAD) as a result of exposure to low frequency wind turbine noise pollution.

* Castelo Branco NAA, Alves-Pereira M. (2004) "Vibroacoustic disease", *Noise & Health* 2004; 6(23): pages 3-20

* Alves-Pereira, M & Branco, N (2007) "*Industrial Wind Turbines, Infrasound and Vibro Acoustic Disease (VAD) PRESS RELEASE*", May 31, 2007 Center for Human Performance, Portugal. "*The Center for Human Performance is a civilian, non-profit organization dedicated to research in vibro-acoustic disease. CPH was founded in 1992 and has been the organization which coordinates all the different teams that work on vibro-acoustic disease research, and that include (in Portugal) the cardiology and pulmonary departments of the Cascais Hospital, the neurophysiology department of the National Institute of Cancer, the department of human genetics of the National Institute of Public Health, the department of speech pathology of the School of Health Sciences of the Polytechnical Institute of Setúbal, among several others over the past 25 years.*"

A brief excerpt from the VAD press release :

*"These results irrefutably demonstrate that wind turbines in the proximity of residential areas produce acoustical environments that can lead to the development of VAD in nearby home-dwellers."*

**WIND TURBINE NOISE POLLUTION**

* James, R (2008) "*Testimony before Wellington City Council RE: noise at Meridian Energy wind project proposal*" Available on line at :

http://www.windaction.org/documents/18014

Expert testimony of Richard James to Wellington City Council on 2nd September 2008 in regard to modeled noise predictions for a Meridian Energy Ltd. wind energy facility in New Zealand. Covers real measurements, computer modeling, dBA and dBC, WHO, Appendix includes some of his co-authored papers including his Noise-Con 2008 paper with Kamperman.

* Kamperman, P & James, R (2008) "*The 'how to' guide to criteria for siting wind turbines to prevent health risks from sound*", V2.1 published by Industrial Wind Action. Available on line at :

http://www.windaction.org/documents/17229

Community noise experts George W. Kamperman and Richard R. James present guidelines for siting industrial wind turbines. This paper focuses on preventing health risks due to sound emissions from the turbines. This paper offers important background information that should be read by all those involved in the siting and approving of wind energy facilities.

* Kamperman, P & James, R (2008) "*Simple guidelines for siting wind turbines to prevent health risks*", 2008 International Noise Conference (Noise-Con), Dearborn, Michigan. Available on line at :

http://www.windaction.org/documents/17095

Reviews sound studies conducted by consultants for governments, wind turbine owners, and local residents for a number of sites with known health or annoyance problems. The purpose is to determine if a set of simple guidelines using dBA and dBC sound levels can serve as the 'safe' siting guidelines.

* Frank H. Brittain, F & Hale, E (2008) "*Some limitations of ray-tracing software for predicting community noise from industrial facilities*", 2008 International Noise Conference(Noise-Con), Dearborn, Michigan. Available on line at :

http://www.windaction.org/documents/18087

This paper covers limitations and problems with the sound propagation standard (ISO 9613-2). This standard model is used for noise assessment studies in the NSW environmental assessments. **A key point with relation to wind energy developments**

**is that the ISO 9613-2 model can give no estimation of its own accuracy beyond 1km, yet it is routinely used for distances exceeding 1km.**

* Van den Berg, G. P. (2006) "*The Sounds of High Winds: the effect of atmospheric stability on wind turbine sound and microphone noise*" PhD thesis available online :

http://dissertations.ub.rug.nl/faculties/science/2006/g.p.van.den.berg/

* Van den Berg G.P. (2004) "Effects of the wind profile at night on wind turbine sound", *Journal of Sound and Vibration* 277 (4-5), pages 955-970.

* Van den Berg G.P. (2007) "Wind profiles over complex terrain." *Second International Conference on Wind Turbine Noise, Lyon, France.*

The research of van den Berg shows that there are significantly higher levels of noise pollution at night than are experienced in the daytime, and the effects of complex terrain such as hills are different to flat terrain. Sound levels can be up to 15dB higher at night relative to the same reference wind speed in daytime. These papers also discuss the flawed methodology of wind induced microphone noise during background sound monitoring.

Vestas (2009) "*General Specification V90 – 1.8/2.0 MW 50Hz OptiSpeed – Wind Turbine",* Vestas Wind Systems A/S

Specification document from Vestas for the V90 wind turbine, specifically referred to on Pages 2 and 3 at the start of this supplementary submission regarding turbulence and its effect on noise. The V90 also has an operating temperature range from -20C to only +30C.

**PROPERTY DEVALUATION**

* Gardner, T (2009) "*Impact of wind turbines on market value of Texas rural land*", South Plains Agriculture Wind & Wildlife Conference in Lubbock, Texas.

Discusses the **reduction of property values for landholders hosting turbines, as well as properties in the surrounding areas of such developments.**

* Luxemburger, C (2008) "*Living with the impact of windmills*", Self Published

Chris Luxemburger is a real estate broker, director of the Brampton Real Estate Board and the Chairperson of the Real Estate By-Laws Committee in Ontario, Canada. In this survey of three-year sales records for the Melancthon Wind Plant and surrounding area, Luxemburger found significant differences among 600 properties within and beyond three nautical miles of the plant. Those in proximity to wind turbines had either a higher rate of non-sale (11% vs. 3%) or took twice as long to sell.

## LOCAL METEOROLOGICAL & CLIMATE IMPACTS

* Baidya Roy, S, & Pacala, S. (2004) *"Can large wind farms affect local meteorology?"*, Journal of Geophysical Research, Vol 109, D19101 Available on line at :

http://www.atmos.uiuc.edu/~sbroy/publ/jgr2004.pdf

Research paper looking at effect on local meteorology of large scale wind farms. The results showed that wind farms significantly slow down the wind at turbine hub-height and create additional turbulence. The effect leads to a warming and drying of the surface air.

* Keith, D et al. (2004). *"The influence of large-scale wind-power on global climate."* Proceedings of the National Academy of Sciences, **101**: 16115-16120. Available on line at :

http://www.ucalgary.ca/~keith/papers/66.Keith.2004.WindAndClimate.e.pdf

Research paper examining the effect of industrial scale wind turbines on changing global climate due to "slowing" the wind by extracting kinetic energy. This paper also reported on the effect of wind producing local climate change, and the need for more research on these effects.

Professor Keith has stated on his website that : "significant *local* climate change could occur in areas where wind farms are concentrated even if wind supplies a small fraction of global electricity demand." (his emphasis)

* Kirk-Davidoff, D & Keith, D. (2008) "*On the climate impact of surface roughness*", (2008). Journal of Atmospheric Sciences, 65: 2215-2243. Available on line at :

http://www.ucalgary.ca/~keith/papers/94.Kirk-Davidoff.SurfaceRoughnessJAS.p.pdf

Kirk-Davidoff & Keith's research paper demonstrating that "large-scale deployment of wind power may alter climate through alteration of surface roughness".

## ECONOMIC / ELECTRICITY MARKET

* Bolinger, M & Wiser, R (2009) "*Wind Power Price Trends in the United States: Struggling to Remain Competitive in the Face of Strong Growth*", Energy Policy 37 pages 1061-1071

Research paper discussing how rising costs in materials, energy used to manufacture wind turbines and currency weaknesses threaten to hamper future growth of wind energy. Long term historical trends demonstrate that recent cost pressures and rising costs impact on wind energy's competitiveness. The paper details the boom-and-bust cycle that characterized the wind market from 1999 through to 2004, and discusses the **uncertainty** in the wind marketplace. The volatility and increasing costs of wind turbines are also discussed, as turbine prices have doubled on average since 2002, and in 2008 transaction prices have ranged fro US$900/kW to a high of US$1960/kW. Installed project costs are also rising steadily since 2004, in 2006 they were 35% higher and in 2008 they were 20% higher than 2007. Average project costs in 2008 have increased

since the 2001 – 2004 period by 62%. These costs will have to be recovered through higher sales prices. The project prices would be even higher without access to state and federal incentives, and therefore the real cost of wind generation is much higher. Wind power projects being built from 2008 onwards are expected to continue to rise in cost, with expected costs in 2009 to be up to US$2250/kw. **This research suggests that there is great uncertainty in wind power costs and prices.**

* Glachant, J (2009) "*Large-scale Wind Power in Electricity Markets*", Energy Policy Editorial.

Editorial piece on the unique future challenges faced by integrating large-scale wind generation such as limited dispatchability, variability in generation, difficulty in forecasting resource availability and geographic location of wind resources. The insertion of large-scale wind power will effect market participants and result in more volatile electricity prices. The long term impact requires careful study and extensive research is still needed in many areas.

* Newbery, D (2009), "*Market Design for a Large Share of Wind Power*", Energy Policy Editorial.

Editorial piece discussing the challenges that the electricity markets face with a large share of wind power. Volatile prices, coupled with low load factors for backup generation will likely lead to a compromised security of supply. Discusses some of the **risks and uncertainty** involved in wind generation.

**WILDLIFE**

* Fry, D, / American Bird Conservancy (2007) Testimony of Donald Michael Fry, PHD. *The House Subcommittee on Fisheries, Wildlife and Oceans Oversight Hearing on: "Gone with the Wind: Impacts of Wind Turbines on Birds and Bats."*

Extensive testimony from the Director, Pesticides and Birds Program of the American Bird Conservancy. States the failure of collaborative efforts to address impacts of wind projects on birds and wildlife. Draws attention to the virtually nonexistent federal and state monitoring of wind energy projects. States that bird populations are at great risk, especially birds of prey and grassland songbirds. Calls for greater research and the need to answer many unanswered questions. Calls attention to the fact that many of the birds affected are already declining species, **so mortality at wind farms is significant**.

* Carrete, M et al (2009) "*Large Scale Risk-Assessment of Wind-Farms on Population Viability of a Globally Endangered Long-Lived Raptor*", Biological Conservation doi:10.1016/j.biocon.2009.07.027

Recent research paper looking at effects of wind turbines on endangered long-lived raptors. Calls for more research on long term effects of wind farms on wildlife populations. Research in this particular study shows that wind farms decrease survival rates and hence **significantly increases extinction probability**. This research also suggests that short term monitoring of wildlife impacts is not adequate to assess actual impacts of wind farms on wildlife. The negative effects of wind farms could result in **major impacts** in a few decades and jeopordize wildlife conservation worldwide.

**Requests that turbines in risk zones should be located further than 15km away from nests.**

* Baerwald et al (2008) "*Barotrauma is a Significant Cause of Bat Fatalities at Wind Turbines*" Current Biology Vol18 No.16 pages R695-R696

Confirmation that bats are being killed in large numbers from barotraumas caused by rapid air pressure reduction near wind turbine blades.

* Arnett, E, (2006) "*A Preliminary Evaluation on the Use of Dogs to Recover Bat Fatalities at Wind Energy Facilities*", Wildlife Society Bulletin 34(5) pages 1440-1445

Postconstruction carcass searches for bats are used to estimate fatality rates at wind energy facilities. Due to variation in detection by human searchers fatality rates can be underestimated. This study evaluated the use of dog handler teams at wind farms to conduct carcass searches. In the trials it was found that dog handler teams fared better than just humans at locating carcasses. This research recommends further study on the use of dogs to recover carcasses.

* Arnett, E, et al (2008) "*Patterns of Bat Fatalities at Wind Energy Facilities in North America*", Journal Of Wildlife Management 72(1) pages 61–78

Widespread and extensive fatalities of bats have caused increasing concern about the impacts of wind farms on bats as well as other wildlife. This paper presents an overview of the research in North America on bat fatalities to date.

* Kunz, T et al (2007a) "*Ecological Impacts of Wind Energy Development on Bats: Questions, Research, Needs, and Hypotheses*", Frontiers in Ecology and the Environment Vol 5 No:6 pages 315-324

Summarises evidence about bat fatalities at wind farms in the USA. Identifies future research needs to help minimize adverse effects of wind energy development. Calls for future research to identify sites with highest adverse environmental impacts. Calls for policy framework requiring owners and developers to provide access and research funds for research and monitoring.

* Kunz, T et al (2007b) "*Assessing Impacts of Wind-Energy Development on Nocturnally Active Birds and Bats: A Guidance Document*", Journal of Wildlife Management 71(8) pages 2449–2486

Guidance paper for researchers, consultants, decision-makers, and other stakeholders for methods and metrics for investigating nocturnally active birds and bats in relation to utility-scale wind-energy development.

* Kuvlesky, W et. al. (2007) "*Wind Energy Development and Wildlife Conservation: Challenges and Opportunities*", Journal of Wildlife Management 71(8) pages 2487-2498

Covers many aspects of wildlife issues including; collision mortality, habitat loss, habitat alteration, and some of the future research needs.

**GREEN JOBS MYTH / RENEWABLES BUBBLE**

* Álvarez, G, Jara, R, Julián, J & Bielsa J (2009) "*Study of the effects on employment of public aid to renewable energy sources*" King Juan Carlos University Study, Spain. Available on line at :

http://www.juandemariana.org/pdf/090327-employment-public-aid-renewable.pdf

Dr. Gabriel Calzada, an economics professor at Juan Carlos University in Madrid, shows that for Spain the "green employment opportunity" has proven elusive and unsustainable. For every "green job" artificially created there 2.2 jobs lost elsewhere in the economy.

* Morriss, A. P., Bogart, W. T., Dorchak, A., Meiners, R. E. (2009) *"Green jobs myths"* University of Illinois Law & Economics Research Paper No. LE09-001 & Case Western Reserve University Research Paper Series No. 09-15 March 12, 2009

This 97 page University of Illinois Law & Economics Research Paper authored by Professor Andrew P. Morriss, Professor William T. Bogart, Andrew Dorchak and Distinguished Professor Roger E. Meiners contains an extensive survey and analysis. This research shows how the special interest groups promoting the idea of green jobs have embedded dubious assumptions and techniques within their analyses. Available on line at :

http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1358423

* Álvarez, G (2009) "*Testimony Of Gabriel Calzada Álvarez, Phd*" Before The Committee On Environment And Public Works Hearings On "Climate Change And Ensuring That America Leads The Clean Energy Transformation" August 6, 2009 Available on line at :

http://www.instituteforenergyresearch.org/pdf/Calzada%20EPW%20Testimony%20Aug%206%202009.pdf

* Álvarez, G (2009) "*Testimony Of Gabriel Calzada Álvarez, Phd*" Testimony Before The House Select Committee On Energy Independence And Global Warming September 24, 2009 Washington, DC. Available on line at :

http://globalwarming.house.gov/files/HRG/092409Solar/calzada.pdf

Testimonies by the lead author Dr. Gabriel Calzada of the Spanish study on green jobs cited above.

**SUSTAINABLE FARMING**

* Fischer, J., Stott, J., Zerger, A., Warren, G., Sherren, K., Forrester, R. (2009) *"Reversing a tree regeneration crisis in an endangered ecoregion"*, Proceedings of the National Academy of Sciences USA 105, 10386-10391. Available on line at :

http://www.pnas.org/cgi/doi/10.1073/pnas.0900110106

Covers the current crisis in NSW and examines an 800,000-ha internationally recognised endangered ecoregion of NSW. Presents sustainable farming practices and calls for new policy supporting sustainable practice.

* McIntyre, S., McIvor, J. and Heard, K (Eds), (2002) *"Managing and Conserving Grassy Woodlands"*, CSIRO Publishing

Extensive CSIRO text on endangered grassy eucalypt woodland of Australia. Covers key areas such as biodiversity, sustainable practice, application principles and ecological concepts. Key text for regional planning, landcare, land management, research and on-ground application. A key section of note in this book is on p178 "Adoption of new practices – some issues" which explains conflicts between new practices and sustainable management. Web page relating to the book :

http://www.csiro.au/resources/ps1fs.html

**TURBULENCE**

* Coppin, P. A., Ayotte, K.A. and Steggel, N. (2003) "Wind Resource Assessment in Australia – A Planners Guide, CSIRO Publishing. Available on line at :

http://www.csiro.au/resources/pf16q.html

Covers terrain aspects relating to turbulence and effects on turbines p47-48.