31 JAN 2011

Flat Rocks Wind Farm Planning Submission

PO Box 88

Kojonup

Phone 98311657.

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SHIRE OF KOJONUP					
FILE:	DB.BDA.8				
CEO	MCS	MRCS	WM	COPO	PB
HR	SFO	NRSM	SHM	PLAN	

Mr Steve Gash

Chief Executive Officer

Kojonup Shire

Kojonup

Dear Steve and councillors,

I would like to take the opportunity to make comments to your Shire Council on the proposed wind farm at Flat Rocks.

We have three properties that are interwoven into the proposed wind farm, two that sit in between the proposed turbines and one that is on the northern boundary. We were offered the opportunity to be involved in hosting a significant number of turbines but declined that and subsequent increased offers on the following grounds.

- The loss of visual amenity.
- The impact on neighbouring land values.
- The strong evidence of significant health issues.
- The impact on land based and aerial spraying operations.
- The serious rifts that might emerge at a community level.

I would like to take the opportunity to expand on the points above, provide some material to support my concerns as well as offer my preferred view on what might be your council's response to this planning application.

Yours Sincerely,

Roger Bilney

For and on behalf of Roger, Maree, Adrian, Nadine, Matthew and Bradley Bilney.

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Attachments

1 "The Great Wind Rush" printed in the Australian on Nov 27th 2010.

2 Aerial Agricultural Association of Australia submission to the senate inquiry.

#3 Illinois Agricultural Aviation Association view on the effects of wind farms.

#4 Eyre Peninsula Local Government Association submission to the Senate Inquiry.

#5 Energy Tree Crops.

#6 Nine pages from the Dean report.

7 CD containing ABC Stateline Victoria program Feb 19 2010.

8 Dr Sarah Laurie's letter to Premier John Brumby.

9 Shane McIntrye Elders National Sales Manager - Re Land Values.

Electricity production and renewable energy sources

I have included the following section in an attempt to show that the cost of energy produced and the green house gas emission reductions claimed for wind farms are not as clear cut as we might think. The rapid expansion of wind farms is not being caused by the economic and social benefits that they might bring, but rather the Renewable Energy Target and its subsequent subsidies.

On August 20 2009 the Federal Renewable Energy Target (RET) legislation was passed, requiring that by 2020 electricity retailers and large industrial users purchase 20% of their electricity from renewable sources. They propose to achieve this through Renewable Energy Certificates(REC), provided by government to certified renewable energy producers. These certificates are then required to be bought by electricity retailers and large industrial users of electricity. A single REC is given for every Mega Watt hour (MWh) of energy produced by wind turbines whilst five are available for small domestic solar systems. The subsidies on installation and generous feed-in tariffs (47cents / KWh versus the 7 cents / KWh cost of Verves thermal generation) for domestic solar appliances has in recent times caused the price of renewable energy certificates to collapse as the number available out paces the number that industry needs to buy.

The amount of renewable energy produced in WA is at present approximately 4.5% of total capacity rising to 9% when the wind farm at Merredin comes into production. Given the average cost per MWH of $70 for coal and gas in WA, versus $130 per MWh cost attributed to wind generation, the renewable energy target of 20% by 2020 will lead to significant tariff increases. The higher cost of wind generation comes from the high capital cost of construction site costs, maintenance and grid connection costs, all of which, along with the developer's profit, need to be recovered during the 20 year life of the turbines.

Intermittent generators (wind and solar) can create problems for grid security and stability, which the publicly owned Verve Energy is required by legislation to manage. This management is a process known as balancing where generators are either shut down or ramped up to continuously match

supply with demand. During moments of oversupply the reduced load on the generators will allow them to spin too fast causing a rise in the frequency of the current, and vice versa, when the load increases the generators will spin more slowly . There are set parameters either side of the standard 50 Hertz which if exceeded will cause tripping in the grid system. At the moment, wind farms are allowed to spill their production into the grid system at any time and at any level at no cost to themselves. The cost of this balancing is estimated to be between $6 and $60 per MWh of electricity produced, which currently is borne by all market participants. Balancing is presently done with coal as gas is too expensive, which means that the level of CO_2 emissions reduction claimed by wind farms is lowered due to the increased inefficiencies of the coal and gas fired generators. **There are currently discussion papers being reviewed which advocate that the true cost of balancing be passed back to wind farm operators, a move which will seriously alter the viability of present and future wind farms.**

The unpredictable nature of wind farms also causes problems for the Independent Market Operator (IMO) to accurately understand the total capacity of the generators on a given day. The scheduled generators bid for capacity credits, related to their ability to produce electricity at any given moment, which if they fail to deliver when asked to, may in fact incur a fine. Intermittent generators on the other hand can offer no such security so the IMO gives them a capacity factor, which on the East coast is as low as 30 % of their total rated output. The present operating wind farms in WA (Merredin is still under construction) are all situated quite close to the coast where the wind resource is at its best, have a slightly higher capacity factor at 35 % or more. However it is fair to say that the project at Kojonup will have a lower level of capacity being so far from the coast and with uneven topography. The poorer wind resource away from the coast creates the need for inland wind farms to be significantly larger to achieve capacities comparable to coastal turbines. This results in greater community impact with regard to health and visual concerns as is witness by the problems created in Ballarat with the Waubra wind farm, one of the largest in the southern hemisphere.

There is little debate about the need for renewable energy sources, but with Government subsidies comes the need to ensure that these

monies are invested in an appropriate place and manner. I would urge that at this early stage of renewable energy development, time is taken to ensure the most suitable generation system is put in place in the Great Southern rather than grasping the first project that comes along. ***I reiterate that it is my firm view that this project is driven by the quest for subsidies and profit for a few individuals, not by the benefits that might flow to the general community or the green house gas emissions it might remove.***

Requests for Consideration in planning for a Wind Farm

I would like to offer the following suggestions as a means to successfully deal with the present and any further planning applications for wind farms that you may receive. I will expand on the reasons for each item later in my submission, but list them now so that you may bear them in mind as you proceed.

1) That you might consider in the first instance of declaring these shires a ***no go zone for wind turbines in the same way that Premier Bailleu has done in Victoria***, for areas of high aesthetic value or in this case the preservation of some of the most valuable farming land in WA.
2) That failing clause one being adopted, ***a two km exclusion zone be declared from property boundaries for 2 MW turbines and something greater for larger turbines.*** This is a move also taken by the Bailleu government, and one recommended by the NSW Legislative Council inquiry chaired by Ian Cohen MLC which reported in Dec 2009.
3) That if noise levels as set out in the planning requirements are breached, or in a similar way GPS, TV and communication signals are interfered with, that sufficient resources and legislative power exists to force compliance.
4) That the shires fully appreciate the concept of a Renewable Bio-mass generating plant and the positive agronomic, environmental and social impact such a plant would have on all members of the community.
5) That consideration be given to removing the ability of hosting property owners to waiver set back provisions to their personal dwellings, as a protection mechanism for children and employees who live on that property.

Land Values

There is no doubt in my mind that the proposed wind farm will have a detrimental effect on property values and the liquidity of surrounding farms. How far away from the turbines this effect occurs will only be determined by the level of intrusion and annoyance they create on particular properties. Any aspect of the environment in which one lives and works that reduces people's willingness to be there, will drive price down until that lower price offsets the disadvantage of the turbines.

Evidence will be very hard to gather in this regard, but it is starting to be recognized with senior real estate figures giving voice to this fact. (Attachment 9) Logic and common sense clearly indicate that very few people will choose to buy a property that has wind turbines in close vicinity. The prospect that a clear link is made between turbines and poor health will see this price disadvantage grow to even greater levels. ***There can be no doubt that with any reduction in land values, even without a sale occurring, there comes the problem of reduced equity for those with borrowings against that land. This loss of equity will need to be recovered from those who cause the loss.***

The loss of value of farm land near wind farms was one of the major reasons that we rejected the Moonies Hill Energy proposal to site turbines on our properties- we were not prepared to inflict such loss of property values onto our neighbours. **This is an area where conflict of interests will surface very quickly leading to a fraying of the fabric that holds rural communities together, that being 'do unto others as you would have done to yourself '.**

The divisive nature of wind farms is evident all over Australia and indeed the world, as is illustrated by an article in the Australian on Nov 27th 2010 (Attachment 1) in which the Gullen Range project of 80 turbines the size of 45 storey buildings is discussed. The former Maritime Union of Australia national secretary John Coombs who is a Crookwell resident said:

" I am very confident that I would never, ever sign on for one of those knowing that I was going to destroy the lifestyle of the people next door irrespective of whether I knew them or talked to them or had anything to do with them."

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And further went on to say,

" What it has shown is that this great bush community, where everyone helps their mate is no different to anywhere else when the money is on the table. "

I believe a two km setback from boundary lines for 2 MW turbines would provide the barest of minimum buffer such that the problems of property devaluation and community disruption might be minimised. I believe that we are in the fortunate position of being able to benefit from the early adoption of wind farms on the east coast, where the problems have been identified.

Impact on Agricultural pursuits

There are obvious impacts on agriculture for those who host turbines but I would like you to consider the impacts that will occur on neighbouring properties.

The Senate Standing Committee on Community Affairs will report in April of this year on its inquiry into "The Social and Economic Impact of Rural Wind Farms". Senator Judith Adams is a member of this committee. Victorian Senator Steve Fielding has pushed for this inquiry for some time. Given that already some 439 MW of wind generated capacity exists in Victoria, coupled with the large number of proposed wind farms (2000 MW either approved or planned), it is clear **that the placement of wind turbines is revealing issues that are not understood but quickly emerging across Victoria , New South Wales and South Australia.**

The reason I mention the inquiry is that the Aerial Agricultural Association of Australia has made a submission to this inquiry (Attachment #2) in which they state,

" The placement of wind farms in areas of highly productive agricultural land is leading to reductions in treatment areas of aerial application companies, with no compensation for this externalization of costs by the wind farm developers"

Further proof of this impact is seen on the web page of the Illinois Agricultural Aviation Association (Attachment #3) where they state,

"The fact is, it is dangerous to fly within the confines of a wind generator farm. Windmills can cause vertigo sensations, create unstable wind conditions, and extend high enough to seriously affect the way an aircraft can work the field. That is why a neighbouring field without a wind generator may not be a candidate for aerial application."

I would argue that any loss of ability to successfully apply either fertilizers or fungicides to our crops by air if the need arose is very significant, and is another reason to apply a two kilometre buffer to boundary lines.

Health Problems

This is the most serious of all the areas involving the planning for wind farms, and one where the most conservative of approaches is warranted until we know better. There are many reports from nearby residents, of Wind Turbine Syndrome, which includes symptoms of sleep disturbance , headaches, excessive tiredness, palpitations and cognitive problems.

In a submission to the Senate inquiry The Eyre Peninsula Local Government association (attachment 4) states,

" The existing Cathedral Rocks farm has ***not to my knowledge raised great public debate, with all turbines on a single farming property with no residents within several kilometres of the farm."***

The comment that no public annoyance has occurred at the Cathedral Rock project suggests two things to me. Firstly that kilometres and not metres, are the order of the day in regard to exclusion zones and secondly that if wind turbines have a place in the environment it is on large scale properties, not in an area where at least twenty eight residences exist within two kilometres of the boundaries to the hosting properties. (See below for names)

Bignell *2, Kinsey, Collins, Dennis *3,Sheridan *3, Carrington Jones, Meaton, Durack, Goodall, Bilney *4, Mathwin, Reinke, Robinson, Wellard Agri *3, Blacklock, Hammet, Palmer, O'Neil, Trezise,

In WA developers have successfully sited wind farms to the north of Perth near the coast, where there are large areas of relatively unproductive land where there are less residences and quite often absentee landlords. It is a coastal area providing a better wind resource, meaning smaller turbines and hence less community disruption.

The Waubra wind farm at Ballarat is of a similar size with regard to the turbines as is proposed at the Flat Rocks Wind Farm. The anguish and disruption to community members living there, is an indication of what we may be facing. Local resident Mr Noel Dean commissioned the sound engineering firm **Noise Measurement Services** to investigate the likely impact of noise from the turbines on surrounding residences.

The Dean Report (161 page Document)

Together with an extract from the front summary page , pages 52,64,65, 69,110,111,113 and 115 are printed as attachment 6.

Dr Robert Thorne – from his summary;

"Wind farm activity appears to create a 'pulsing' infrasound and low frequency pattern. These patterns are illustrated in sonograms in this Report. My hypothesis at this stage is that wind farm sound has an adverse effect on individuals due to this pulsing nature, as well as audible noise due to the wind turbines. These effects may be cumulative".

"It is concluded, from the information presented, that Mr Dean has been and is currently adversely affected by the presence and activity of the Waubra wind farm .The effects as stated by Mr Dean as affecting his health and statutory declarations from his family and residents in the vicinity of the wind farm attest to adverse health effects. Adverse health effects such as sleep disturbance, anxiety, stress and headaches are, in my view, a health nuisance and are objectionable and unreasonable".

The size of the 'exclusion zone' is being debated in NSW, Victoria and South Australia and other parts of the world including New Zealand. A court in New Zealand is about to hear a case involving 750 people who live near the Makara wind farm(Ref.ABC Stateline). In Denmark, the wind farm capital of the world, wind farms have been forced out into the ocean, out of sight and away from human beings. The health issue has now become a **glaring problem.**

Page 69 paragraph below fig 1

"Audible noise from modern wind turbines is primarily due to infrasound, turbulent flow and trailing edge sound. Sound character relates to blade characteristics and blade/tower interaction and can be grouped into four main bands. The sound can be characterised as being impulsive and broadband, audible and inaudible (infrasonic)"

It is no coincidence that the worst health problems are being experienced on the farms adjacent to the largest wind farm in the southern hemisphere, Waubra. Clearly, as stated in the Dean report there is a direct correlation between the size of the blades (length and breadth) and the amount of sound

created as these blades pass the tower. Further to this, the number of towers and their placement is having a cumulative effect on the amplification of the sound.

Page 113 table W1 - Demonstrates that at least 12 families, varying in distance from 550 - 4600metres from the turbines are suffering unacceptable health effects.

The ABC's Victorian Stateline program televised on Feb 19 2010 shows the Federal Environment Minister, Peter Garrett putting the responsibility of wind farm planning at the feet of both State and local Government. The then Victorian State planning minister Justin Madden declined a request to talk to the media for an interview, but he issued a statement saying complaints regarding noise levels at the Waubra wind farm have been investigated and no breach of the conditions have been found. One wonders just where this **responsibility will finally rest.** Attachment 7 is the full Stateline program which is the most confronting information I have come across, it needs to be played via a computer and lasts for 8 minutes.

The primary and fundamental responsibility of **Federal, State and Local Governments** is to protect the health and wellbeing of their citizens over whom they govern. The onus of proving the safety of these generators lies with government and the developers, rather than those whose health is affected having to prove the cause of those health issues. Dr Sarah Laurie as medical director of the Waubra Foundation speaks to this in a letter to the then Premier of Victoria John Brumby in October of 2010. Attachment 8

Given the evidence already available regarding community health impacts associated with wind farms, the Kojonup Shire should be very mindful when contemplating the Development Application for the Flat Rocks Wind Farm.

In short

"When in doubt – don't".

Alternative Renewable Energy Sources

In my mind the Renewable Energy Target legislation has many similarities to the home insulation scheme. One clearly setting out our intent to address global warming by a reduction in carbon emissions in electricity generation and the other achieving a similar outcome from reducing the need for home heating and cooling.

Governmental haste has the capacity to derail both of these projects. The haste to achieve a self imposed target of 20 % renewable energy by 2020 the government has effectively stifled research and development into other forms of renewable energy. Wind technology is the only one which has the immediate capacity to come on board for the RET, but so many questions remain unanswered, whilst projects considering wave, solar or bio- energy are struggling to move from development to construction.

I have included (attachment 5)a paper titled Energy Tree crops for your information which indicates that a Bio- energy plant may be better suited to this particular region. The use of Bio-mass including products such as oil mallee, straw or the residue from bluegum harvesting would allow all members of the community to be rewarded, enhance the environment and create employment way beyond the scope offered by wind farms.

The technology needs further development but the opportunity for a base load renewable energy source that offers real and measurable benefits to everyone in the Great Southern should be of great interest to the community leaders within our shires. This opportunity and others that may be in the wings will be lost if we hastily turn all the available renewable energy capacity to wind farms.

Moonies Hill Planning Submission

There are areas of the Planning and Environmental report of the Moonies Hill Energy Co that warrant comment.

1) **FRWF Benefits 4**

The claim to avoid 660,000 tonnes of CO_2 from being emitted appears to be too large. The total rated output of FRWF is 150 MW, which at 33 % of capacity produces on average 50 MW per hr or 438,000 MWh per year saving less than 395,000 tonnes of CO_2 emissions. The average weight of carbon emissions per MWh of electricity generated in WA by Verve Energy is 0.9 of a tonne hence it would require a capacity factor of over 55% to save the amount claimed, ***something which is not achievable at this site.*** Furthermore this makes no allowance for the increase in emissions caused by the inefficiencies associated with the balancing that needs to occur with intermittent wind generators.

2) **Consultation 8**

Claim is made that landowners within a 10 km radius of the development site were consulted, several people within that catchment were completely unaware of the proposed wind farm until very recently. There is also no reference to the many concerns raised at that meeting, in fact no one other than the proponents spoke favourably about the proposal.

3) **Fauna 9.4**

There is no mention made of the Carnaby's Black Cockatoo found in the area or the uniqueness of the Ngopitchup swamp an elevated wet land.

4) **Electromagnetic Interference 9.6**

The suggestion that there is a level of acceptable interference by claiming " that no turbines within the proposed layout are likely to cause unacceptable interference " is critical , there is simply no level of interference acceptable for GPS or communication systems. The claim made that they have consulted with all registered licensed communications operators is false, our VHF system is licensed (licence # 327853 with call sign VH6BAU) and no discussion has taken place with ourselves with regard to interference to that system at any point.

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My contact with the Chief Fire Control officer in Kojonup Ned Radford, reveals that they have not been consulted about possible interference even though Moonies Hill Energy acknowledges the real possibility of such interference existing.

5) **Shadow Flicker 9.8**

The suggestion, that provided flicker intrusion into homes is less than 30 hrs per year is acceptable, is of great concern to me. There needs to be a genuine commitment to value neighbours well being.

6) **Conclusion:10**

The claim that the project has "strong community and landowner support " is in the most absolute terms false. Four of the six land owners (Ian Palmer , Craig and Brant Dennis, Roger Bilney and the Reinke family) that I know of being approached to host turbines have refused and every neighbour that I have spoken to has voiced their opposition. Recently at very short notice 14 neighbours came together to voice their concerns, no one present said that they supported the proposal.

Conclusion

The comparative costs of the electricity generation in WA are,

- Wind energy $130 - 140 / MWh
- Thermal (Coal and Gas) $70 / MWh

The article in The Australian ' The Great Wind Rush ' compares the cost of avoiding each tonne of carbon emissions using Eastern seaboard figures

- Wind with gas back up $1149
- Coal with carbon capture and storage $56
- Combined Cycle gas generation $33
- Nuclear $22

Clearly electricity generated by wind is very expensive as is the cost of any CO_2 emissions that are claimed to be removed, couple this with the widespread reported evidence of serious health impacts, decreased property values and the visual pollution they create, I would urge the shires to learn from the mistakes made in New South Wales and Victoria and protect the well being of all local residents, it is too late to make changes once they are built. The wind resource is available in other superior coastal locations, the Great Southern region would be better served to accommodate other forms of renewable energy. .

The fact that our family chose to leave very significant sums of money on the table rather than inflict the impact of wind turbines on ourselves or our neighbours is in my view the most powerful commitment that we can make to the members of our regional community.

We seek the support of the Kojonup Shire Council in placing peoples well being as their highest priority. My belief in the need for renewable energy sources is strong and one that I am prepared to pay for, but for a wind farm of this type, the cost, in terms of peoples well being is simply too high to ask a group of individuals to bear.

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Interestingly the German philosopher Schopenhauer wrote:

All truths travel in a cycle.

First they're ridiculed.

Second, they're violently opposed.

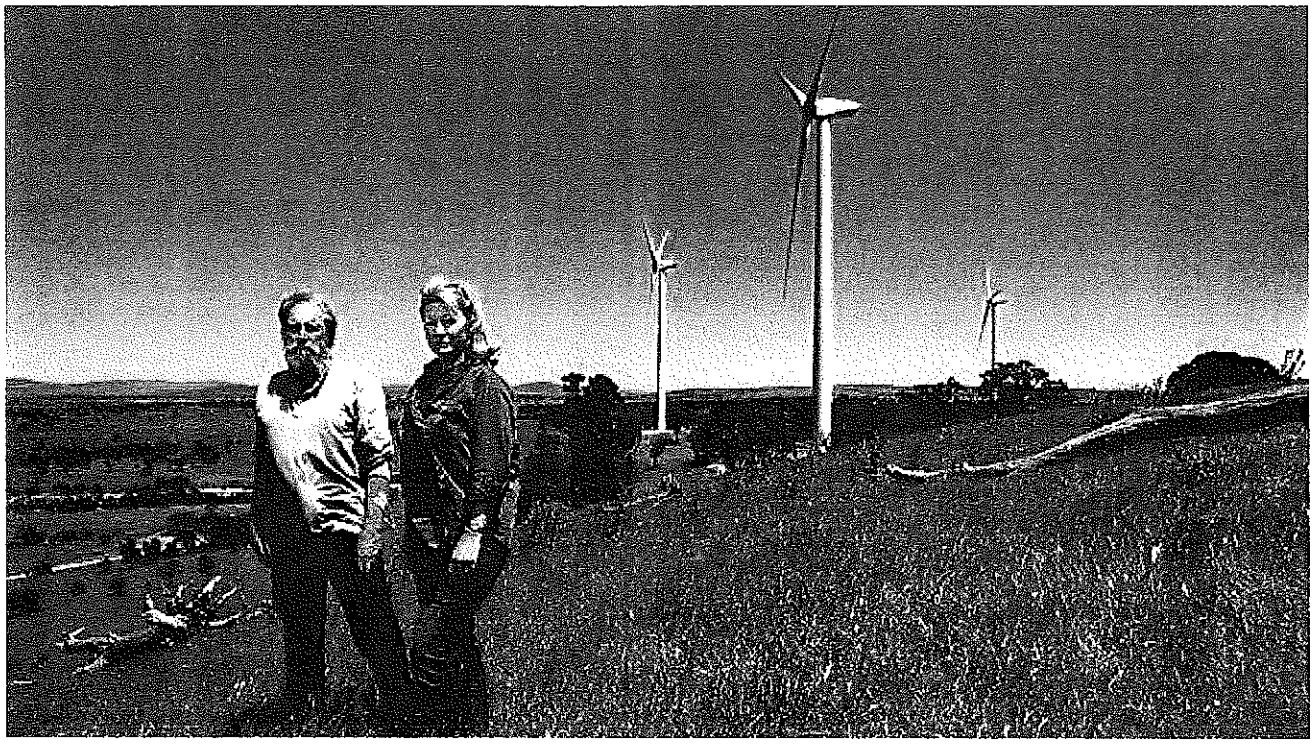
And third, they're declared to be self-evident.

It is worth remembering the battle that has been waged against tobacco and asbestos. It is important to think about the people being forced out of their homes and off their properties by wind farms; they have been ridiculed for being part of a groundswell of opposition, but soon to be recognized as victims of poor government policy and planning.

The Australian

The Great Wind Rush

- **Graham Lloyd, Environment editor**
- From: **The Australian**
- November 27, 2010 12:00AM



Humphrey and Jennifer Price-Jones face the prospect of becoming neighbours to 80 wind turbines, each as tall as a 45-storey building. Picture: Vanessa Hunter
Source: The Australian

As wind turbines sprout across the country, turbulence is building over their cost, health effects and aesthetics

IN a world obsessed with climate change, Humphrey Price-Jones believes wind turbines have become the crucifix of a new religion, a towering, unmistakable symbol of good intent. They feature in almost every glossy brochure and television commercial promoting clean energy, turning silently somewhere in an empty paddock, doing the right thing for the environment.

But as wind turbines continue to grow in size and spread like triffids on the windy ridges and plains across the nation, turbulence is building.

Clean energy campaigners insist wind power is still the best renewable option available. As a result, wind power is at the early stages of a government-stimulated lift-off that could lead to the number of towers -- at present 1052, generating 1.5 per cent of the nation's power needs -- increasing tenfold during the next decade.

And as the wind farm footprint grows, so do questions about cost, reliability, health effects and the methods being used by wind-tower spruikers to propagate what has become a modern-day wind rush.

Price-Jones is an imposing figure of Irish descent, "born with clenched fists", he says, who together with his wife, Jennifer, has spent the past decade tilting at windmills. A wildlife artist of international repute, Price-

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Jones has a $1000-a-night suite named in his honour at Broome's Cable Beach Club, complete with his drawings of birds of prey, alongside suites named after Sidney Nolan and Elizabeth Durack.

Price-Jones can see irony but no humour in the fact windmills threaten not only the visual and potentially the health amenity of his NSW southern tablelands grazing property and studio at Crookwell, about 170km southwest of Sydney, but also the survival of the birds on which he has relied for a living by capturing them on canvas.

Where Price-Jones sees the windmill as a crucifix , his near neighbour, ABC chairman Maurice Newman, favours the analogy that wind turbines will turn out to be for power generation what the zeppelin was for air transportation: it looked promising but was not the answer.

Newman made waves recently when he criticised the media's group-think on climate change, declaring the science had yet to be settled. He bought a property at Crookwell six years ago and is concerned the local council may "very well live to regret the support it has given to wind farms" by embracing the notion that the area could become what boosters like to call the "wind power capital of Australia".

Newman holds a view common in Western Australia, South Australia, Victoria and almost everywhere in the world that wind turbines are being installed: that this is an expensive, unsightly and sub-optimal means of generating power.

Family First's Steve Fielding last month successfully established a Senate inquiry to investigate the health impacts of living near windmills, and the submissions have started to roll in.

The inquiry will examine any adverse health effects for people living in close proximity to wind farms; concerns over excessive noise and vibrations; the effect of rural wind farms on property values; and the interface between commonwealth, state and local planning laws as they pertain to wind farms.

Reg Brownell of Australian Landscape Guardians in Victoria -- a body "committed to achieving better outcomes for natural and cultural landscape protection through the planning process" -- says electricity from wind is four times as expensive as from coal.

The cost of carbon saved, he says, is $500 a tonne compared with $15 a tonne by switching from coal to gas.

Vicki Mitchell from South Australia says the state government has overridden council by-laws on industrial development in the Flinders Ranges in the north of the state and is set to "rape and pillage our country in order to satisfy a popular political agenda".

Diana Laube of the Eyre Peninsula Local Government Association, representing 11 member councils based in the west of South Australia, has called for "a national planning system that provides a consistent approach to planning for wind farms that offers protection to rural residents from the well-documented negative effects of these massive industrial developments".

If there is a common theme it is the belief that city politicians are happy to destroy rural communities in the quest for urban votes.

Newman tells Inquirer: "In an area such as the southern tablelands there are many attractive and environmentally sustainable industries that could be introduced based on amenity. The proliferation of wind turbines has a detrimental impact on land values and general property."

Jennifer Price-Jones says it is all about public perception.

"Wind towers are big, so you cannot miss them," she says. "They are in country areas, so people who are jumping up and down saying wind energy is wonderful don't have to have them in their back yard and don't have to look at them.

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"They look ideal to the green urban voter but they don't want it on Bondi Beach, they don't want it offshore where they can see it. They want it somewhere else."

If the Gullen Range project goes ahead in Crookwell, the Price-Joneses will be able to see all 80 of the proposed turbines.

Each is as tall as a 45-storey building, with 50m blades that cover 2ha of sky and create enough turbulence to tear apart any bird that strays too close.

There is a common misconception that birds are sliced up by wind turbine blades, which appear to be spinning slowly but are actually travelling at speeds of up to 200km at the tip. In fact, birds die when they encounter the windshear and pressure changes caused by banks of wind turbines churning up the air. They literally pop and fall out of the sky. This is why there is a ban on wind farms being built near airfields, lest light aircraft pilots meet the same fate.

Equally unsettling has been the way state governments have redrawn the rules to favour potential developments, giving them critical infrastructure status to remove court challenges and, in NSW, explicitly removing the noise generated by wind turbines from oversight by the Department of Environment.

That power has been given to local councils, which lack the resources or will to undertake it.

Another common complaint has been the methods used by small companies seeking to sign agreements with landholders for sites for wind turbines that then can be sold to someone else with money for development.

Landholder agreements are secret but can be $10,000 a year for each wind turbine. Absentee landholders, or those with large properties, are selling permission for turbines that are lucrative and out of their sight but clearly visible from neighbouring properties.

And there are persistent claims of conflict of interest relating to councillors with family members who stand to profit from a pro-wind-farm development stance.

"Any chance I had of having a reasonable approach to this was lost on the basis of these shonks selling them up," says former Maritime Union of Australia national secretary John Coombs, another Crookwell resident.

"I am very confident that I would never, ever sign on for one of those knowing I was going to destroy the lifestyle of the people next door irrespective of whether I knew them or talked to them or had anything to do with them.

"What it has shown is that this great bush community, where everyone helps their mate, is no different to anywhere else when the money is on the table."

Ironically, after a career spent stopping the shipment of nuclear waste at the Australian waterfront, Coombs says nuclear energy is the future and wind turbines are nothing more than expensive political window-dressing. "I am very much a political person," he says. "I have been in the Labor Party all my life and it is abundantly clear in many things there is a political basis to why things happen. I really think there has been an attempt to be seen to be doing something."

For Queensland Nationals senator Ron Boswell, wind farms are another example of how electricity users are being forced to pay the price for misguided federal government policy.

In a speech to the Senate this week, Boswell said: "The government is attempting to engage in massive subsidisation of wind. The subsidy it is trying to implement is off the budget, but if it is successful it will be on consumers' power bills."

The subsidy works through the way the rules are being changed to help increase the price of renewable energy certificates for the large-scale renewables sector.

In a bid to make it easier to raise finance for big projects such as wind farms, the renewable energy certificates system has been split into two: small projects and large projects.

This is partly because certificates from small, rooftop-scale solar installations have swamped the system because of generous state government feed-in tariffs and increasingly generous commonwealth subsidies as the cost of rooftop solar installations falls.

From next year, only certificates issued by large-scale renewable projects will be eligible to offset the emissions of electricity providers and heavy electricity users.

Power providers and big energy users are forced to buy renewable energy certificates to account for the government's renewable energy target of 20 per cent by 2020.

It is estimated that about 40 per cent of the renewable energy target will come from wind farms. That means the government is targeting about 18,000 gigawatt hours of wind.

There are at present 1052 wind turbines in 52 wind farms in Australia, almost half of them located in South Australia.. Together they are capable of generating 1879 megawatts of electricity.

In 2008-09, wind power produced about 1.5 per cent of Australia's electricity, enough to power about 770,000 homes.

To satisfy the government's 2020 renewable energy target, turbines capable of generating more than 16,000GWh will have to be built between now and 2020, an almost tenfold increase.

Boswell says at $2.4 million per kilowatt hour, the construction cost for wind is about 2.5 times that of coal or gas.

"Why would anyone in their right mind, given the other pressures on power prices, force householders to pay more than twice the going rate for power?" he asks.

He says there are three big factors that make wind expensive.

"First, there is the high capital cost. Second, there is the need for fossil fuel-based back-up power to keep the lights on when the wind drops or does not blow.

"Third, there is the high cost of connecting remote and often small wind farms into the transmission infrastructure."

The additional overcapacity and infrastructure costs, according to industry experts such as Origin Energy managing director Grant King and commentator Keith Orchison, have been estimated to be as high as $22 billion.

Given the amount of concrete and steel used in their construction and the fact wind turbines produce only 30 per cent of their rated capacity in a year because they rely on the correct wind conditions, there are also tough questions about how much carbon emissions they actually save anyway.

Retired engineer Peter Lang, who has 40 years of experience in the energy business, says the cost of wind energy with open-cycle gas back-up is $126 a megawatt hour compared with $51 a megawatt hour for closed-cycle gas.

The cost of avoiding each tonne of carbon emissions using wind with gas turbine back-up generation is calculated at $1149. This compares with a figure of $56 a tonne for coal with carbon capture and storage, $33 for a more efficient combined cycle gas turbine and $22 for nuclear energy.

But for Clean Energy Council chief executive Matthew Warren, wind remains the lowest cost large-scale renewable option available. He says the real misconception lies in the belief that the energy world of tomorrow will be the same as that of today.

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"The frustrating thing about much of the narrative on renewable energy is that the easiest way to marginalise renewable technologies is to compare them with what we have at the moment," Warren tells Inquirer. "They are different technologies. You can't build a carbon-based energy market using renewables. If we are to [decarbonise] the economy, we have to have some flexibility in the way we use energy.

"The way we currently supply energy is that whatever the market wants, it gets. It is a dysfunctional system. We ultimately need to send bigger price signals to electricity users to let the market shift demand around."

This means higher electricity prices generally and potentially exorbitant electricity prices during times of high peak demand.

Warren acknowledges there are social issues regarding wind. "The major one is that landholders who agree to host wind turbines get a fee but their neighbours do not," he says.

But wind, he says, is the pace-setter for alternative energy.

"It is industrial scale and it works. Wind will deploy to the extent that other technologies can't beat it."

However, none of this makes sense to Humphrey Price-Jones.

"Wind must be the only technology where you can prove inefficiency and people say, 'We'll have to build two of them or three of them or four,' " he says. "You can't sell anybody any other piece of equipment and say to them, 'We don't know if it is going to work. Sometimes it will work really well, sometimes it won't work at all and other times it will work a bit.' You just couldn't do it. That is why as soon as there is an alternative to wind, people have stopped using it."

* * *

Danes losing their faith in turbine farms

DENMARK, the wind power capital of the world, has found itself in the eye of a renewable energy storm. After reaching political consensus during 2008 to lift its renewable energy target to 50 per cent by 2025, the Danes have been rapidly falling out of love with wind.

To avoid public opposition to new towers, nearly the whole of the expansion of wind power in Denmark will now come from offshore wind farms, mostly out of sight "over the horizon". The decision to go offshore will compound the financial shortcomings and inefficiencies of wind power identified in a controversial assessment of the renewable energy program by Danish think tank the Centre for Political Studies.

The assessment gives the lie to claims that Denmark is supplying 20 per cent of its energy needs from wind sources.

In reality it is subsidising the electricity costs of neighbouring countries Norway and Sweden that provide significant amounts of fast, short-term balancing reserve hydro power to even out the unpredictable performance of wind turbines.

Up to half of Denmark's wind electricity is exported but paid for at high cost by Danish power consumers.

The wind power exported from Denmark saves neither fossil fuel consumption nor CO2 emissions in Denmark, where it is all paid for.

And, by necessity, wind power exported to Norway and Sweden supplants largely carbon neutral hydro-electricity in the Nordic countries.

Graham Lloyd

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#2.

AERIAL AGRICULTURAL ASSOCIATION OF AUSTRALIA LTD.

ABN 13 002 501 886 • ACN 002 501 886

~

21 August 2009

The Director
General Purpose Standing Committee Number 5
Parliament House
Macquarie Street
Sydney NSW 2000

By email: gpscno5@parliament.nsw.gov.au

Dear Director

AAAA Submission to Inquiry into Rural Windfarms

The Aerial Agricultural Association of Australia (AAAA) represents Australia's aerial application industry, including crop protection spraying, fertilizer application and firebombing.

Aerial application is heavily regulated by the Civil Aviation Safety Authority and pilots and operators are licenced to at least Commercial Pilots Licence standard and undergo ongoing professional development conducted by CASA appointed examiners and AAAA.

AAAA works closely with CASA and industry members on safety promotion, training, regulatory development and identifying emerging threats to aviation safety and appropriate responses.

A key emerging threat to aviation safety both in Australia and overseas is developing windfarm infrastructure. In particular, wind monitoring towers are a critical threat to low level aviation safety.

Wind monitoring towers are very tall in relation to aerial application operations, are erected within very short timeframes, are extremely difficult for any pilot to identify from the aircraft and are often not notified to aviation users because of the lack of a Government-mandated notification system and the desire of the developers to keep their positions a secret because of commercial issues.

There are two quite distinct issues arising from windfarms that affect aerial application:

- safety of the aircraft and pilot and
- economic impact on aerial applicators.

Safety Impacts
AAAA view is that the case of *Sheather v Country Energy* (NSW Court of Appeals) clearly established that anyone with infrastructure posing a threat to aviation must consider the risks that infrastructure poses to aviation safety and respond appropriately through marking or other measures to safeguard aviation operations. This precedent is of critical relevance to windfarm developers although not apparently widely known to them.

There are also a range of activities currently underway that are important to the consideration of the impact of windfarms and potential directions for the future. These include:

- Commonwealth Aviation White Paper (Department of Infrastructure etc)
- Commonwealth Inquiry into Safeguards for Airports and the Communities Around Them (Department of Infrastructure etc)
- CASA consultancy on safety implications of tall structures not in the vicinity of airports
- Relatively recent review and release of Australian Standard AS3891 - Air Navigation - Cables and their supporting structures - Marking and safety requirements

AAAA has made submissions to each of these processes and has consistently raised the need for appropriate risk management of windfarms and wind monitoring towers in an aviation context.

For example, the AAAA submission to the Commonwealth Government's Aviation White paper included the following recommendation:

- Establish and fund a national database of powerlines, wind monitoring and power generation towers and other obstacles so as to address this significant threat to low-level aviation. Despite the best efforts of AAAA, such information is not made available from any power companies and most wind farm developers.

This proposal is expanded on in the attached recent submission to the Commonwealth Government Inquiry into Safeguards for Airports which is at **Attachment A**.

AAAA has done a lot of work to make it easier to mark guy wires and powerlines – including on wind monitoring towers – through amendment of the national standard on marking of wires so as to use a new marker developed by Country Energy (NSW) with the cooperation of AAAA.

There is now little practical reason why wind towers and especially wind monitoring towers should not to be clearly marked at least.

In addition, AAAA has attempted to provide relevant information to developers through the Wind Energy Association, but this process/advice is voluntary and consequently will not provide coverage of all developers.

AAAA also passes on information to members that has been provided to it by wind farm developers on the physical location of wind monitoring towers. However, only a few developers provide this information and again there is little doubt that many towers are going

up unmarked and unknown until hopefully spotted by pilots during pre-application inspections.

More comprehensive safeguards must include a mandatory national system of communication of the position of all wind monitoring towers and the inclusion of this on a national database accessible by low level pilots.

This is a very real issue for topdressing and firebombing operations - as wind monitoring increases, so does the threat to legal aviation activities.

Economic Impacts
Safety is not the only consideration that is imposing additional risk and consequences on the aerial application industry.

The placement of wind farms in areas of highly productive agricultural land is leading to reductions in treatment areas of aerial application companies with no compensation for this externalization of costs by wind farm developers.

For example, placement of a wind farm may affect flight lines and application height or even whether the application can be conducted at all - leading directly to either an increase in cost or a reduction in income - and sometimes both - for aerial application operators.

AAAA's submission to the Commonwealth Inquiry into Safeguards at Airports **(Attachment A)** makes a number of points regarding land planning issues that are equally relevant to the development of wind farms regardless of whether they are near airports or in agricultural land that may be treated by air.

In particular, AAAA is concerned that not enough consideration is being given through the State planning approval processes to the impacts of windfarms on productive agricultural land and the aerial application industry, remembering that it may not only be the land footprint where the windfarm is sited, but also land surrounding that for some kilometers where aircraft may have to maneuver to conduct aerial application.

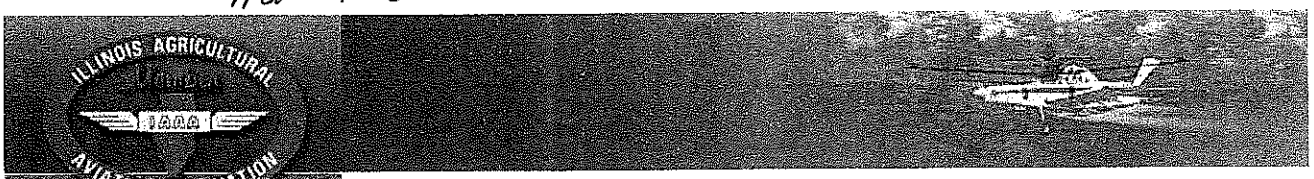
At the very least, windfarm developers should be required to pay compensation to aerial applicators where it can be reasonable established that there will be an economic impact imposed on the aerial application company by the wind farm developer.

Further information
If you require any further information or would like AAAA to expand on or further explain any of the issues raised in this submission, please do not hesitate to contact the Association's CEO, Mr Phil Hurst on 02 6241 2100 or email: phil@aerialag.com.au. Similarly, if it would be of assistance, AAAA would be happy to appear at the public hearing on the 9th September.

Yours sincerely

Phil Hurst
CEO - AAAA

Att #3.



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Wind power farms are being highly touted as a renewable energy source that is clean, safe, and a responsible way to generate electricity for our nation. However, nothing comes without sacrifice and these projects are no exception. The issue is being complicated, either intentionally or otherwise, by not openly addressing the very real fact that farmers with wind generators may lose the option of aerial application of farm protection products, seed, fertilizers, etc. on their farm ground. Possibly more significant is that their neighbor farmers, who have no wind generator(s) and consequently no income from them, stand to lose that option as well.

Some proponents of wind farms tend to dismiss this possibility out of hand, with the explanation that "those guys can fly around them with no problem," or "just get a helicopter to do it." Others say that ground application can still be effectively performed so the aerial option is insignificant. Unfortunately, it is just not that simple. Sometimes weather problems and/or timeliness of application dictate an application from the air.

The fact is, it is dangerous to fly within the confines of a wind generator farm. Without going into the technical aspects, windmills can cause vertigo sensations, create unstable wind conditions, and extend high enough to seriously affect the way an aircraft can work a field. That is why even a neighboring field without a wind generator may not be a candidate for aerial application: there's no room to make a turn.

Proponents of wind farms point that the $4-5,000 paid each year to the landowner is a lot of money for a small piece of farm ground. Asian Rust has not been a factor thus far in Illinois, but the potential is huge. Match the $5,000 against a possible 80% yield loss of soybeans expected to average 60 bushels per acre. At $12/ bushel, that's $576. If it's an 80 acre field, that's $46,080 lost. Cropping decisions will be tough in the future considering you can't change your mind once the wind generator is up and operating.

Will a farmer find an aerial applicator willing to book a field in the vicinity of a wind power generator? The answer is "maybe." It will most definitely be at an increased application cost; possibly double. Helicopters are not the answer because there are only a few working the Midwest and they don't like working in the wind farms either.

The Illinois Agricultural Aviation Association (IAAA) has been disappointed in the lack of candor by some wind generator proponents with regard to farmers' potential loss of an aerial application option. We believe it is critical that a truthful picture be presented so that an informed decision can be reached. In June, 2005, the following Resolution was passed by the IAAA Board of Directors. It was re-endorsed on March 10, 2009.

ILLINOIS AGRICULTURAL AVIATION ASSOCIATION RESOLUTION

WHEREAS, we acknowledge the need for affordable electric power and the efficient distribution of that power to the point of its consumption, and

WHEREAS, we acknowledge the environmental benefits of wind generated electrical power, and

WHEREAS, we understand the financial considerations involved when decisions are made to place wind turbines on otherwise productive farm ground, and

WHEREAS, wind turbine generator farms create uniquely hazardous and unacceptable dangers to pilots flying agricultural aircraft in a ground environment,

WE HEREBY RESOLVE that, in the interest of pilot safety, we will refuse to make an aerial application of any product inside a grouping of wind generators, or to farm land immediately adjacent to a grouping of wind generators, should that proximity be considered hazardous by the pilot of the agricultural aircraft.

Att #4.

EYRE PENINSULA LOCAL GOVERNMENT ASSOCIATION

Department of the Senate,
PO Box 6100
Parliament House
Canberra ACT 2600

Dear Sir/Madam,

Inquiry into the Social and Economic Impact of Rural Wind Farms.

ISSUE: PLANNING ISSUES

I operate a regional local government organisation (Eyre Peninsula Local Government Association)for all eleven Member Councils based in the West of South Australia. Our geography means we enjoy particularly good wind speeds (often in excess of 10m/sec) so have attracted a good deal of interest from both the State Government (mentioned in July by Premier Rann in announcing his Green Grid vision) and wind farm operators. Currently, we have 68 turbines in 2 windfarms; one along the Cleve Hills (35 turbines) and the other along our Southern coast at Cathedral Rocks (33 turbines.) Each has a claimed capacity of 2MW. However, we are poised to potentially receive applications for many farms.

The existing Cathedral Rocks farm (I live 30kms away and can see it) has not to my knowledge raised great public debate with all turbines on a single farming property with no residents within several kms of the farm. Anecdotally, I am told that at least one of the residents near Cleve suffers some of the cluster of symptoms referred to as "wind turbine syndrome" but signed a gag order as part of their agreement with the operators. I have heard no major outcry from residents near that windfarm either.

Premier Rann suggests that EP may be able to support another 5,000 turbines and, keen to provide updated planning briefing for all our Members, I turned to the Planning SA Better Development Plan Policy Library, the basis of our Planning system in SA. The advice to our Councils about the framework and principles they need to apply, in those instances where they are the relevant planning authority, were last updated in 2002. The 2010 version of the BDP Policy library has a single page that makes no mention of the cumulative impacts, one of the main issues globally where residents impact is highest. Indeed, currently residents in the Mid North of SA are voicing strong opposition to the scale of development along ridgelines there and we are keen to ensure our members receive the best planning

briefing possible prior to significant further developments in our region. I have had several contacts with Planning SA who has told me they currently have no one available to consider windfarm planning issues and to update their advice to Councils as their workload is dedicated to the Plan for Greater Adelaide. I am still pursuing this as a matter of priority for our region.

In my opinion, the following specific planning issues have potential to cause our Councils concern.

- **Noise level**. We know NZ6808 has set a maximum noise level of 40dB, as has I understand Denmark. However, there are issues associated with how that is measured, what it means in reality etc etc. The SA EPA Noise Guidelines (July 2009) seem to be a moving target in terms of background issues, noise monitoring etc and seems to have no compliance "grunt" in demanding noise levels be adhered to. I'm not sure they represent direction to planners.
- **Turbine setback from residential housing.** I've sought a recommended safe setback for each turbine and can find no such defined target. The WHO (World Health Org) has previously issued guidelines and different set backs are suggested by a number of authors. The official planning advice I was given by Planning SA is that there is no known link between windfarms and adverse health effects for humans (the so called "wind turbine syndrome.") Searching the many doctors' papers on the internet, and referred to in medical journals, it seems the missing information may be that no baseline health data has been collected on a community prior to windfarms being established. Consistently, the medical profession (including doctors in SA) have expressed concern at the cluster of similar symptoms experienced by some people in the vicinity of turbines but disappearing as soon as a person moves away. The Ontario Health Study, writings of American Dr Nina Pierpont and many others should be cause for some caution and it is interesting that standards of set back, erring on the side of conservatism, are not suggested for planning authorities.
  The health of regional Australia needs better attention!
- **Turbine Wake Plume and effects on airplane movements**. Few authorities have given planning advice in relation to turbine wake plume although aviators in Australia have expressed concern. I am aware of a paper from Ralph Holland (November 2009) who looked at potential impact on Crookwell airport. His calculations suggested the extent of velocity deficit extended a considerable distance from wind turbines are represented a safety issue for light and ultra light craft either taking off or landing. Exactly who would be the relevant planning authority in relation to this consideration is not clear. I'm unclear if CASA would be likely to make comment but, with emergency air ambulance flights an integral part of our primary health care system, this is an important planning considerations for our Councils.
- **Status of National Windfarm Development Guidelines 2010 (DRAFT)** Although not apparently released and endorsed by Planning SA, this has been available on the Environment Protection and Heritage web this year. Even if not endorsed, it represents an attempt to plug a clear deficiency in not having a standard planning approach to windfarm development in rural Australia. Interestingly, the effects on human health and visual amenity are rarely dealt with and there are no standards suggested.

While there are no set back guidelines, no consistency in planning information in relation to the cumulative impacts and generally poor information available for planning authorities, the public response form those who live in close proximity will be often less than enthusiastic. No doubt you will receive several submissions dealing with loss of amenity, economic impacts from being surrounded by windfarms (property may not be saleable so be worthless.)

- **Impacts on neighbouring property**> For planning authorities, many of the adverse reactions of residents don't really emerge until the development is in place. The sheer scale of modern turbines, coupled with the aggregation of numbers, is causing problems. However, the economic inflows are only available to the landowners with turbines on them, so other affected residents are then forced to turn their attention to the planning authorities to seek solution. Ultimately, we know this often ends in litigation.
- **Benefits of windfarms?**
  Governments are often keen to endorse windfarms as they are popular with the "green" voter who typically lives in a regional or metro centre, is not exposed to the negative impacts, and blindly believes they are a solution to our AGW climate change panic. Even Denmark struggles to show emissions reduction from their increased reliance of wind power, typically a high cost, low efficiency, non-baseline power source.

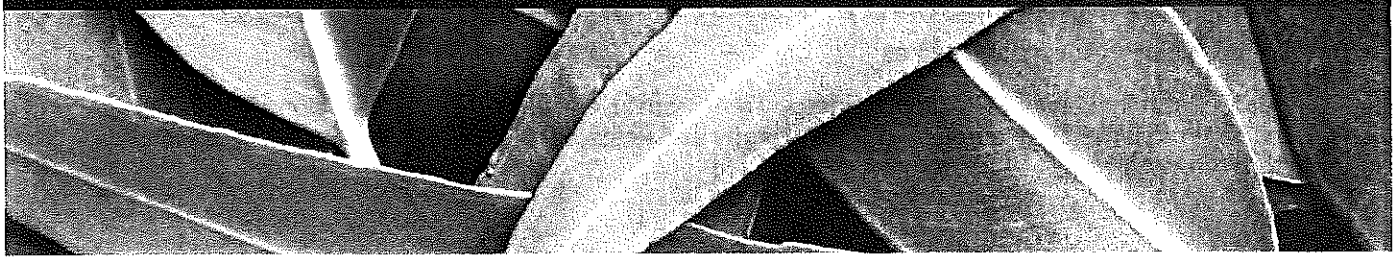
  As a matter of urgency, we need to develop an integrated national planning system that provides a consistent approach to planning for windfarms and that offers protection to rural residents from the well documented negative effects of these massive industrial developments.

Diana Laube

AH # 5.

ENERGY TREE CROPS

Renewable energy from biomass could be the commercial driver to large scale adoption of woody crops and to structural improvement to dryland agricultural systems in Australia.



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FUTURE FARM INDUSTRIES CRC

Energy Tree Crops

Publisher:

Future Farm Industries Cooperative Research Centre (FFI CRC)
University of Western Australia
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Crawley WA 6009
Australia

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Cover: An energy tree crop comprising mallees planted in belts alongside a cereal crop.

Photos: FFI CRC.

Contents

Energy Tree Crops

Energy tree crops, strategically integrated into dryland agricultural systems in narrow belts, and harvested every 3 to 8 years, have the potential to:

- Produce feedstocks for renewable base-load electricity and biofuels while reducing greenhouse gas emissions;
- Diversify farm incomes and regional economies by complementing rather than displacing existing agricultural industries and food production;
- Avoid trade-offs with water use in high-rainfall and irrigation areas;
- Provide salinity and biodiversity benefits; and
- Provide local base-load electricity generation in peripheral areas of the grid thereby reducing transmission losses.

Global estimates of future bioenergy use by the International Energy Agency indicate that by 2050 bioenergy could provide 25 to 33 per cent of total global energy requirements[1]. Biomass already provides 23% of primary energy and over 75% of thermal energy needs in Finland, and 32% of Sweden's final energy use. According to preliminary Swedish Energy Agency statistics presented by the Swedish Bioenergy Association, bioenergy passed oil as the biggest energy source in Sweden in 2009 in final energy use[2].

There are compelling economic, social and environmental reasons why Australia can also be prominent in developing bioenergy industries. Energy tree cropping can be designed and laid out in such a way that it cohesively integrates with agricultural enterprises on wheatbelt farms without compromising food and fibre production or security of water supply.

Mallee eucalypts are an ideal woody crop for biomass production in the extensive Australian cropping and grazing regions. After being harvested they regenerate readily by re-shooting (coppicing) from their rootstocks. Through repeated harvesting, mallee biomass can be a relatively secure long-term source of renewable energy.

Economic studies conducted by the Future Farm Industries Cooperative Research Centre (FFI CRC) demonstrate that energy tree crops have the potential to match financial returns from existing agricultural enterprises[3]. By growing mallees in skilfully designed layouts on less than ten percent of the property, enough cash flow is generated from the sale of biomass to cover establishment costs within the first cycle of 5 years. This financial payback is achieved with minimal trade-off in cereal crop production and water use. If there was a price on carbon, the relative competitiveness of energy tree crops would be improved, but even without a carbon market such plantings are potentially viable.

Other studies have shown that mallee bioenergy is cost competitive with other forms of renewable energy and that biomass electricity can be a strategically important base-load power complement to the currently more popular wind and solar energy sources. FFI CRC modelling of potential regional bio-electricity generation in WA and co-firing with coal in regional power stations in NSW and Victoria, estimates that the scale of mallee bioenergy could be 163,200 ha of belt plantings providing 2.6 million tonnes of biomass per year and offsetting the equivalent of 1.35 million tonnes of greenhouse gases (CO_2-e) per annum by displacing the use of coal. The cumulative greenhouse gas abatement potential of this enterprise is around 12 million tonnes over a 13 year period.

Under this coppice agroforestry system model, carbon dioxide (CO_2) from the atmosphere is recycled through the trees and the solar energy used to repeatedly grow the crop is made available by burning the biomass. Instead of having to off-set fossil CO_2 emitted elsewhere, users of energy tree crops will displace fossil fuels. By perpetually producing carbon-neutral energy, energy tree cropping will achieve more, in terms of limiting fossil carbon emissions, than carbon sequestration forests over the long term and so-called 'first generation' biofuels based on food crops. In the wheat-sheep regions, farmers, food production and agriculture are not displaced by energy tree cropping. The rural economy will be diversified rather than diminished.

Woody crops are best integrated into existing farm businesses, with about 10 percent of the land growing woody crops and 90 percent producing conventional crops and pastures. The deep-rooted tree belts do not compete fully with the annual crops, because the trees also exploit moisture and nutrients that have escaped below the root-zone of the shallow rooted annual crops. Well-planned tree belts also provide additional benefits such as wildlife habitat, shelter, salinity mitigation and erosion control.

Several belts of mallee energy tree crop on a cereal farm in regional Western Australia

The diversification of agriculture with woody crops will make both rural economies and environments more adaptable and resilient. The commercial activities of growing, harvesting, transporting and processing of biomass will require new regional industries, adding to the strength of rural communities. Energy tree crops have the potential to make a significant contribution to improving the agricultural environment, to renewable energy and to the mitigation of greenhouse gas emissions in Australia.

This paper presents the case for energy tree cropping, backed by regional scenario modelling and farm-level economic analysis that will guide development of tree planting, biomass production and bioenergy in the extensive cropping and grazing regions of Australia.

Energy Tree Crops allow more profitable farming, supply energy and reduce greenhouse gases

The overall potential benefit of developing large scale tree planting and woody crop industries remains attractive despite the Australian Government's deferral or replacement of the Carbon Pollution Reduction Scheme. There are several motivations to proceed with such developments:

Climate change remains an issue of national and international concern.

Australia has adopted a mandatory renewable energy target for electricity generation - 20 percent by 2020.

Renewable energy technologies are rapidly developing and will become more attractive economically as well as improving national energy security.

Biomass for bioenergy is a major renewable energy option. It is the only renewable source that can replace fossil fuels in all energy markets (heat, electricity and fuels for transport).

Biomass for bioenergy at sufficient scale effectively offers renewable baseload power generation.

Second-generation woody cellulosic biofuels are substantially more efficient in energy and greenhouse gas reduction terms than first-generation biofuels based on starch, sugar and plant-oils;

In Australia, the production of biomass using various forms of woody crops can be commercially viable.

Energy tree crops will be mainly native species, especially mallee eucalypts, and these could provide important biodiversity benefits, including habitat, avoiding the weed risk associated with exotic species and provide protection for areas of remnant native vegetation.

Volunteer carbon sequestration by tree planting is a complementary measure being undertaken by many large companies.

Woody crops deployed in carefully designed layouts can contribute to more sustainable and profitable agriculture. Mallee eucalypts are an obvious selection for development as woody crops, but many other native species are potentially available to diversify the range of woody crops for the extensive rainfed cropping and grazing areas. Focusing on the 450mm to 600mm rainfall zone growing grains and producing livestock from grazing systems across southern Australia avoids the trade-off with water yields that could potentially occur with large-scale plantations in high-rainfall and irrigation districts.

We call this energy tree cropping.

Farming trees as energy crops - good for farmers, good for regions, good for the environment

Energy tree cropping produces a renewable biomass fuel by harvesting trees as a crop. The crop extracts CO_2 from the atmosphere and through the process of photosynthesis uses solar energy to store carbon in biomass. Using biomass as a fuel converts it to usable energy and returns the CO_2 to the atmosphere. Bioenergy from tree crops can therefore replace fossil fuels and avoid the release of fossil carbon into the atmosphere.

Good for farmers and the environment

Woody crops have many features that will make them a good biomass production option in dryland cropping and grazing regions of Australia. Native tree species are robust and well suited to Australian soils and climate. They can tolerate droughts and take advantage of irregular rainfall events. They coppice readily and trees live for several decades which reduces their planting and maintenance costs. When planted in a belt and alley system they can complement the existing farming systems as well as diversify farm income with products ranging from biomass to oil derived from their leaves.

In some farming systems woody crops have potential to manage water and nutrient balances. They are excellent as shelter belts for sheep off shears or during lambing. They offer aesthetics and environmental benefits, including food and shelter for fauna. Energy tree crops are also a positive factor in the carbon balance of the farm as they sequester carbon in their roots.

The two row belt configuration is recommended in order to achieve acceptable growth rates in the long term. Widely spaced tree belts (between 70 and 80 metres apart, 1,000 trees per belt kilometre) maximise tree production per paddock hectare, while allowing crops and pastures to grow in the alleys. Careful integration of the two forms of land use will increase the total productivity of the paddock mainly due to better use of water and nutrients via the deep tree root systems.

Energy tree crops are a diversification opportunity for rural landholders. By trading in feedstocks for bioenergy, farmers can take advantage of any increase in the value of renewable energy over the long term. Tree cropping also entails a level of risk, but farmers will have the flexibility to move in and out of energy tree cropping as they choose, subject to biomass supply contracts. Farmers are accustomed to making these business decisions.

Good for regions

Trees as biomass crops have large energy balance benefits and future energy markets will be large enough to absorb very large amounts of biomass. Farmers can grow the tree crop primarily as an energy feedstock and combine it with other currently under-utilised farm residues such as cereal straw to improve the economies of scale for bioenergy projects and increase farm returns.

The economic activity of repeatedly growing, harvesting, transporting and processing biomass creates long term employment and contributes to regional economic development. Existing modern farming enterprises will remain dominant in the farming business, but the woody crops provide an opportunity to diversify the rural economy and improve the environment.

Producing transport fuels from biomass grown in Australia will improve national energy security, and the balance of trade.

Start-up with Mallees

Mallees have been grown as a crop in the WA wheatbelt since the early 1990s, mainly as a potentially economic means of addressing landcare concerns. This existing resource, of about 13,000 hectares planted on 1000 wheatbelt farms, offers a valuable start-up supply.

Mallees are a forerunner to other energy crop species and they are an invaluable source of knowledge and experience which can be transferred, with important adaptations, to other parts of the Australia and potentially overseas.

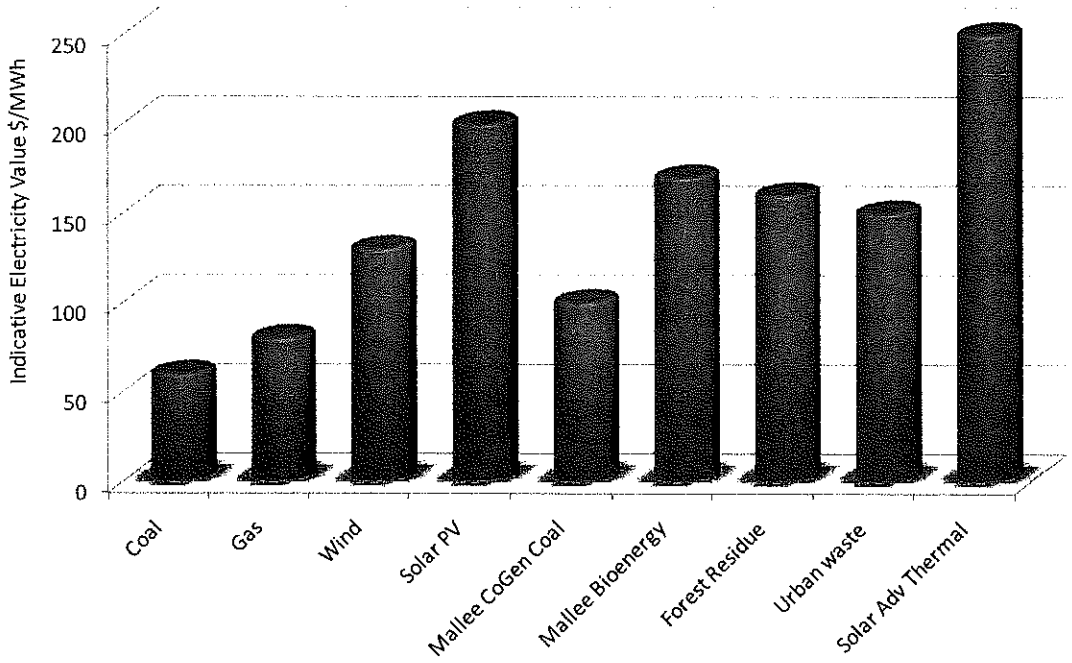
Comparing electricity costs using different fuels

For more than a decade Verve Energy, WA's leading energy producer, has been evaluating bio-energy options to expand its renewable energy portfolio. This included a demonstration 1 MW capacity integrated wood processing (IWP) plant at Narrogin that used mallee biomass sourced from wheatbelt farms as its feedstock. They found that a commercial-scale plant of at least 5MW could be economic but there was a high risk in the marketing of the products (electricity, activated carbon and eucalyptus oil), and it relied on a fully-developed harvesting/delivery system for the biomass, which was not then available.

As part of their continuing development Verve Energy commissioned a study to quantify total benefits and costs (financial and societal) associated with both a 5MW IWP project and an equivalent 7MW bio-energy plant, compared with other renewable energy options. In the case of biomass crops, total benefits include better management of salinity that provides a range of on and off-farm benefits. Of the eight options examined, including wind, solar PV and solar thermal, the mallee-based options provided the highest total economic (financial and societal) returns to the State.

From industry contacts, FFI CRC has been able to update and compare indicative electricity prices across energy options for meeting the 2020 Renewable Energy Target. Mallee co-generation with coal is the cheapest option and mallee bio-energy is on a par with other sources of biomass (forest residue, urban waste) and solar PV, cheaper than solar thermal but more expensive than wind. See Figure 1.

Figure 1: Indicative electricity value for conventional and renewable energy options.



The indicative electricity prices account for a realistic profit margin and return on investment to the generator. In this analysis it was assumed that:

To generate one MWh of electricity will require 0.55 tonnes of coal, one tonne of mallee biomass or 0.84 tonnes of forest residues. Mallee biomass typically has about 40 per cent moisture.

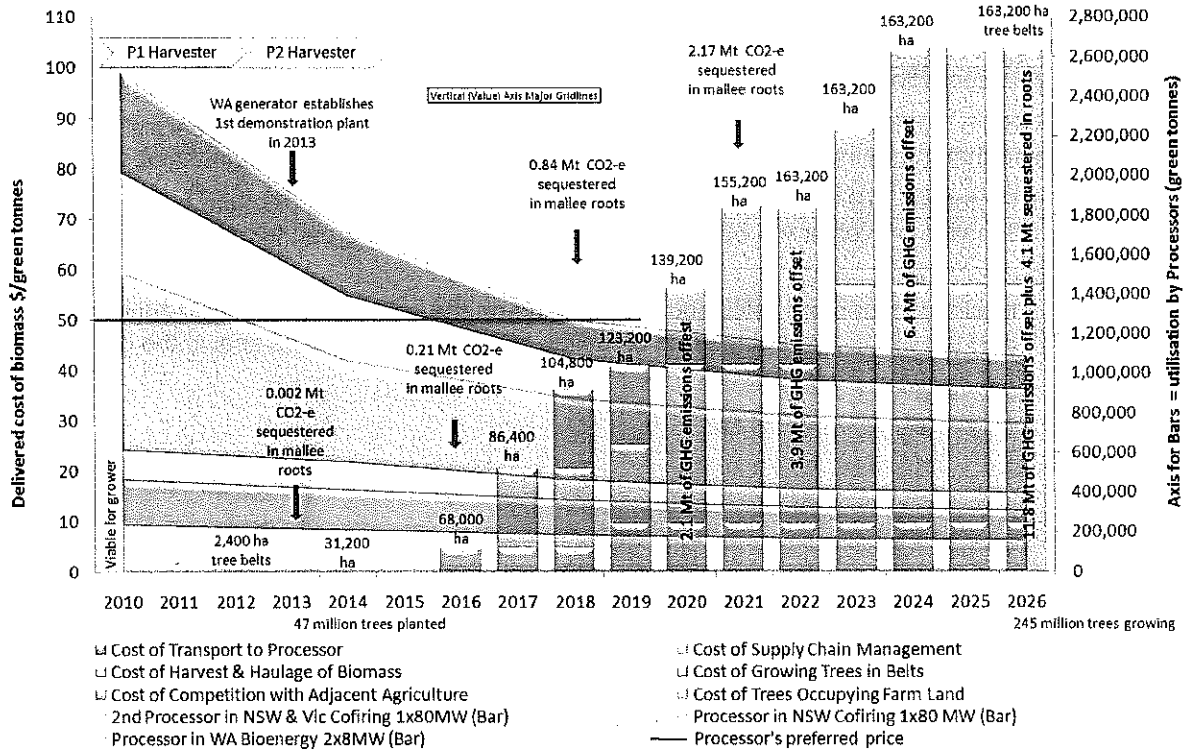
The generation process will be considered by the regulator as carbon neutral. A $10 carbon price will raise cost of generation from coal by $10 /MWh and gas by $5 /MWh as the generator has to pay the cost of emitting GHGs.

Electricity generation from Energy Tree Crops

Scenario modelling by Future Farm Industries CRC estimates that 163,200 hectares of short cycle mallee tree crops could profitably supply 176 MW of electricity generation using 2.6 million tonnes of green biomass per year by 2026. At full development 1.3 million tonnes of greenhouse gas emissions could be offset per year, or close to 12 million tonnes over a 13 year period.

This scale of energy tree cropping would contribute significantly to the regional economy, generation of renewable energy certificates and diversification on the farm. Figure 2 shows how this occurs.

Figure 2: Delivered cost of farm grown biomass from mallee tree crops of WA, NSW and Vic, and utilisation by electricity generating plants.



This analysis is based on the electricity generator in WA developing two eight MW plants each requiring 120,000 tonnes of green biomass per annum. It is likely to use a modular dedicated bioenergy system that allows an increase in generation by 2 MW every couple of years. The two generators in NSW and Victoria would each require 1.2 million tonnes of biomass per annum for co-firing with coal in conventional generators. It is assumed that the processors in WA, NSW and Victoria will ultimately pay $50 per green tonne and sign forward contracts with growers to ensure plantings and delivery.

This scenario modelling draws heavily on FFI CRC's supply chain R&D and associated analysis of the total cost of delivered biomass (shown as a slowly declining set of all cost components over time with costs shown on left hand axis). Today's growing, harvesting and transport systems and infrastructure delivers biomass at just under $100 per green tonne. However, it's likely costs will progressively decline with technology advance and operational experience, to less than $50/gt by 2018.

The right side vertical axis shows the estimated amount of mallee biomass harvested, delivered and utilised by electricity generators in their bioenergy projects by 2026. Each bar shows the tonnage used by the processor. On top of each bar is the area of tree belts from which the volume of biomass will be harvested. Within each bar is the estimated cumulative abatement of greenhouse gases.

32

Other specific assumptions in this modelling include:

The trees are planted in belts across the 450-600 mm rainfall zones of WA, NSW and Victoria within economic transport range of the electricity plants, staggered and scheduled to match future demand and reach the 163,200 ha by 2026. Each hectare has 1285 trees to give a total of 245 million trees.

The schedule of tree plantings in three states to meet the projected future demand from electricity generators will be 19,200 ha in WA planted at 2,400 ha/yr from 2012 to 2019, and 144,000 ha in NSW and Victoria (half in each state) planted at 16,000 ha/yr between 2014 and 2022.

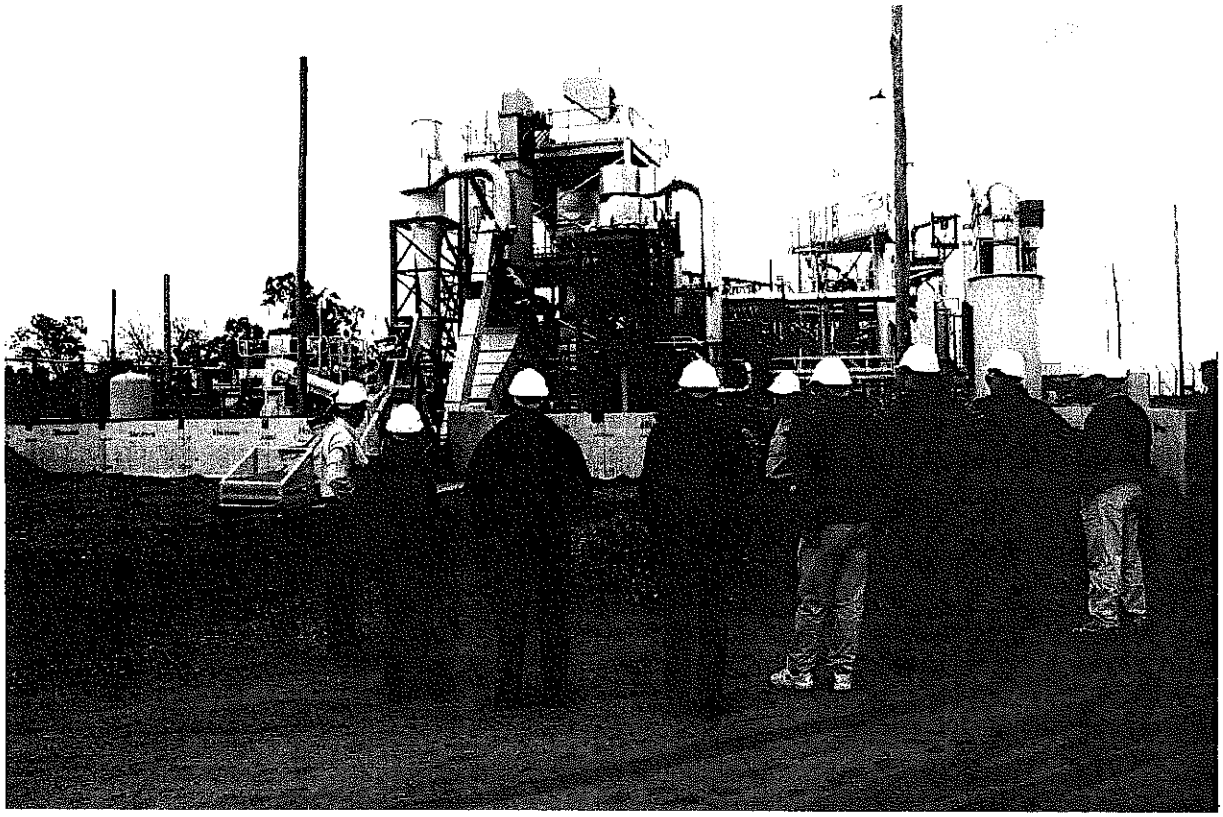
The landholder grows the trees in two-row belts across 8 per cent of the farm and gets paid enough per tonne of green biomass to recover the costs of planting as well as the forgone net income from agricultural land use in the area occupied by mallee trees and the competition with adjacent crops. Tree belts offer shelter benefits to livestock and reduce the incidence of wind erosion. They compete with adjacent crops and pastures within a few metres of the tree belts.

For each hectare of tree belt there will be about 12 hectares of conventional agriculture in the adjacent alleys. The mallee belts may have positive as well as negative effects on production within the adjacent alley.

It is assumed the first harvest is in year 5 of each planting and then every three years afterwards. It is estimated that the trees will yield 50 green tonnes per hectare of belt at each harvest.

The current Prototype 1 (P1) harvester has a capacity of 20 green tonne per hour but the more advanced P2 mallee harvester will be designed to operate at 60-80 green tonne per hour, and at lower cost.

The GHG emissions abatement calculations are based on the assumption that 0.51 tonnes of GHG (in CO2-e) are abated for each tonne of mallee biomass that replaces coal in the generation process.



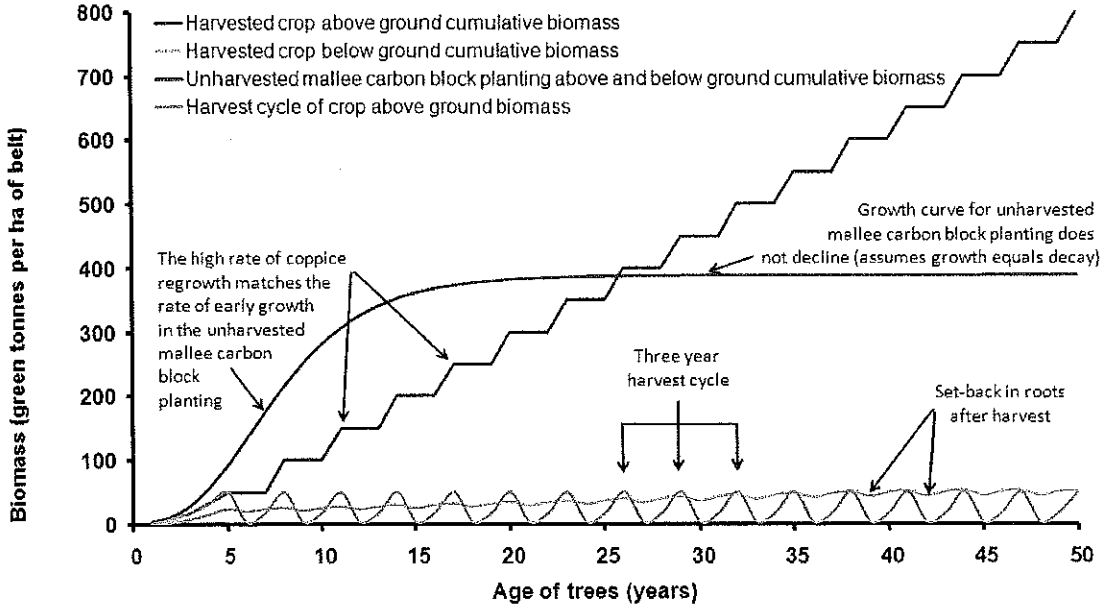
Demonstration of integrated wood processing, including 1MW electricity, at Narrogin, WA

Cash flows from crops and Energy Tree Crops

Economic modelling by the FFI CRC has compared mallees integrated into agriculture in the WA wheatbelt with business-as-usual cropping over a 50 year period into the future. The principles of this experience can be adapted to other areas of the extensive low to medium rainfall agricultural zone, as has already occurred in New South Wales.

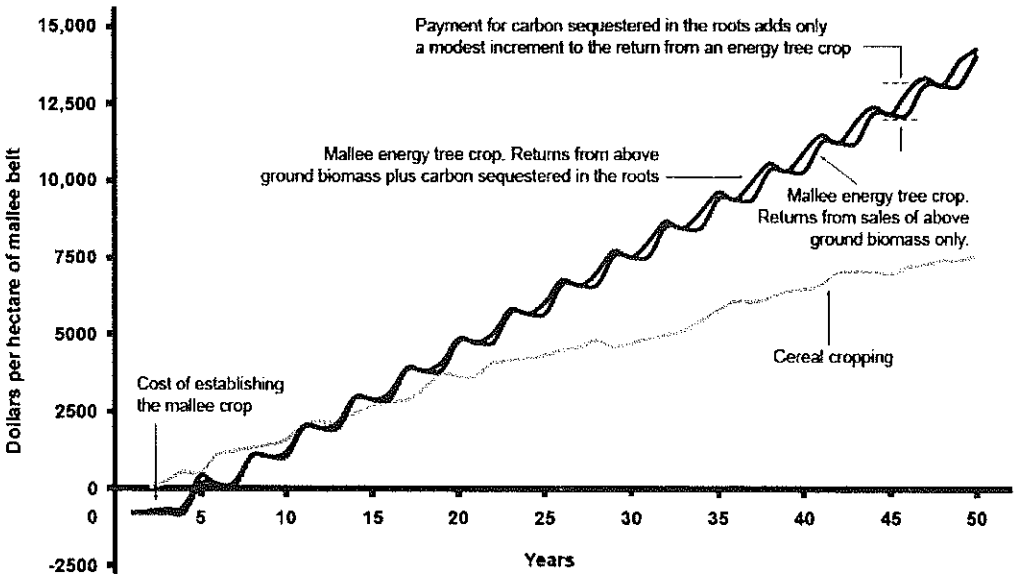
The study was based on mallees grown in two row belts and harvested and regenerated as depicted in Figure 3.

Figure 3. Modes of mallee tree biomass production for bioenergy and carbon sequestration at Narrogin, WA.



The production of mallee biomass from this strip of land (including an allowance for the competition between the mallees and the adjacent wheat crop) was compared with annual cropping on the same strip of land. The results are presented in Figure 4 over the page, and the assumptions are outlined below. A more detailed discussion is presented in Bartle and Abadi (2010)[3].

Figure 4. Cashflow for a mallee crop harvested for bioenergy versus business-as-usual agricultural land use which involves rotation of annual crops such as grain cereals with pastures for sheep grazing.



In an analysis of this type it is necessary to make some assumptions about the yields and prices of commodities of the alternative production systems proposed for an agricultural land. For instance the price of wheat was projected to follow past trends with variation in yields based on past variability in rainfall.

Historical records indicate that during the past 200 years, food prices have fallen in real terms and the terms of trade for food production have declined. In the past 50 years, this has mostly been due to improvements in agricultural efficiency. Future population growth is projected to decline to near zero by the end of this century. It was assumed for this study that agricultural practices will continue to advance as they have in the recent past. This is discussed in greater detail in Bartle and Abadi (2010)[3].

On the other hand, many industrial commodities have increased in value in real terms over this same period as wealth and consumption have increased. It is reasonable to assume that energy prices will increase substantially over the next few decades, making it likely that the price for delivered biomass will also increase.

Other, rather conservative assumptions of this analysis include:

An annualised net present value from agriculture of $164 per hectare, derived from a cash flow configured to reflect seasonal variability.

A realistic value of $50 per green tonne for biomass feedstock destined for renewable electricity production.

Establishment costs for trees of $800 per hectare of belt area (a one-off cost).

An annual maintenance cost of tree belts of $5 dollars per hectare.

Above ground biomass is 50 per cent of total biomass to first harvest.

A 30 per cent loss of root biomass on harvest, with a net 7.5 per cent gain by the following harvest.

A projected rise in the carbon price from $25/tonne CO2-e in year one to $115/tonne at year 50.

No emissions limits are currently applied to agriculture in Australia.

As the technologies develop in the future the best market for biomass is likely to be in biofuels, where energy values are significantly higher than for electricity.

Summary: Bioenergy from Energy Tree Crops is a strong contender for future renewable energy

Many new renewable energy technologies will be developed in the future, each with their relative strengths and weaknesses. The advantages of using lignocellulosic materials for bioenergy are:

Biomass is a potential base-load fuel for electricity generation due to the ease with which the biomass can be stored.

It is suited to electricity generation in rural regions, which will enable power stations to be sited at appropriate grid locations where transmission costs can be minimised.

Biomass is a renewable source of organic material. Emerging technologies will be able to convert biomass into transport fuels which can be blended with petroleum based fuels and distributed through existing infrastructure.

Significant transport activities occur outside the niche of battery-powered city commuting. Due to their energy density, liquid fuels are likely to remain the most appropriate form of energy for heavy road transport, air transport and personal rural transport.

Woody crops have the potential to make an important contribution to the economic and environmental well-being of rural Australia.

Energy tree crops represent an alternative cropping enterprise for farmers which will do more to reduce carbon emissions as cumulative crop production exceeds the capacity of the same land resource to store carbon in aging carbon forests. By 2026 it is conservatively estimated that 163,200 ha of farm planting could be supporting two 8 MW bio-electricity plants in regional WA and co-firing in existing large coal-fired power stations, one each in NSW and Victoria. At this scale the advantages listed above will start to be realised.

Energy tree crops established strategically in the dryland wheat-sheep belt of southern Australia have the potential to deliver substantial benefits in renewable energy production, greenhouse gas mitigation, more diverse and resilient farming systems and regional economies, a distributed energy grid and environmental co-benefits such as erosion and salinity control and wildlife habitat, without compromising water yields or food and fibre production.

Energy tree crops offer a classic 'win win' option amid the often-conflicting insecurities at the intersections of carbon, water, energy and food.

Addendum: Future of bio-energy

Global bio-energy

There have been a number of important studies relating to bioenergy that have been published in the past two years[1,4,5] that have forecast the productive capacity of global agricultural land and commercial forests, and then related that capacity to projected global energy demand.

Bioenergy accounts for about 10 per cent of current global energy consumption. About half of this is fuel-wood for heating and cooking in traditional systems. However, the modern bioenergy proportion is now expanding rapidly. Sweden sources more than 30 per cent of its total energy requirements from forestry and timber processing residue, and in Brazil the proportion of ethanol from sugar cane in the national petrol supply is over 40 per cent. These two nations have seen steep reduction in bioenergy cost as the scale of their operations has increased. Many other nations are investing heavily in bioenergy R&D.

The technical potential volume of biomass supply at 2050 is projected to be sufficient to meet total global energy demand, without compromise to the required level of food production[4,5]. There are substantial current and projected biomass residues and these will make a major contribution to future bioenergy production. However, there is potential for large scale woody crops, especially where they are used in production systems that are complementary to agriculture, or where they utilise degraded land, to be competitive with residues and form a major component of future biomass supply. Projections by the International Energy Agency rank biomass as the largest renewable energy source with a market share up to 15 per cent by 2030 and 33 per cent by 2050[5].

Global corporate merger and acquisition (M&A) activity provides another insight into bio-energy's future. The recent 2010 survey of more than 250 senior executives in the renewable energy industry[6] indicated that large corporate utilities, in particular, were emphasising biomass targets in their M&A plans. The appeal of biomass projects to all companies and investors (37 percent of corporates looking for transactions) had risen to slightly exceed solar (36%) and onshore wind (35%). Biofuels came next, appealing to 29 per cent of renewable energy companies and investors. They were attracted to biomass by greater potential returns and its potential to operate as a base-load power source. The lack of visibility of long term resource supply and pricing was seen as a constraint.

Bio-energy in Australia

Bio-electricity and biofuels in Australia, in contrast to Europe and the United States, are operating at very small scales. In 2009 it was estimated that biomass contributed 0.7 per cent of total electricity and biofuels supplied 0.45 per cent of total transport fuels.

It is most notable that bio-energy receives very little attention in media coverage and policy discussion of Australia's renewable energy future. Yet if this nation is to achieve a low carbon future there are compelling reasons why bioenergy industries will be strategically important. For example, ClimateWorks Australia's 'low carbon growth plan'[7] released in March 2010 estimated biomass/biogas and biomass co-firing to be comparable to onshore wind and geothermal on the investor cost curve for greenhouse gas abatement (in the range of $60-80 per tonne CO_2-e). For the period to 2020 biomass is predicted to be significantly cheaper per unit than solar thermal, solar PV and wind. The more recently published Beyond Zero Emissions 'zero carbon Australia stationary energy plan'[8] mapped a path to Australia's energy needs being met with 100% renewable by 2020. The technologies chosen were wind, solar thermal solar PV and hydroelectricity. Significantly, biomass energy supply was included as back-up electricity supply to offer energy security when a combination of low wind and low daily solar radiation occurs. This would be in the form of biomass co-firing of solar thermal plants, with 15 GW electrical equivalent of biomass-fired backup heaters representing about 2 per cent of total capacity. To achieve this more aggressive vision there would need to be $6 billion invested in bioenergy supply as part of the total of $370 billion, including a national transmission grid.

Energy Tree Crops, bioenergy and biofuels

Energy tree crops are only one potential source of biomass for bio-energy. The full range of sources can be classified as follows:

Primary: various forms of energy crops, field residues from agriculture and forestry;

Secondary: wastes generated in manufacturing products from agricultural and forestry feedstocks; and

Tertiary: salvage material collected after secondary use.

In industrial systems there are two main forms of bioenergy:

bio-electricity: commonly used where residues are readily available such as in forestry, timber mills and sugar mills, and in the future, from primary energy crops.

bio-fuels: where starch, sugar and plant-oil feedstocks are converted to transport fuels using conventional technologies. These technologies are often referred to as 'first generation', in anticipation of emerging 'second generation' technologies to follow. Second generation processes are now being actively developed to convert the potentially large supply of low-cost cellulosic biomass from primary energy crops, both herbaceous (especially grasses) and woody crops, into the transport fuels of the future.

Primary energy crops will include:

A range of starch, sugar and plant-oil producing species that have biomass components suitable for conversion to bio-fuels using conventional technologies, e.g. maize and sugar cane to ethanol, oil seeds and oil palm for biodiesel.

Perennial woody and herbaceous species that produce high yields of cellulosic biomass and are able to regenerate by coppice/sprouting under a short harvest cycle.

Lignocellulosic biomass is a renewable source of hydrocarbons. This plant material embodies solar energy that may be stored in the standing crop or in stockpiles. By using CO_2 from the atmosphere to grow biomass, the carbon emitted from the combustion of the biomass does not cause the release of fossil carbon that causes so much concern in relation to climate change.

The biomass may be burnt directly to produce heat (thermal) energy for industrial and domestic uses, or to produce super-heated steam to generate bio-electricity. However, the greatest economic potential for cellulosic biomass lies in it being converted into higher value liquid or gaseous fuels[4] — the second generation bio-fuels. The various processes by which this can be done could also produce many of the compounds that are the basis of the wider petrochemical industry (for example, plastic precursors and resins).

Energy Tree Crops complement farming for food.

The term 'bioenergy' often raises concern about food versus fuel. This is due to the use of grains, sugar, and oilseeds to produce first generation biofuels. For example, the recent rapid expansion of ethanol from maize in the United States caused considerable controversy. This issue has stimulated interest in second generation fuels derived from lignocellulosic biomass such as cane bagasse, wood, inedible foliage and crop stubbles[3]. If woody crops such as mallee or willow are grown for energy, they can be established on land not used for food production, or configured in ways that allow the tree component to complement on-farm food production enterprises.

Most first generation biofuels also require large inputs of energy per unit of energy in the fuel produced. They are doing little better than converting fossil coal, oil and gas into biofuels. The energy efficiency of second generation biofuels production is much higher than for the first generation fuels.

If the future of biomass energy is focused on second generation fuels, there remains the question of the extent to which woody crops will encroach on the finite agricultural land resource and put upward pressure on food prices. This is not expected to be a problem because not all the potential economic production of bioenergy will come from woody crops, and in occupying agricultural land their economic value is likely to be greatest where they have a comparative advantage and deliver collateral benefits as a component of the agricultural system. These benefits include diversification of the rural economies, interception of nutrient rich run-off, salinity control, protection of soil from episodic wind erosion events, conservation benefits and provision of shelter for livestock during lambing and off-shears. Furthermore, with declining global population growth rates it is expected that advances in agricultural technology will be more than able to maintain food supply. Bartle and Abadi (2010) cite many studies published between 2003 and 2009 on this topic.

Further research

It was noted previously that there is a technical capacity to produce most of the world's energy requirements from biomass by 2050, but studies indicate that the economically viable proportion will be less, ranging from 10 per cent (of a larger energy market) under a business-as-usual scenario, to 33 per cent if there is a global endeavour to restrict CO_2 concentration in the atmosphere to 450 parts per million in 2030[1,5].

A very important factor that will constrain the expansion of cellulosic biomass for bioenergy is expected to be the cost of producing and delivering biomass to market. In consequence, it is anticipated that bioenergy will be most successful as second generation biofuels sold into markets traditionally supplied by the oil and gas industry[5].

In Australia there has been a sustained endeavour to reduce the cost of producing biomass from mallees to enable it to compete in the energy markets. To support the development of the new industry a prototype harvester is under construction at Toowoomba, Queensland. This work is funded through the Future Farm Industries CRC by the WA Government's Low Emissions Energy Development (LEED) fund. Field trials started in early 2010. The objective of this project is to produce technology that can harvest and chip small trees at a per-tonne cost of about half that of best practice in plantation forestry; an ambitious objective given that small trees are normally the most expensive to harvest in plantation forestry. This will be achieved by combining felling and chipping into a single continuously travelling machine analogous to the machinery used in sugar cane or forage harvesting operations.

Definitions

Alleys: The open spaces, where normal cropping and grazing enterprises occur, that separate belts of woody crops. Alleys are usually 90 per cent or more of the total paddock area.

Belts or **tree belts**: Trees may be integrated into agricultural systems by planting in narrow belts of two rows or more with wide alleys (between 70 and 80 metres) between the belts. Belts can be linear or on the contour and there are important interactions between the belts and the crops or pastures in the alleys.

Bioenergy: Any energy product made from biomass.

Biofuels: Liquid fuels produced from biomass.

Biomass: In this context, any traded or measured plant material either in its primary form (grown and harvested crops), secondary (as the residue of agricultural or forestry crops) and tertiary (urban and industrial wastes).

Blocks or **tree blocks**: Trees planted in contiguous areas varying from less than a hectare to many hectares, as is usually employed in high rainfall tree plantations. Block plantings operate somewhat differently from belts in that there is more competition between trees and they are not integrated into an agricultural system, meaning there is less interaction between the trees and the agricultural system.

Carbon sequestration: The process of placing CO_2 into storage to prevent the CO_2 from entering the atmosphere. It includes geosequestration and biosequestration. An example of geosequestration is the underground storage of fossil CO_2 from a coal-fired power station. By contrast, biosequestration is the removal of CO_2 from the atmosphere using photosynthesis by plants. Biosequestration is typically used to offset fossil CO_2 emitted elsewhere (for example planting trees to offset air travel).

Carbon sink: A store of carbon, in this context, a long term planting of shrubs or trees on former farmland, which would then be defined as a carbon forest.

Energy crops: Biomass crops grown primarily for bioenergy and usually defined by the plant form (tree, shrub, woody or herbaceous). For example, energy tree crop, woody energy crop.

First generation feedstocks: Materials such as cereal grain, oil seeds, palm oil and cane sugar which are readily converted into biofuels using existing technologies. The sugars and starches are fermented to produce ethanol and the oil feedstocks are processed to produce a diesel substitute.

Second generation feedstocks: In the context of this paper, biomass from woody plants containing the characteristic woody material of lignin combined with cellulose. Second generation feedstocks are also called lignocellulosic feedstocks. Agricultural wastes such as cane bagasse and cereal straw are also second generation feedstocks. There are numerous processes being developed to convert these materials into a range of biofuels.

Woody crops or tree crops: Any tree or shrub grown as a crop for harvest to produce biomass for processing into energy or other industrial products. Woody crops can be grown in large contiguous areas (plantations or forests), or be dispersed as small blocks or long belts. The term 'woody crop' can embrace plantation forestry, farm forestry and agroforestry. In the context of agricultural regions, woody crops usually refers to small trees and shrub-form species harvested on a short cycle of less than 10 years.

End notes

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7. ClimateWorks Australia (2010) Low Carbon Growth Plan for Australia. Report summary, March 2010. Available at: www.climateworksaustralia.org
8. Wright, M. and Hearps, P. (2010) Beyond Zero Emissions: Australian Sustainable Energy Zero Carbon Australia Stationary Energy Plan, The University of Melbourne Energy Research Institute. July 2010. Available at: www.energy.unimelb.edu.au

Att #6

-The Dean Report: A Noise impact assessment of the Waubra Wind Farm

June, 2010 by Robert Thorne, PhD, MS, FRSH, MIOA, MAAS (from Windaction: the website of the Industrial Wind Action Group: www.windaction.org)

Summary:

Mr and Mrs Noel Dean requested a Report providing an assessment of the potential for adverse effects due to activity from the Waubra wind farm while living in their residences and while working on their farms. Dr. Robert Thorne undertook the study. His full report can be accessed via the link at the bottom of the 3rd paragraph. Below is a summary of Dr. Thorne's findings and conclusions.

My research to date for this investigation indicates "ordinary" wind has a laminar or smooth infrasound and low-frequency flow pattern when analysed over short periods of time. Wind farm activity appears to create a "pulsing" infrasound and low-frequency pattern. These patterns are illustrated in sonograms in this Report. My hypothesis at this stage is that wind farm sound has an adverse effect on individuals due to this pulsing nature, as well as audible noise due to the wind turbines. These effects may be cumulative. Research into this hypothesis is described further in this Report.

It is concluded, from the information presented, that Mr Dean has been and is currently adversely affected by the presence and activity of the Waubra wind farm. The effects stated by Mr Dean as affecting his health and statutory declarations from his family and residents in the vicinity of the wind farm attest to adverse health effects. Adverse health effects such as sleep disturbance, anxiety, stress and headaches are, in my view, a health nuisance and are objectionable and unreasonable. http://www.windaction.org/documents/28511

Windaction Editor's Notes:

[1] The Waubra wind energy facility is located near Ballarat, in western Victoria, Australia. It is the largest operating wind facility in the southern hemisphere consisting of 128-1.5 megawatt turbines for a total installed capacity of 192 megawatts. The turbines were first turned on in February 2009; the facility was fully operational by July 2009.

[2] Noel Dean and his family moved away from their farm in the spring of 2009 when the headaches and other symptoms worsened.

Attached are extracts (pages 52,64,65,69, 110,111,113 & 115) from the above report. Please note illustration on page 69: One version of the proposed Flat Rocks Wind Farm provides for a turbine (tower plus blade) that is 21M higher than the largest turbine as shown in the illustration. For comparison the Albany Wind Farm turbines have a 65m tower and three 35m long blades making a total height of 100M.

The turbines (tower plus blade) proposed for the Flat Rocks Wind Farm are 146M in height, which is equivalent to a 48 story building. There are 74 turbines proposed.

5 SOUND AND HEALTH

Introduction

This Introduction is by B. Rapley as recorded in 'Sound, Noise, Flicker and the Human Perception of Wind Farm Activity' introducing the monograph by Dr D. Shepherd.

> To understand the nature of the potential hazard, it is necessary to understand the nature of sound and the way it interacts with the human body. Dr. Daniel Shepherd takes on this task, providing a tutorial on the nature of the phenomenon and the method of interaction with human physiology. He makes the important point that, contrary to popular belief, we do not become used to noise (unwanted sound). To assume that someone can simply learn to accommodate a noise and ignore it is largely untrue. Dr Shepherd concludes that there is now convincing evidence in the literature that community noise causes annoyance, disrupts sleep, impairs children's school performance and negatively affects cardiovascular health. It also impedes rest, relaxation and recreational activity.
>
> The latest research indicates that nuisance noise from wind farms is associated with psychological distress, stress, difficulties with falling asleep and sleep interruption. Furthermore, it is very hard to predict how annoyance from noise will compromise the health of susceptible individuals by considering the physical properties of the noise. This surely raises red flags for both those setting noise standards and those involved with policing consents. On these issues alone it is clear that there must be far more care in the siting of any future wind farms and a better understanding of how to mitigate the noise and compensate the affected individuals. The age-old question still exists: when do the needs of the many outweigh the needs of the few?

Brief excerpts from Dr Shepherd's monograph follow. For the complete monograph and references see 'Sound, Noise, Flicker and the Human Perception of Wind Farm Activity' the evidential text for the proposed Turitea wind farm (New Zealand) hearing.

What is noise

Sufficient evidence now exists to link community noise to health problems, with one literature review concluding the following:

> "It can be seen that these international groups of experts considered that there was sufficient evidence for the effects of noise on health regarding annoyance, school performance, ischaemic heart disease, hypertension and various aspects of sleep disturbance."

7 WIND FARM NOISE AND HUMAN PERCEPTION

Investigations in New Zealand have proven that the sound(s) of wind turbines are audible at low amplitudes inside homes. Such sound has readily identifiable perceptual dissonance and has a direct relationship to annoyance and sleep disturbance. This Report presents the effects of wind farm noise on residents near the Waubra wind farm and two wind farms in New Zealand and identifies concerns with potential adverse health effects, including audible, low frequency and infrasound effects.

My observations and measurements indicate that a wind farm is a source of noise (sound and vibration). It is a highly complex source of noise and is, in my opinion, unique due to its complexity and human perception. The receivers of the noise (that is, people) are highly complex in response. People do not respond to "single number" sound levels or noise levels for that matter. In the event, the installation of turbines at Waubra and Te Rere Hau and Makara (New Zealand) has resulted in widespread complaint concerning sleep disturbance due to unreasonable noise. My observations within a Makara residence show that outdoor levels of modulated sound below Leq 30 dB(A) are clearly audible within the home at night under calm weather conditions outside.

Based on my observations in the Manawatu, at Makara and in Waubra, it is my opinion that a background sound level of 40 dB(A) (or 38 dB(A) LAeq) due to wind farm noise is too high at residences. At the West Wind (Makara New Zealand) Hearing Dr van den Berg and I received agreement from the Experts' Caucus to present a separate statement to the agreed matters-

> *"We believe that the conditions here agreed upon will protect residents from severe annoyance and sleep disturbance, but not from annoyance and loss of amenity. We believe annoyance and loss of amenity will be protected when the wind turbine noise limit would be 30 dBA L_{95} in conditions of low wind speed at the dwellings and modulation restricted to 3 dB."*

The LA95 background sound level of 30 dB(A) is broadly equivalent to 32 dB(A) LAeq.

I am of the opinion, based on my own research, that wind farm noise can and does create unreasonable noise within residences and consequential adverse effects in the sense of sleep disturbance, annoyance and potential adverse health effects to residents living within 2000 metres of large wind turbines set in a wind farm. These risks are quantifiable and the effect is significantly more than minor.

Based on my observations within the Manawatu and Makara I am of the opinion that wind farm sound can be heard and recorded within residences situated within 3500 metres of large turbines

set in a wind farm. The risk of adverse effect due to sleep disturbance and annoyance is quantifiable and the effect is significantly more than minor.

Based on anecdotal evidence I have heard from affected people visual amenity also affects the perception of sound from sources of noise. This effect should be considered as part of a risk assessment. Perception of noise is enhanced when the turbines have visual dominance. By day, blade glint and flicker increase perception. At night, the red warning lights cause blade glint and strobing effects. Light bounce from low cloud creates visual dominance.

As previously stated the most significant issue for the practical management of wind farm noise is that the New Zealand standard lacks a methodology to separate single-value LA95 sound levels created by the wind turbines from ambient LA95 sound levels existing at a specific time and place due to wind movement, vegetation movements, bird song and so on. The "different" background levels cannot be separated using the standard's approach unless the turbines are switched off.

Unreasonable or disturbing noise will occur when the sound from a wind farm disturbs sleep and thereby causes anxiety, annoyance and stress. That unreasonable or disturbing noise can occur is well documented in peer-reviewed and impartial research. My research over 5 years and in Victoria and New Zealand indicates the existence of noise induced sleep disturbance and adverse health effects due to wind farm noise.

The expression sub-audible character is given in this Report to differentiate between low frequency sound (which has a solid foundation in hearing response) and infrasound, which has a less solid foundation in hearing response. Infrasound, however, has characteristics that may lead to adverse health effects. There is an extensive world-wide debate between acousticians, health professionals and the community (primarily affected persons) concerning potential adverse health effects due to the influence of wind farms. This is still the subject of debate, as outlined in this Report. However, there is sufficient peer-reviewed research and solid acoustical foundation for analysis to be made.

The above issues are debated in more detail in the evidential text *"Sound, Noise, Flicker and the Human Perception of Wind Farm Activity"* that was prepared for the Board of Inquiry Turitea Wind Farm Proposal Hearing, New Zealand, March 2010. The authors are a team of researchers that provide independent unbiased advice to the community and wind farm developers concerning the potential for adverse effects and mitigation of wind farm activity on people.

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Chapter 1: Audible Sound and Noise

Wind farms and wind turbines are a unique source of sound and noise. The noise generation from a wind farm is like no other noise source or set of noise sources. The sounds are often of low amplitude (volume or loudness) and are constantly shifting in character ("waves on beach", "rumble-thump", "plane never landing", etc). People who are not exposed to the sounds of a wind farm find it very difficult to understand the problems of people who do live near to wind farms. Some people who live near wind farms are disturbed by the sounds of the farms, others are not. In some cases adverse health effects are reported, in other cases such effects do not appear evident. Thus wind farm noise is not like, for example, traffic noise or the continuous hum from plant and machinery. Wind turbines such as those proposed are large noise sources relative to dwellings, Figure 1:

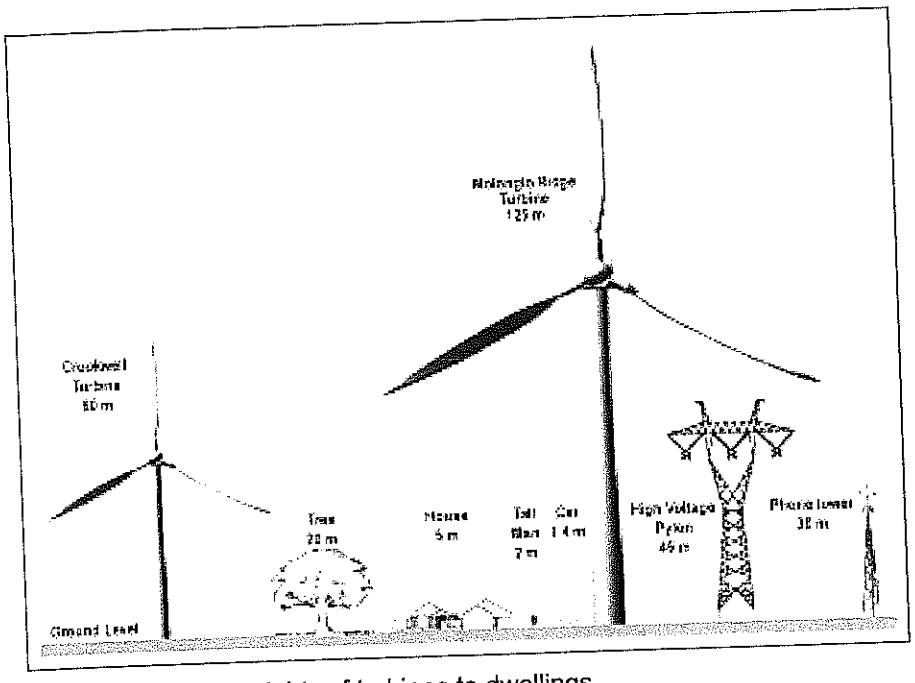

Figure 1: Relative heights of turbines to dwellings

(Source: Molonglo Landscape Guardians, by permission)

Audible noise from modern wind turbines is primarily due to infrasound, turbulent flow and trailing edge sound. Sound character relates to blade characteristics and blade/tower interaction and can be grouped into 4 main bands. The sound can be characterised as being impulsive and broadband, audible and inaudible (infrasonic):

- Infrasound below 20 Hz
- Low frequencies 20 Hz to 250 Hz
- Mid Frequency 250 to 2000 Hz (broadly, although the higher level could be 4000 Hz)
- High frequency 2000 Hz to 20,000 Hz

The Effects on People near the Waubra Wind Farm, Victoria

The Waubra wind farm commenced operation in March 2009 in the Ballarat section and May 2009 in the northern Waubra section. Within a short time nearby residents were becoming concerned about noise. By August 2009 adverse health effects were being reported. In September-October I interviewed 5 different families near the northern section of the wind farm, all of whom report some adverse reaction since the commissioning of a nearby wind farm earlier in the year. The families are all within approximately 1000 – 2000 metres of turbines and had at least two sets of turbines near to them. Under these circumstances the residences are affected by wind farm activity over a range of wind directions. The interviews were preliminary in nature and standard psych and noise sensitivity tests were not conducted, nor were detailed health notes recorded.

Family A reports headaches (scalp and around the head pressure), memory problems and nausea when the turbines are operating. Symptoms include an inability to get to sleep and sleep disturbance, anxiety and stress, pressure at top and around head, memory problems, sore eyes and blurred vision, chest pressure. When the turbines are stopped the symptoms do not occur. A difference in severity is recorded with different wind directions. A personal comment made states:

> *"I am having problems living and working indoors and outdoors on our property ... problems include headaches, nausea, pain in and around the eyes, sleep disturbance, pain in back of head; we feel this is coming from generation of wind from wind farm as it is OK when turbines are stopped."*

Family B reports tinnitus, dizziness and headaches since the turbines have started operating. Sleep disturbance at night with the sound of the turbines interrupting sleep pattern. Vibration in chest at times. Tiredness and trouble concentrating during the day. Does not have problems sleeping when not at Waubra overnight.

Family C reports the noise coming from the turbines at night disturbs sleep. During the day there is noise which causes bad headaches, sore eyes causing impaired vision earache and irritability.

Family D reports suffering from sleep disturbance, headaches, nausea and tachychardia (rapid heart rate) since the turbines started operating.

Family E reports that when the turbines are operating symptoms include feeling unwell, dull pains in the head (acute to almost migraine), nausea and feeling of motion sickness. At night when the turbines are in motion sleep disturbance from noise and vibration (unable to get any meaningful deep sleep), sleep deprivation leading to coping problems. The problems are reported as:

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"Some days when the wind is in the north-eat my eyes feel swollen and are being pushed out of the sockets. I have a buzzing in my ears. On these days I feel it very difficult to summon memory and difficult to concentrate."

and

"The sound of the turbines when functioning is on most days so intrusive that it affects my concentration and thought processes when performing complex tasks. I suffer from sleep interruption as a direct result of the noise which then affects my ability to function at 100% the following day. One is aware of a throbbing in the head and palpitations that are in synchrony with the beat of the turbines and to a degree the flashing of the red lights. Because of this impact on my everyday life it causes me great stress and in turn great irritability.

Two families identified blade glint / flicker and the red warning lights on the top of each tower as an additional source of annoyance.

Statutory declarations (June 2010) concerning noise issues have been declared by residents affected by the Waubra wind farm. Noise from the turbines is being experienced by residents within approximately 1000 metres of the nearest turbines and at distances of approximately 3000 to 4000 metres distant from the nearest turbines. The locales where the residents experience noise are shown in Plate W1. The noise and health effects experienced by residents are presented in Table W1.

The Waubra north and Ballarat locales are rural in nature with relatively low hills and rolling countryside. The northern section of the wind farm is illustrated in Plate W2 following. The locale is affected by south-west winds at turbine level but can be relatively calm at residences. The prevailing winds at Ballarat airport are shown in Figure W1, following. The measured wind directions are given to illustrate the importance of accurate wind data in predicting or assessing complaints.

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Table W1: Waubra wind farm affects, perception and complaint analysis

Locale	Distance	Noise affect
1	1500-2500	Sleep disturbance, headaches, affects eyes and back of head, tinnitus. Worst affect is while working the farm. Heart pressure changes
2	1000	Sleep disturbance, headaches, high blood pressure
3	1000-1300	Sore eyes and headaches when the turbines are operating
4	1250-3000	Sleep disturbance. Affects people working on the farm. Headaches, earaches, blood pressure changes and poor eye sight.
5	1300-2200	Insomnia, headaches, sore eyes, dizziness, tinnitus and heart palpitations. Deteriorating health due to lack of sleep and stress levels. Unable to sleep through the night. Affects while working outside on the farm.
6	2000-2300	Headaches and pressure in ears when working on the farm.
7	550-1400	Sleep disturbance, windows vibrate. Affects while working on the farm. Headaches, lack of sleep, major problem with flicker. Excessive noise under a strong southwest wind
8	1000-3500	Headaches when working farm within 1500 metres of turbines. Dizziness when 2 turbines inline and in sync, effect went when approx 300m out of alignment. Sleep awakenings and disturbed by pulsating swish. Heart palpitations, vibrating sensation in chest and body. Headaches while at home. Stress and depression.
9	3500-4300	Frequently suffer from headaches, tinnitus, irritability, sleepless nights, lack of concentration, heart palpitations. Turbines exhibit a loud droning noise and pulsating whoosh.
10	3400-3800	Headaches, ringing in ears when turbines are operating. Pressure in ears, heart palpitations and anxiety attacks. Awaken at night, sleep disturbance.
11	3000-4600	Elevated blood pressure, heart palpitations, ear pressure and earache, disrupted sleep, increasing frequent headaches, head pressure, vibration in body, mood swings, problems with concentration and memory. Awaken at night, sleep disturbance.
12	1000-1200	Headaches, sickness, frequent sleep disturbance, very stressed. Affects personal life. Lights on turbines cause extreme distress. Ear pressure and loss of balance while working on the farm. Enormous pressure and stress on home and work.

Notes: 'Distance' is the distance in metres between the locale and the nearest turbines. The distances vary where turbines are in different directions surrounding the locale. Each locale contains one or more affected families. A common observation is that the adverse health effects noted did not exist before the wind farm commenced operation or diminish / disappear when not in the district affected by turbines.

The Effects on People near the "West Wind' wind farm, New Zealand

The Westwind wind farm commenced operation in May 2009. From my observations at Makara New Zealand at a residence situated approximately 1200 - 1300 metres from 5 turbines and within 3500 metres of 14 turbines there is known probability that the wind farm will exhibit adverse "special audible characteristics" on a regular basis resulting in sleep disturbance, annoyance and stress.

The observations and measurements being recorded at Makara involve the residents taking notes of the noise heard when they are awakened. At the same time a fully automated monitoring system records exterior audio as well as exterior and interior sound level data in summary levels and third-octave band levels. This allows the generation of tracking data and sonograms for compliance and unreasonable noise assessment. The complaint data is retained by the City Council. Statistical data is retained by the wind farm operator and summarized for the Council. Audio data for real-time analysis of special audible characteristics is not recorded by either Council or the wind farm operator. Audio data is recorded, however, by at one affected resident.

In the period April 2009 to 31 March 2010 a total of 906 complaints have been made to the Wellington City Council New Zealand concerning noise from the wind farm at Makara. These complaints have been made by residents living near to and affected by the wind farm. The turbines are Siemens 2.3MW machines situated approximately 1200 metres to 2200 metres from residences.

In personal interviews at Makara some residents have identified nausea as a problem. In the most severely affected case known the residents have bought another property and moved away from their farm.

Low frequency sound and infrasound are normal characteristics of a wind farm as they are the normal characteristics of wind, as such. The difference is that "normal" wind is laminar or smooth in effect whereas wind farm sound is non-laminar and presents a pulsing nature. This effect is evident even inside a dwelling and the characteristics are modified due to the construction of the building and room dimensions.

An analysis of the complaint history has been made. The character of 650 complaints has been sorted by type, figure WW1. Rumble, with 252 mentions, is the most common characteristic. Hum and thump are the next most common annoying sounds. In comparing complaints of noise outside to inside, of 650 complaints, only 23 specifically mention the noise as being outside. This, from my measurements, would be outdoor background levels of much less than 40 dB(A), around 28 to 30 dB(A) L95. Of the indoor complaints, 4.5% specifically mention sleep disturbance.

Att # 8.

Open Letter to the Premier of Victoria, Mr John Brumby 20/10/2010

My name is Dr Sarah Laurie, and I am the Medical Director of a newly formed national organisation called the Waubra Foundation. Our task is to act as a catalyst to ensure that independent peer reviewed research into the emerging issues of adverse health effects associated with wind turbine developments is urgently carried out. We have the current situation where our peak health body, the National Health and Medical Research Council, rightly says there is no peer reviewed evidence of adverse health effects from these wind turbine developments, but this does not mean there is no problem.

In the light of the extensive and growing anecdotal reports of health problems being experienced by those who live and work close to these turbine developments across the world, and the planned deployment of turbines close to homes and workplaces, it is imperative that such research is urgently carried out, independent of all those with vested interests in the outcome of such research.

As part of my duties as Medical Director, I have recently spent 2 weeks in Victoria, and spoken with people from Toora, Waubra and Cape Bridgewater. I have listened to the stories of those people who claim their health has been adversely affected since the turbines in their area started operating, met with public health and local council officials, provided information to interested Medical Practitioners, given public presentations, and spoken with the media, and discussed possible areas for research with interested researchers.

I was shocked at the extent and severity of symptoms which have been experienced by some individuals which appear to be related to the turbines when they are operating. Some patients experience symptoms when they are five km away from the nearest turbines.

Five people have had a clinical history consistent with a very rare and serious condition known as an acute hypertensive crisis, where they develop a sudden acute severe headache, nausea, a sensation of their heart leaping out of their chest, and they feel extremely unwell. This pattern of symptoms is associated with a dangerously high blood pressure, and warrants immediate medical attention. The Director of the Emergency Department at Ballarat Base Hospital is now aware that patients who develop these symptoms will be coming to his department. I was also shocked at the extent of acute psychiatric distress which some of these patients have been experiencing. Both the episodes of apparent hypertensive crises and depth of psychiatric distress have also been noted by the Canadian researchers I am in contact with, although this has not yet been described in any formal published medical studies.

I am appalled at the number of families I spoke to or was told about, who have had to leave their land because of poor health which they attribute to the turbines, thus losing not just their health, their homes, but often their livelihoods as well, as they were unable to

continue working their land. This pattern has been experienced across the world, and has been well described by Dr Nina Pierpont (USA), Dr Robert McMurtry (Canada), Dr Michael Nissenbaum (USA), and Dr Amanda Harry (UK).

Two individuals from different parts of Victoria who have signed confidentiality agreements restricting them from talking publicly about their symptoms and health problems spoke with me, in confidence, and I was dismayed to hear of this practice by the wind companies. I understand it is also widespread overseas. This has unfortunately contributed to a situation where health problems have gone undetected by the medical community because of this restricted access to information which inevitably delays proper public health research.

At the end of this month I am attending the International Wind Turbine Health Conference in Ontario, Canada, together with clinicians and researchers from across the world, who are all concerned about this issue and wish to share current knowledge and plan future research. This is a growing international issue, impacting many rural communities. Rural residents, clinicians and acousticians working in Canada, the USA, the UK and Scandinavia are all becoming aware that turbines appear to be affecting people's health in unexpected and unexplained ways. The patterns of symptoms being experienced are however, remarkably similar. Some countries, such as Denmark, have decided to only build new turbines out to sea. Mr Peter Jorgensen, the Danish Wind Industry Expert recently in South Australia as the guest of the premier Mr Mike Rann, confirmed this at a public meeting at the Adelaide Town Hall and during a radio interview on ABC Adelaide local radio with Carol Whitelock. Mr Jorgensen specifically stated that this was because of concerns about noise and health.

Our request is simple and not unreasonable. We agree that the peer reviewed independent acoustic, scientific, and health studies have not yet been done. So let's do them properly, independently, and with the appropriate levels of funding. Let's proceed with caution, delay construction and approval of further wind developments which are closer than 10km to homes and workplaces, until the results of these studies are known.

Dr Sarah Laurie,

Medical Director

Waubra Foundation,

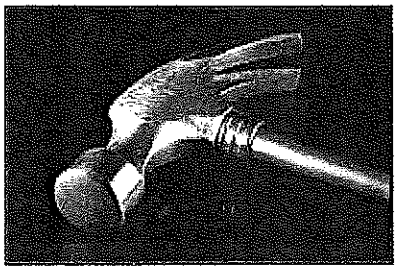
PO Box 1136 South Melbourne, VIC 3205

Att # 9.

-  "Waubra Death Trip": How Big Wind Killed a Community (Australia)

Expert confirms wind turbines hammer property value (Australia)

By admin Friday January 21, 2011



"There is absolutely no doubt that the value of lands adjacent to wind towers falls significantly in value."

—Shane McIntyre, National Sales Manager, Elders Rural Real Estate Services (1-18-11)

I have been a Licensed Estate Agent for 30 years, specialising in the sale of Rural property, essentially all over Australia, with an emphasis on Victoria and the Riverina. I have held senior management positions with the largest rural real estate companies in Australia.

Shane McIntyre

In recent years the growth of activity and the actuality of wind towers throughout the Victorian rural landscape has been significant.

Challicum Hills, Coddrington, and Mt Mitchell have all emerged as large-scale wind farms, located on the tops of the low hill-country, interrupting the landscape for many kilometres.

Of significant importance is the negative effect on the value of adjoining lands where wind towers have been erected. Visually, the towers are seen by the majority of the market as repulsive. Audibly, the towers affect the stillness a property enjoys, in particular the resonating tones in the night, invading serenity of the adjoining lands.

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A proliferation of wind towers adjacent to a property has the same effect as high voltage power lines, rubbish tips, piggeries, hatcheries, and sewerage treatment plants. That is, if buyers are given a choice, they choose not to be near any of these impediments to value.

The ultimate effect is that the number of buyers willing to endure these structures is significantly less than if the structures were not there. This logically has a detrimental effect on the final price of the adjoining lands.

Experts assess the loss of value to be in excess of 30 percent, and sometimes up to half.

My personal experience is that when an enquiry (potential buyer) becomes aware of the presence of wind towers, or the possibility of wind towers in the immediate district of a property advertised for sale, the "fall out" of buyers is major. Very few go on to inspect the property, and even fewer consider a purchase. On the remote chance they wish to purchase, they seek a significant reduction in the price.

There is absolutely no doubt that the value of lands adjacent to wind towers falls significantly in value. The ambience of a rural property is important and, oftentimes, the sole reason why a purchaser selects a particular area or district.

The imposition of wind towers destroys this ambience forever.

0 Comments

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