Siting Guide for Wind Farms in Australia

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Abstract

The search for renewable energy sources has led to an increasing interest in the use of wind farms. With such an abundance of open space and wind, Australia seems an ideal place for the farms to boom. Whilst the proposed wind farms have the support of a majority of Australians, the developments must also protect native vegetation, endangered bird life and consider aesthetic issues. Brownouts are expected across Australia within four years. This coupled with the targets set by state and federal governments for renewable energy - post Kyoto Climate Summit - are expected to intensify the use of wind farms.

The criterion set out in this paper is intended to establish a socially acceptable approach to the siting of wind farms in Australia. It is acknowledged that each proposed wind farm must be assessed on its individual merits. However, users would benefit from a series of guidelines as well as government policy and procedures, and public consultation. This paper offers a technical and social perspective for the siting of wind farms. The technical perspective encompasses issues such as blade glint, shadow flicker and noise. It is intended that this work will facilitate the growth of the Australian wind energy industry in an environmentally and socially acceptable manner.

1. Introduction

The Kyoto Summit highlighted the need for renewable energy sources worldwide. In response to the summit, the Australian government set a target to source 2% of the nation's energy requirements from renewable resources by 2010 (Coppin 2003). Victorian State Government Energy Minister Mr. Theo Theophanous is aiming for 10% in Victoria by 2010 (Myer 2003). David Schultz of GHD Consulting Engineers, in a lecture given at Swinburne University of Technology on 26th August 2003, warned staff and students that Australia will begin to be affected by brownouts within four years. Brownout is a condition of lower than normal power line voltage being supplied due to power shortages.

Australians are in the main, an environmentally aware people. The community wants a sustainable, environmentally friendly and clean energy source. Wind farms do not produce harmful emissions. For this reason they are seen as a possible solution to both the energy shortage problem and the need for clean, green energy production. However, the spread of wind farms must be controlled to ensure there are no detrimental effects on local flora and fauna. Aesthetic, social and economic impacts must be considered. Attention needs to be paid to existing land uses, disruption of natural habitat and indigenous land uses, together with government planning, Acts of Parliament and government policy.

The potential in-service effects of wind farms on the local population must be considered. Public and professional opinion must be investigated to gain an understanding of what is socially acceptable. Guidelines need to be developed through the synthesis of public opinion, environmental considerations and technical factors. Public opinion is however, a major consideration. The general view of affected persons is covered in this paper, however it is recommended that public consultation be addressed for each individual case.

2. Initial Site Investigation

Before investing finances into a project, there must be reason and purpose behind the financial drive. There are several questions that must be answered, even before the question of *"Is the wind speed at the site sufficient?"* Table 1 offers a quick-start preliminary checklist for the siting of wind farms. Through preliminary investigation of factors such as proximity to grid, current land use, planning controls, site ownership, environmental, cultural and heritage significance and economic impacts, the potential suitability of the site can be determined. If the checklist indicates that the site is potentially suitability, wind anemometers should be placed to evaluate the wind speed. If the measured wind speeds then indicate the site is suitable for a wind farm, then a more detailed investigation of the site should be carried out.

3. Public Opinion and Acceptance

3.1. Aesthetics and Acceptance

The aesthetic value of wind farms is debateable and subjective. At the time of construction The Eiffel Tower and the Sydney Opera House were two of the most outrageous and criticised structures. Today the Sydney Opera House and the Eiffel Tower form the northern and southern hemispheres' most recognisable icons.

The French media, artists and intellectuals alike in 1889 described the Eiffel Tower as *"this truly tragic street lamp," (Léon Bloy) "this belfry skeleton," (Paul Verlaine) "this mast of iron gymnasium apparatus, incomplete, confused and deformed" (François Coppée)* (Official site of the Eiffel Tower 2003). Sydney Opera House Designer Jørn Utzon left Australia disgraced mid construction.

Only the North Sea separates Denmark and The United Kingdom, yet the acceptance of wind farms in both countries are poles apart. In Denmark wind farms are a source of national pride. One of Denmark's most recognisable exports, Thyholmer Pilsner beer, depicts wind farms on its label as a symbol of its country. Conservative British MP Sir Bernard Ingham described wind farms as *"Lavatory brushes in the sky"* (Gipe 1995).

Table 1. Site Candidacy Checklist

Date:		**Inspector:**		**Position:**		
Item No.	**General Criteria**		**Proposed Wind Farm Site**	**Yes / No**	
1	Grid Location	(a)	Located within 0 – 10 km		
		(b)	Located within 10 – 20 km		
		(c)	Located >20 km		
2	Current Land Use	(a)	Private Land		
		(b)	Crown Land		
		(c)	Primary Industry		
		(d)	Other		
3	Planning Controls	(a)	Located in an ESO		
		(b)	Located in a Planning Overlay		
		(c)	Other		
4	Site Ownership	(a)	Crown Land		
		(b)	Resident		
		(c)	Other		
5	Ownership of Abutting Land	(a)	Crown Land		
		(b)	Resident		
		(c)	Other		
6	Land Acquisition	-	Is it required?		
7	Bird Migration	(a)	Within migration zone		
		(b)	Is there a defined flight path?		
8	Other Fauna	-	Is there additional fauna in the area?		
9	Flora	(a)	Vegetation removal		
		(b)	Native to local area		
		(c)	Endangered species		
10	Cultural Significance	-			
11	Local Resources	-			
12	Economic Impacts	(a)	Positive		
		(b)	Negative		

3.2. Public and Professional Opinion

Public opinion is an "entity" that has the ability to hinder any type of project. The people of the community and/or action groups can voice their mindsets, which can cause major problems in the planning stages of any project. With regard to wind farms, the majority of objectors are residents and local lobby groups within the area where the wind farm is being proposed (DSE 2003) (DSE 2002). Objectors have a wide range of concerns including aesthetics issues, noise levels, location, harm to wildlife, shadow flicker, and/or impact on the environment. Although there is objection to the wind farms, the public do agree that there is a need for environmentally friendly energy generation.

Wind farm developers, during planning and developmental stages of the project, can be bombarded with a number of complaints and arguments that require public meetings to convey information. By holding these meetings during the planning and developmental stages of construction, the project itself can often be delayed.

There is no easy solution to the problems that can develop from the resistance built by the public, but there are avenues that can be explored to ease tensions and inform people in regard to wind farm developments. The Conservation Council of South Australia, have suggested that questionnaires be provided at Public Exhibitions, which will help to gauge the community and stakeholders support for development proposal such as wind farms. *"Engaging school groups can also assist the wind farm proponent, as energy education is paramount in developing good public relations over the long term. Instilling the concept of sustainability, and creating awareness of the need for wind farm developments, is an important process that can engage the entire community"* (Johnstone 2001).

The role of the media can assist in informing the public about the benefits of wind energy. The media is a powerful tool as the information it conveys can be heard or read by a multitude of individuals. When the media is utilised by developers and organisations, it can be used to inform the public about the development, the positives and negatives of the project, and why it is being developed. General Motors Holden release a magazine each season, informing their potential customers of the new vehicles currently on the market. In the Winter 2003 issue, the Codrington Wind Farm Victoria (CWF) has been used as a backdrop for the advertisement of the latest Holden Vectra. CWF was used as the backdrop as Holden believe that wind turbines represent new thinking.

"As the new force in clean electricity production, they represent a paradigm shift for a power industry traditionally reliant on fossil fuels and hydropower. Parked nearby, and the reason for our journey to this hilltop for a photo shoot, is another paradigm shift, this time in automotive design and engineering." (General Motors Holden)

General Motors Holden is marketing their products as an environmentally friendly and progressive design. By associating the new Holden Vectra with the Codrington Wind Farm, Holden endeavour to market the vehicle as an efficient and clean form of transportation. By introducing the public to the advantages and benefits of environmentally friendly energy, the concept can be easily understood, and maybe even accepted by the majority. Arguments regarding wind farm developments generally arise due to the public being unaware of both the benefits and shortcomings of wind energy generation.

3.3. Professional View

Views of professional organisations are quite similar to those of the general public. Their concerns are also based on aesthetics issues, noise levels, location, harm to wildlife, shadow flicker, and/or impact on the environment, within their related field of expertise. Organisations such as National Trust, Victorian Coastal Guardians and Victoria National Parks Association agree with the views of the general public. They believe that wind power is an environmentally friendly method of power generation, as opposed to the current coal-burning practices employed in Australia, but their arguments are that the proposed coastal sites are unsuitable locations for wind farms.

Managing Director of Energy Equity, Mr. Maurice Brand, on top of completing a majority of work to develop the wind farms, must also answer the multitude questions or arguments forwarded by objectors. Mr. Brand states, *"...it was difficult to find suitably windy sites close to the power grid. Much effort went into the strategic placing of turbines to maximise wind energy."* (Watkins 1998) The misconception among a majority of organisations, as well as the general public, is that the wind farm locations are just chosen because of the available wind speed. There are many factors that are considered including proximity to the power grid, current land use, proposed land use, heritage values, and cultural significance.

3.4. Public Opinion and Acceptance Recommendation

Public education and public consultation are as much a part of perception as the aesthetic value of turbines. Techniques to help overcome these issues are as follows:

- Convene public consultation meetings;
- Seek the public opinion when the developments are in the research stage;
- Educate and sell the idea of wind farms and what they offer to the area;
- Utilise the local community during the development by frequenting the local traders for materials, food, etc.;
- Meet the affected persons and address their individual concerns as it is critical that developers are willing to give some ground;
- Provide detailed proposals for the minimisation of social impacts;
- Call attention to the environmental management plans.

4. Technical Perspective

4.1. Blade Glint

Blade Glint is caused by sunlight reflected off the spinning blades of a turbine. This causes flickering beams of light, which potentially intrude on homes disrupting natural light. When turbines are situated near roads (depending on road alignment and the orientation of turbines), blade glint can potentially distract drivers (Maddox 2002). The majority of EES statements note blade glint and its would-be effects. In reality, this issue often provides the pro-wind farm activists an easy response. Residents complain of the effects that the blade glint and

developers, governments and consultants have a ready-made response *"we will coat the turbines with non reflective materials"*.

Recommendation: Turbines should not be erected where blade glint may have the potential to cause hazard or disruption. The blades of turbines shall be painted with a non-reflective coating to minimise the effects of blades glint.

4.2. Shadow Flicker

Shadow flicker occurs when the blades of the turbine cast rapidly moving shadows across the ground or nearby structures. Shadow flicker is generally a problem faced in the East and West directions as most shadows are cast during sunrise and sunset. The phenomenon of shadow flicker is more of a problem in Northern Europe due to the latitude and lower incline of the sun (Gipe 1995), however it can cause problems worldwide. Europeans are concerned that shadow flicker can disorientate and trigger seizures in the 2% of the population that suffer epilepsy (Gipe 1995). Near Flensburg in Schleswig-Holstein, German researchers found that neighbouring residents were affected by shadow flicker for approximately 100mins of the year (Gipe 1995).

On their website (Access Washington 2002) Wind Engineers Inc. show the modelling process used to restrict the amount of flicker on neighbouring properties at the Kittitas Valley Wind Power Project WA. EMD of Denmark has created a computer model, which is being adopted around the world, to model the effects of shadow flicker. The model forms part of the WindPro modelling software package. It requires the following inputs:

- Turbine locations;
- Shadow flicker receptor locations;
- USGS 1:24,000 topographical map;
- USGS DEM (height contours);
- Rotor diameter;
- Hub height;
- Joint wind speed and direction distribution;
- Hours of sunshine (monthly averages).

This package models shadow flicker with speed. This is important to note that at low speeds there is no flicker created. The data produced allows engineers to orientate turbines in order to create the lowest flicker effect. Wind farm developers want to harness the maximum amount of wind energy possible. In Australia the Australian Standard AS 1170 shows that the highest wind speed come from the west (Standards Australia 2002).

Recommendation:

Turbines should not be erected where they cast shadows that may cause hazard or disruption. They should not be erected where shadow flicker may have the potential to cause hazard or disruption and the effects of shadow flicker should be minimised through use of computer modelling.

4.3. Noise Levels

Wind energy generates noise from several parts of a turbine: the generator, the gearbox, and contact between the nacelle and the supporting tower, which together give rise to mechanical noise. There is also aerodynamic noise from blade rotation (EECA 2003). A perspective can be gained from the comparisons of wind farm noise with general suburban sounds made every day. For example the threshold of pain is 140dB, a chainsaw rates at around 110dB, normal speech reaches 60dB, a soft whisper is rated at 35dB and the threshold of audible sound is averaged at 20dB. This is shown in Figure 1. A regular size wind farm measured from 300m away by the New Zealand government rates at close to 43dB placing it somewhere between a soft whisper and a living room in a suburban area (EECA 2003).

The Danish Wind Industry association comments, "*large, modern wind turbines have become very quiet. At distances above 200 metres, the swishing sound of rotor blades is usually masked completely by wind noise in the leaves of trees or shrubs.*" (DWIA 2003) The noise level of an operational wind farm is measured in dB(A)L_{90}. The dB(A)L_{90} represents the decibel sound level that is exceeded 90% of the time (DHNO 2003). In South Australia, the South Australian EPA sets guidelines of 35dB (equivalent to 33dB(A)L_{90}). The Australian Wind Energy Association (AusWEA) suggests that 35dB is *"unnecessarily onerous and is more constraining than other Australian state and any other country in the world."* (Maddox 2002).

Recommendation: When in service, 40dB(A)L_{90} should be the maximum sound level measured at the closest point, of the nearest residence to the wind farm. That is for 90% of the time the wind farm may not exceed 40dB(A).

5. The Environmental Impact

5.1. Development of Existing Land

The development of some land with existing uses is covered under the Federal Government's Primary Industries and Energy Development Amendment Acts. In addition to the Acts, a combination of State and Council level planning regulations should be considered (Westcott 2003). Should Planning zones restrict the development of a suitable site, the planning scheme may need to be amended (City of Holdfast 2003).

Councils are likely to contact the Environmental Protection Agency (EPA), the local transport authority, the Department of Environment and Heritage and other relevant authorities (City of Holdfast 2003). Predicting the issues that may arise as a result of consultation with authorities and implement suitable controls is recommended. The existing land uses will be covered in the Environmental Effects Act where applicable.

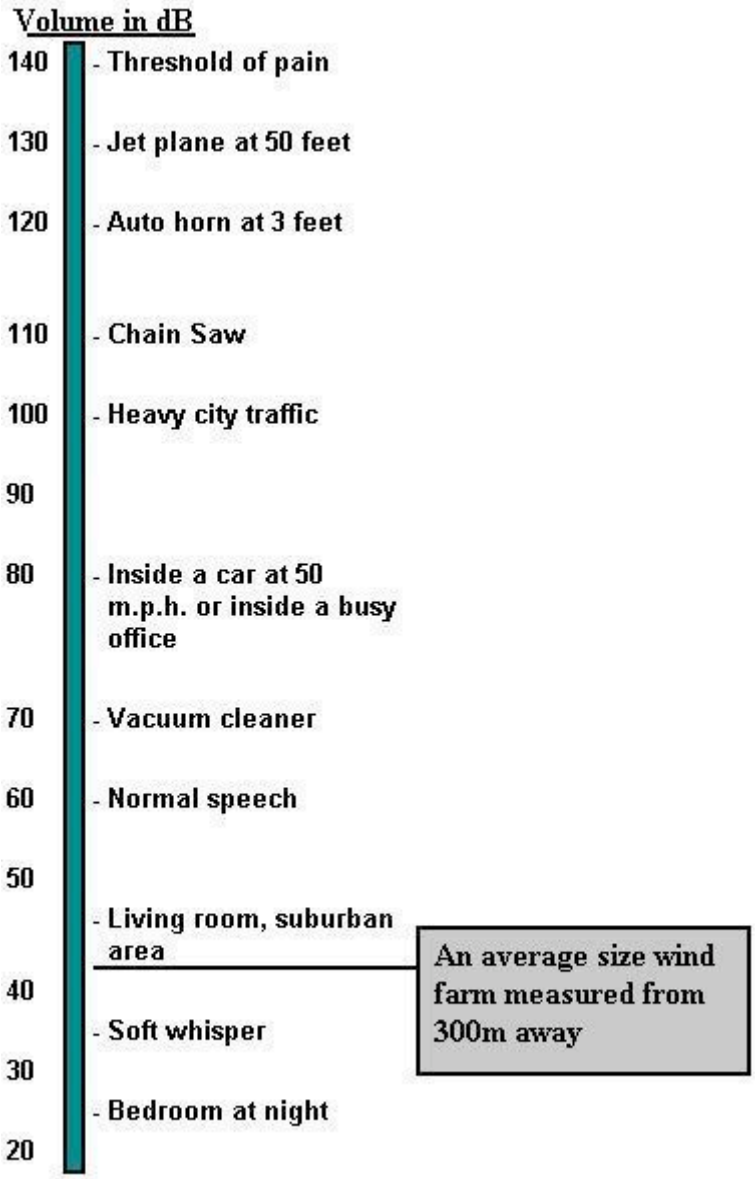

Figure 1. – Sound Comparison (Mayberry 2003) (EECA 2003)

5.2. Environmental Effects Statement

Environmental Effects Statements (EES) are utilised by the Government, to ensure that a proposed project will not significantly impact the environment. Under the Environment Effects Act 1978 (Victoria 99c), the Minister for Planning may require an EES (VCA 2003).

The project proponent prepares the EES. The process is used to assess the potential environmental impact of a proposal. It is carried out before decisions are made on whether to proceed with the project and how the impacts should be managed. It provides a formal means of evaluating whether the proposal is 'ecologically sustainable' and if it has an acceptable balance of environmental, social and economic outcomes. The EES involves investigation of the biological, physical, cultural, economic and social consequences of the potential impacts.

The EES process is administered through the Department of Sustainability and Environment in Victoria (DSE) (VCA 2003). The Commonwealth Minister for the Environment and Heritage may approve or reject the project under the Commonwealth Act if the Federal Act is applicable in this case (Australia 99) (Australia 2000). The EES for proposed developments is then be critically explored. Using the Portland Wind Energy Project (PWEP) EES as a guide, the following is a critical breakdown of what is required to develop an EES (Pacific Hydro Pty Ltd 2002).

Recommendation: If required, a detailed Environmental Effects Statement must be compiled in accordance with the Environmental Effects Acts (1978) (Victoria 99c). The use of the guidelines stated in this report and from the State Government (DOS 2003) will also aid in the development of the EES.

5.3. The Impact on Flora and Fauna

The principle impact on local flora and fauna is from road grading. Clearing is rarely a major issue as generally wind farms are located in wide-open planes. However, clearing the few trees that do exist can still be a problem. The disruption of habitat can cause an effect on local wildlife (Gipe 1995). Wind Energy consultants Tierra Madre in their study of the San Gorgonio Pass, USA, found that few small animals were killed directly through the installation of wind turbines. They estimated that only a small incremental loss of venomous snakes occurred in this case. Rattlesnakes were impacted mainly due to the attitude of the labour force (Gipe 1995).

Recommendation: The impact of wind farms on flora and fauna must be minimised where practicable. The effects of road grading should conform to Environmental Effects Statements, government advice, policy and procedures and the environmental guidelines set out by state traffic authorities such as VicRoads in Victoria and the Road Traffic Authority in New South Wales.

Hierarchy of Importance

It is not clear at all what is being discussed here and the purpose of this list.

1. Federal Government Legislation: Planning, Policy and Procedures
2. State Government Legislation: Planning, Policy and Procedures
3. Environmental Effects Statements / Environmental Impact Studies
4. Local Government Advice, Planning, Policy and Procedures
5. State roads authority guidelines for environmentally friendly construction.

On each occasion when a wind farm is proposed a detailed flora and fauna study must be undertaken. The study should identify potential impacts the wind farm may have on any particular species and the strategies that will be put into place to protect them should be identified.

5.3.1. Impact on Birds

Paul Gipe describes bird mortality as a result of wind farms as a *"hot button issues that elicits strong emotional responses"* (Gipe 1995). Gipe suggests that the industry's European market appears more concerned about the loss of habitat than statistical analysis of kills. Tierra Madre Consultants consider the loss of life insignificant and much less severe than that caused by a residential development (Gipe 1995). The website New Wind Energy responds to the question 'Does wind-generated electricity have a negative impact on birds?' *"No, not when wind farms are sited properly" (this is not scientifically valid)*. Previously, some wind farms were sited poorly and as a result, had detrimental effects on bird migrations. When properly sited, wind farms will have little effect on bird wildlife (Community Energy Inc 2003).

Curry and Kerlinger Inc. are consultants to the wind power industry on birds and other wildlife issues. On their website they note low bird mortality had been found at European wind power sites, with the exception of some coastal sites frequented by migrating birds. Curry and Kerlinger, for an Environmental Impact Study on a site in Sardinia, noted that this particular site will not have a major detrimental effect on birds, as it did not lie within the migration zone (Curry and Kerlinger Consultants 2002). The Niagara Frontier Wildlife Habitat Council on their website uses other human impacts on birds to justify the mortality rate of birds the striking turbine blades:

"Overall, very few bird deaths can be attributed to collisions with wind turbines. For perspective, CandK (Curry and Kerlinger) notes that some 1,000 raptors are electrocuted each year by high-tension wires, and glass windows may kill as many as 100 to 900 million birds annually as they collide with them." (NFWHC 2002)

All these sites have a vested interest in the wind energy field. However, to draw a conclusion from the various sources of information, siting outside migration zones significantly reduces bird mortality. Bird mortality can become critical if sited within migrations zones. This has become more and more evident in the United States where poorly sited wind farms in the 1980s killed Bald Eagles and Raptors (NFWHC 2002). In Australia the orange-bellied parrot is a migratory bird, which breeds only in coastal southwest Tasmania and spends the winter in coastal Victoria and South Australia. In early October the birds arrive in the southwest Tasmania and depart after breeding season in March and April (DPIWE 2003).

Millions of migratory water birds make a long migration each year between the Arctic tundra of the northern hemisphere and the coastal beaches and mudflats of the southern hemisphere. These birds cross more than 20 countries along their migratory path. The path known as the East Asian–Australasian Flyway accommodates bird through the three phases of their annual life cycle breeding, migration and non-breeding (DEH 2003).

Recommendation: No wind farm should be sited in the direct path of bird migration zones. The endangered Orange Bellied Parrot, the East Asian–Australasian Flyway and other such migratory patterns must be held in higher regard than the generation of wind energy. Wind Farm planners and designers must check the flight paths of migratory birds, bats and other flight capable animals.

Independent studies should be carried out on bird species potentially impacted by the proposed wind farm development. Any potential impacts highlighted as a result of independent studies should be presented in the Draft Environmental Effects Statement. The

Draft Environmental Effects Statement should propose strategies to minimise potential effects. The strategies should then be amended where applicable and accepted strategies should be presented in the Final EES. Wind -arms should not be sited where they will potentially cause a significant effect on bird species.

6. Australian Policy and Legislation

6.1. Legislation

The creation of national parks under the National Parks Act (1975) (Victoria 2003a) protects all significant landscapes (including coastal) from disturbance (DOS 2003). This prohibits wind farms from being developed within any National Park zones. The Department of Sustainability and Environment states in the *Policy and planning guidelines for wind energy in Victoria* (DOS 2003), that no wind energy development should have a harmful influence on critical environmental or cultural values. The Commonwealth Environmental Protection and Biodiversity Conservation Act (1999) (Australia 99) protect areas of natural environmental significance from disturbance.

Local and statewide habitat in Australia is protected under state guidelines and legislation. An example of this is The Flora and Fauna Guarantee Act (1988) (Victoria 2000), which protects plant and animal species state-wide in Victoria (DOS 2003). Places of Aboriginal significance are protected under the State Aboriginal Lands Act (1999) (Victoria 99a), Aboriginal and Torres Strait Islander Heritage Protection Act (1984) (Australia 87) and the Commonwealth Native Title Act (1993) (Australia 197). These acts should work in conjunction with state government acts such as the Victorian Governments Archaeological and Aboriginal Relics Preservation Act (1972) (Victoria 99b) and local government policy.

6.2. Planning in Australia

The following planning processes were established to insure environmental and social impacts are minimised (Victoria 1992).

- Environment Effects Statement (EES) if required by the Minister for Planning under the Environment Effects Act 1978 (Vic) (Victoria 99c); or
- Planning and Environment Act (1987) (Victoria 2003b).

6.3. Planning Permit Procedures

The planning process can be simplified to the following three basic steps:

- Council receives and assess planning application(s)
- Council Planners make an informed decision on behalf of Council
- Council Planners recommendations to Council about the issuing of Planning Permits

If the application is refused, the applicant may challenge the issues with the tribunal responsible for planning disputes in the relevant state. In Victoria the Victorian Civil and Administrative Tribunal (VCAT) is the responsible Authority (City of Maribyrnong 2003).

7. Conclusion

This paper is intended to facilitate the growth of the Australian wind energy industry, in an environmentally and socially acceptable manner. The recommendations made are intended to establish a socially acceptable approach to the siting of wind farms in Australia. It is acknowledged that each proposed wind farm must be assessed on its individual merits. The issues raised are intended to provide users with a guide and they must be used in conjunction with government policy and procedures, and public consultation. Wind farms must be controlled to not have a detrimental effect on local flora and fauna. Aesthetic, social and economic impacts must be considered. Attention must be paid to existing land uses, disruption of natural habitat and indigenous land uses together with government planning, Acts of Parliament and government policy. A technical perspective has been provided as well as the social perspective. The technical perspective encompasses issues such as blade glint, shadow flicker and noise.

Blade glint is caused by flickering beams of light reflecting off the blades of a wind turbine. Blade glint can be hazardous to affected persons and must be controlled. Control measures include painting the blades of turbines with non-reflective coating to minimise reflectivity and not erecting turbines where they have the potential to cause hazard or disruption. Shadow Flicker occurs when the blades of the turbine cast rapidly moving shadows across the ground or nearby structures. Shadow flicker is generally a problem faced in the East and West directions as most shadows are cast during sunrise and sunset. Turbines should not be erected where they cast shadows that may cause hazard or disruption. The effects of shadow flicker can be minimised through use of computer modelling.

Wind energy generates noise from several parts of a turbine: the generator, the gearbox, and contact between the nacelle and the supporting tower, which together give rise to mechanical noise. There is also aerodynamic noise from blade rotation. Through comparison of the noise levels generated in every day life and noise as a function of distance, a socially appropriate and technically practical sound level was chosen. It was decided that when in service, 40dB(A)L_{90} should be the maximum sound level measured at the closest point, of the nearest residence to the wind farm. That is for 90% of the time the wind farm may not exceed 40dB(A).

The aesthetic value of wind farms is debateable and subjective. Public education and public consultation are as much a part of perception as the aesthetic value of turbines. The opinions of the general public, lobby groups and profession organisations have lead to heated debates over the years in regard to new developments and schemes. Wind energy is a new concept that is growing in its complexity yet its benefits are currently being outweighed by human opposition. The education of the general public and professional organisations is crucial for the development of knowledge of wind energy generation. By introducing the concepts, advantages and drawbacks of the developments, the community will be able to assemble an improved awareness. When considering the stance that the professional organisations are making in regard to cultural significance and wildlife, the development of the wind farms

should entail the development of an Environmental Effects Statement under the Environmental Effects Act (1978) (Victoria 99c).

The Environmental Effects Statement, if required for the development, is an extremely detailed document covering a range of topics from Project and Strategic Content, to matters of Environmental Significance. Existing land uses must be covered to determine the significance of the land, its value both culturally and financially, and whether the area has the ability to be developed. The Environmental Effects Statement is an integral step in the development of wind farms, and determining if any new development that will impact on the environment and the surrounding area. The potential impact of wind farm development on all flora and fauna must be minimised during construction and operation. No wind farm should be sited in the direct path of bird migration zones. The endangered Orange Bellied Parrot, the East Asian–Australasian Flyway and other such migratory patterns must be held in higher regard than the generation of wind energy. It is recommended that all these issues be considered in conjunction with federal and state government policy.

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