Nature Conservation Council of NSW

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ISF: REPORT

THE ROLE OF WIND POWER IN NSW

For Nature Conservation Council of NSW

July 2007

THE ROLE OF WIND POWER IN NSW

Final Report

For Nature Conservation Council of NSW

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Institute for Sustainable Futures

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Acknowledgements

The authors wish to thank Sarah Jones from Auswind, Chris Dunstan from the Business Council for Sustainable Energy, Richard Finlay-Jones from Energreen and Colin Liebmann from RES Southern Cross for providing input to this report. We are also grateful for the excellent comments on the draft report provided by Owen Pascoe of the Nature Conservation Council NSW, which have greatly improved the final report.

Executive Summary

Introduction

The need for Australia, and New South Wales, to greatly reduce greenhouse gas emissions to avoid dangerous climate change is now well established. One of the biggest challenges will be to rapidly stabilise and then reduce emissions associated with electricity generation. In NSW, electricity generation alone accounts for 37% of total emissions (Australian Greenhouse Office 2007) and these emissions have grown rapidly since 1990.

One technology that shows great promise as a way of reducing greenhouse gas emissions from electricity generation is wind power. Globally, the use of wind power is growing rapidly due to its low cost relative to other renewable energy sources, the abundance of global wind resources, the maturity of the technology and its low lifecycle greenhouse gas emissions. It has been estimated that wind power could supply as much as 29% of global electricity needs by 2030 (GWEC & Greenpeace 2006).

However, in NSW, there are only four wind farms, supplying much less than 1% of our electricity generation. The development of wind power in NSW has been hindered by a lack of consistent government support at the Federal and State levels and by community resistance to particular wind farm proposals.

This report aims to provide balanced material on the benefits of wind farms, criticisms of wind farms and the ways that wind farm development might be improved to respond to community concerns. The report is accompanied by a set of fact sheets, available from www.nccnsw.org.au.

What is wind power?

Wind contains a lot of energy and the energy increases rapidly with wind speed. To capture this energy, the modern wind industry uses **wind turbines**. A typical wind turbine consists of a tower and foundation, supporting a nacelle (a housing for a gearbox and generator) and a rotor with three specially shaped blades. When the wind passes over the blades, their shape creates pressure differences and causes the rotor to turn. The rotor is attached to the generator, which creates electricity.

Typical wind turbines installed in Australia today can generate around 2 or 3 megawatts of power and may be more than 100 metres high from base to blade tip. Wind turbines can only generate electricity when the wind is actually blowing at a suitable speed – not too low and not too high. In Australia, these conditions occur about 30% to 40% of the time. This is a very good wind resource by world standards.

A **wind farm** is a group of linked wind turbines at a particular location. Wind farms are usually located in elevated, exposed areas to capture the best wind, making them very visible in the landscape. They range in size from a few turbines to hundreds. The best wind farm locations have high average wind speeds and consistent wind throughout the year. These conditions are most common in coastal areas and in elevated inland areas, such as along the Great Dividing Range in NSW.

The rapid global growth of wind power is driven by their low greenhouse impact, their potential to create jobs, their technological maturity, their contribution to the diversity of electricity generation and their use of a fuel that is free, abundant and inexhaustible.

Wind power around the world

The global wind power industry has grown at an annual rate of 28% over the last 10 years and now employs around 120,000 people with an annual turnover of more than US$14 billion (GWEC 2007b). By the end of 2006, there was enough wind power installed globally to supply all of the annual electricity demand in Queensland, New South Wales, Victoria and South Australia. The leading countries in terms of installed wind power are Germany, Spain, USA, India and Denmark. Australia currently ranks 15th.

In Germany, Spain and Denmark, where wind power supplies a significant proportion of total electricity generation, the following conditions are in place:

- Higher electricity prices (particularly for fossil fuels)
- The availability of low-interest loans to wind farm developers
- Challenging renewable electricity targets
- Guaranteed access to the electricity network for wind farms
- Guaranteed payment of a premium price for wind power fed into the grid.

These conditions do not currently apply in Australia.

The potential for wind power in NSW

The wind resource in NSW is very good by global standards. There is strong potential for wind power along much of the NSW coast and in exposed parts of the Great Dividing Range. Currently, NSW has only 17 megawatts of wind power, although there are wind farm proposals for up to 1,175 megawatts of additional wind power. Of these, 428 megawatts is already approved.

The electricity grid in NSW could readily accommodate 3,100 megawatts of wind power as long as the wind farms are well distributed across NSW and supported by advanced wind turbine technology and wind forecasting. This would be enough to supply about 10% of electricity generation in NSW. Even more wind power could be used with modification of the electricity grid to allow for the variability of wind power.

The main barrier to greater use of wind power in NSW at present is the failure to include the cost of climate change in the cost of electricity generation. Power stations that use coal and natural gas generate greenhouse gas emissions that contribute to climate change. The Stern Review of the Economics of Climate Change estimated that every tonne of greenhouse gas emitted has a social cost of US$85 because of its contribution to the negative impacts of climate change (Stern 2007). When these figures are taken into account, wind power is much cheaper than coal or natural gas power.

Until the cost of climate change is included in the cost of electricity generation, wind power relies on government support. The main Australian Government support scheme, the Mandatory Renewable Energy Target, is no longer stimulating investment in wind power because the target has been set too low. The NSW Government plans to introduce its own renewable energy target during 2007, with the first interim target planned for 2008. At present, many wind farms approved for NSW are on hold while they wait for the details of the NSW scheme to be finalised.

Wind farm planning and approval

All wind farms in NSW require environmental and planning approval. Wind farms greater than about 16 megawatts in size are considered to be State Significant Development in NSW, which means they are assessed under Part 3A of the *Environmental Planning and Assessment Act 1979*. The Minister for Planning is responsible for approval. Local councils are responsible for assessing smaller wind farm proposals. Where a wind farm has potential to impact on threatened and migratory species, wetlands, World Heritage properties or National Heritage places, it may also require approval by the Australian Government under the *Environment Protection and Biodiversity Conservation Act 1999*.

In a typical NSW approval process, the wind farm proponent submits a Development Application to the Department of Planning and is then provided with the requirements for an Environmental Assessment, which will identify key issues to be addressed and the level of assessment required. The proponent must then prepare an Environmental Assessment to meet these requirements. The Environmental Assessment is lodged with the Department of Planning and, if it meets the requirements, is publicly exhibited. Submissions are invited from the public.

After the exhibition period, the proponent is provided with all submissions and a summary of issues raised, and is asked to respond to these issues and modify the project as appropriate. The Department of Planning prepares an Assessment Report and the Minister makes a decision either to reject, approve with conditions or approve the project. Under certain circumstances, proponents and objectors can appeal the Minister's decision through the Land and Environment Court.

Community perspectives on wind farms

Wind power has both supporters and critics. Polls and surveys indicate that the majority of Australians support greater use of wind power as a response to climate change. However, there has been vocal opposition to particular wind farm projects in NSW, particularly from communities that are located near proposed wind farm sites. Perhaps the most controversial issues are the impacts on visual amenity and landscape values and noise impacts associated with wind farms.

Criticisms of wind farms

While some see wind farms as a positive element in the landscape, others see them as a blight on the landscape. There is no objective way to resolve differences of opinion on aesthetics. However, the Australian Wind Energy Association and the Australian Council of National Trusts are developing a National Assessment Framework on wind farms and landscape values that will help wind farm proponents to assess visual impacts and find ways to avoid, mitigate or minimise them. In resolving conflicts over landscape impacts, it is important to consider the broader public interest of avoiding dangerous climate change. It is also important to compare the impacts of wind farms to those of the alternatives – coal mines, coal-fired power stations and large transmission lines.

The blades of wind turbines create a whooshing noise that can potentially be heard at adjacent properties. At a distance of 350 metres, the sound of a wind farm is roughly equivalent to the sound of a busy road 5 kilometres away and it may be audible for short periods in a quiet bedroom in rural areas. Noise decreases with greater distance. Wind farm owners are required to comply with limits on allowable noise at adjacent properties. In general, the noise from a wind farm is considered marginal and acceptable if it exceeds background noise levels by no more than 5 decibels. In some cases, specific noise proofing or purchase of adjacent properties may be appropriate to address noise impacts.

Wind farms also have the potential to negatively impact on biodiversity by killing birds and bats that collide with the turbine blades. It has been estimated that a typical wind turbine kills less than five birds and five bats per year. These numbers are dwarfed by the numbers of birds and bats killed by land clearing, electricity transmission lines, impacts with vehicles and buildings and cats. Further, climate change is likely to pose a much greater threat to biodiversity than wind farms.

Other criticisms of wind farms include their impact on property prices and on tourism and their potential fire risk. In general, these criticisms do not stand up to analysis although they should be considered on a case by case basis.

Working with the community

When wind farms become contentious, it is often because the wind farm developer has not worked closely with the affected community to understand and address their concerns. Wind farm proponents need to go beyond the minimum consultation requirements to genuinely engage the affected community as early as possible. The Australian Wind Energy Association has developed Best Practice Guidelines for implementation of wind energy projects that include a Community and Stakeholder Engagement Framework. Wind farm proponents should follow this Framework as a minimum.

There is potential to go even further and establish Citizen Advisory Panels that would be involved in all aspects of the decision to build a wind farm. This kind of collaborative approach to community engagement can help to confer legitimacy on a wind farm proposal and defuse community tensions.

Supporting wind power and barriers to growth

The discussion in this report demonstrates that NSW has the potential to expand its use of wind power as a cost-effective way of responding to climate change. NSW could get at least 10% of its electricity from wind power with appropriate government support and careful planning to ensure relatively even distribution of wind farms. Available research indicates that the majority of Australians support the expansion of wind power.

Many of the criticisms of wind power appear to be misplaced. However, some are valid and need to be carefully considered by wind farm proponents. These valid concerns include the impacts on visual amenity and landscape values, noise impacts and potential impacts on biodiversity at specific sites. The wind power industry is pursuing several approaches to improve its identification and management of impacts of wind farms, including an accreditation program for wind farms that comply with Best Practice Guidelines and the development of a National Assessment Framework for wind farms and landscape values. Where there are still objections to wind farms, it is important to weigh these against the negative impacts of climate change.

The key conclusion of this report is that the greenhouse and other benefits of an expansion of wind power in NSW outweigh the narrower concerns of those who object to specific wind farm proposals. This does not mean that those concerns should be ignored; rather, they need to be sensitively addressed.

If there is to be an expansion of wind power in NSW, there will be a need for government support to address barriers to growth. The following actions are recommended.

Technical

The NSW Government should:

- Support research into advanced wind turbine technologies that allow remote monitoring and control of wind farm output
- Support the development of advanced wind forecasting techniques
- Undertake a study to identify high-priority areas for wind farm development, based on available wind resources and the needs of the electricity grid

Wind farm proponents should:

- Use advanced wind turbine technologies that allow remote monitoring and control of wind farm output where feasible
- Seek to develop wind farms in different parts of the grid to existing wind farms or proposed wind farms.

Economics

The NSW Government should:

- Continue to support the development of an Australian emissions trading scheme as a way of starting to incorporate the cost of climate change into the cost of electricity generation
- In the interim, provide specific support to renewable energy by adopting a target of generating 25% of NSW electricity use from renewable sources by 2020
- Require that all of the new renewable energy needed to meet the NSW Renewable Energy Target is obtained from generators located in NSW
- Ensure that renewable energy projects counted towards the NSW Renewable Energy Target are not counted towards other state targets.
- Establish guaranteed access to the grid for wind farms and specify a premium feed-in tariff for wind power.

Planning and approval

The NSW Department of Planning should:

- Require wind farm proponents to comply with Auswind's Best Practice Guidelines as one of the requirements for the Environmental Assessment and as a consent condition on any approvals. This should include specific requirements to comply with the best-practice consultation framework.
- Consider the geographic distribution of existing and approved wind farms when making decisions on proposed wind farms. Wind farms that provide geographic dispersion to assist with management of variability should be given preference.

Auswind should incorporate the National Assessment Framework on wind farms and landscape values into its Best Practice Guidelines once the Framework is finalised. Compliance with this framework should be an accreditation requirement for wind farm developers.

Community engagement

Wind farm proponents should:

- Comply with the best-practice consultation framework in Auswind's Best Practice Guidelines as a minimum requirement
- Commence community engagement from the initial selection of possible sites and continue it throughout the process
- Seek participation, rather than consultation
- Consider the use of more innovative engagement processes to support greater participation in wind farm decisions. A Citizen Advisory Panel that has input on decisions throughout the life of the project is a recommended model.

The wind industry (e.g. Auswind) should consider the potential of small-scale wind power and community-owned wind farms as a way of easing tensions over wind farm proposals. The NSW Government should produce a community guide on how to establish a community-owned wind farm. Interested communities should investigate the potential to initiate their own community-owned wind farms.

Residents of affected communities should seek to become fully informed about the advantages and disadvantages of wind farms and to participate in available engagement approaches in the public interest.

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Glossary

AusWEA or Auswind	Australian Wind Energy Association
AWEA	American Wind Energy Association
BBC	British Broadcasting Corporation
Capacity factor	The capacity factor of a power station is a measure of the annual energy output divided by the theoretical maximum output if the power station was operating constantly. It is usually expressed as a percentage, e.g. 30%
EWEA	European Wind Energy Association
GW	gigawatts
GWEC	Global Wind Energy Council
HREA	Hepburn Renewable Energy Association
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
ISF	Institute for Sustainable Futures
MRET	Mandatory Renewable Energy Target
m/s	metres per second
MW	Megawatts
Nacelle	The structure on the top of a wind turbine tower that houses the gearbox and generator
NCC	Nature Conservation Council of NSW
NEM	National Electricity Market
NRET	NSW Renewable Energy Target
NSW	New South Wales
SEDA	Sustainable Energy Development Authority
UTS	University of Technology, Sydney
WWEA	World Wind Energy Association

1 Introduction: the challenge of climate change response

The need for Australia, and New South Wales (NSW), to greatly reduce greenhouse gas emissions to avoid dangerous climate change is now well established. The most recent assessment report by the Intergovernmental Panel on Climate Change (IPCC) clearly states that the climate system is warming and that the main cause of this warming is human greenhouse gas emissions (IPCC 2007b).[1] Humans and ecosystems around the world are already experiencing the early impacts of a warming climate (IPCC 2007a).

In Australia, climate change is expected to decrease rainfall and increase bushfires, threatening our water security, agricultural production and forestry production. Coastal development is at risk from sea-level rise and increases in the severity and frequency of storms. Biodiversity in some of our most treasured ecosystems, including the Great Barrier Reef, Queensland Wet Tropics, Kakadu and the alpine regions, is expected to decline, as species that are unable to adapt to the changing climate become extinct (IPCC 2007a).

Scientific experts believe that we must limit temperature rises from climate change to no more than 2 to 2.5°C to avoid dangerous climate change (United Nations-Sigma XI Scientific Expert Group on Climate Change 2007). If Australia is to contribute in an equitable way to achieving this objective, we will need to reduce our emissions to about 30% below 1990 levels by 2020 and as much as 80% below 1990 levels by 2050 (den Elzen 2005). At the moment, however, we are heading in the wrong direction. The Australian Government projects that Australia's emissions will be 27% *above* 1990 levels by 2020 (Australian Greenhouse Office 2006). Clearly, Australia needs to do much more to play its part in avoiding dangerous climate change.

The biggest challenge for Australia (and NSW) is to turn around the growth in greenhouse gas emissions from energy use. Energy production and use is the largest source of greenhouse gas emissions, globally and in Australia. Stationary energy use accounts for 48% of total emissions in NSW and electricity generation alone accounts for 37% of emissions (Australian Greenhouse Office 2007). Emissions from electricity generation are growing rapidly; NSW emissions grew by 31% between 1990 and 2005 (Australian Greenhouse Office 2007) and Australian emissions are projected to be 62% above 1990 levels by 2010 and 87% above 1990 levels by 2020 (Australian Greenhouse Office 2006). If NSW is to achieve emission reductions of the scale required to avoid dangerous climate change, then emissions from electricity generation must be rapidly stabilised and then reduced.

The NSW Government has set a target of limiting greenhouse gas emissions in 2025 to 2000 levels and then reducing emissions by 60% by 2050 (NSW Greenhouse Office 2005). While this target falls short of what many scientists recommend, meeting it will still require huge changes in the way we produce and use energy. Further, one of the NSW Government's election promises was to re-evaluate these targets for potential increases and to pass legislation backing the targets (Iemma 2007). This means there is potential for NSW to adopt an even more challenging greenhouse gas reduction target in the near future.

There has been a great deal of debate over the advantages and disadvantages of different energy technologies that have the potential to reduce greenhouse gas

[1] To be precise, the IPCC concludes that it is more than 90% likely that human greenhouse gas emissions are responsible for the observed climate change.

emissions. Some advocate the continued use of fossil fuels to generate electricity, with capture and storage of the resulting greenhouse gas emissions. Others believe nuclear power may offer a solution. However, there is little doubt that renewable energy is one of the most attractive low-emission technologies from a long-term sustainability perspective. Renewable energy generates almost no greenhouse gas emissions during operation and relies on energy sources that will not run out on human timescales – the sun, wind, moving water and the heat of the Earth.

Of the various types of renewable energy, wind power has shown the fastest growth in installed capacity in recent years due to its relatively low cost (compared to other renewable energy technologies) and the abundance of wind resources globally. Between 1971 and 2004, the quantity of energy supplied by wind power has grown by an average of 48% per year (IEA 2007b). With political support, and paired with strong energy efficiency measures, wind power has the potential to supply as much as 29% of global electricity needs by 2030 (GWEC & Greenpeace 2006). However, wind power currently supplies much less than 1% of global electricity generation (IEA 2007b).

In NSW, installed wind power capacity is only 17 megawatts (MW), spread across four wind farms, although another 1,175 MW is proposed (Auswind 2007).[2] Total installed generation capacity in NSW is about 12,414 MW, so wind power currently makes up only 0.13% of installed capacity (NEMMCO 2006b). By comparison, in 2005, wind power supplied 18% of all electricity generated in Denmark, 7.2% in Spain and 4.3% in Germany (IEA 2006). Clearly, there is great potential to increase the role of wind power in the NSW electricity supply from its current marginal role.

The development of wind power in NSW has been hindered by a lack of consistent government support at Federal and State levels, sending mixed signals to potential investors. The Australian Government's Mandatory Renewable Energy Target (MRET) provided a brief stimulus for the wind industry but the target was too low to stimulate ongoing investment and was not extended. This has prompted the NSW Government to introduce a NSW Renewable Energy Target (NRET) requiring that 10% of electricity used in NSW is from renewable sources by 2010 and 15 per cent by 2020 (NSW Government 2006). NRET includes interim annual targets, with the first target set for 2008. Environment groups have raised concerns that the NRET is also too low and that it allows projects outside of NSW, which may be counted towards other states' targets.[3] As with its greenhouse gas reduction targets, the NSW Government has committed to review these targets for potential increases and to back them with legislation (Iemma 2007).

In addition to the inconsistent political support for wind power, there has also been significant community resistance to particular wind farm proposals in NSW. In some cases, this has been due to poor site selection or consultation by wind farm proponents. In other cases, it has been a result of more general objections to wind power. Whatever the specific objections, it is apparent that the siting of wind farms is an emotive issue for some communities. If the wind industry in NSW is to make a significant contribution to climate change response, it is important to provide communities with reliable information on wind power so that they can make informed decisions on whether to oppose or support particular wind farm proposals.

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[2] The Auswind figures have been slightly revised based on our own investigations (see Table 5).

[3] These concerns were raised in a letter to the relevant NSW Minister, Joe Tripodi, from the Nature Conservation Council of NSW, Greenpeace Australia Pacific, the Australian Conservation Foundation and the Total Environment Centre in December 2006.

This report aims to provide balanced material on the benefits of wind farms, criticisms of wind farms and ways that wind farm development might be improved to respond to community objections. It draws on case studies of actual wind farm projects in Australia, including the Albany Wind Farm in Western Australia and the proposed Ben Lomond and Taralga Wind Farms in NSW.

The report is structured as follows:

- Section 2 (What is wind power) describes how wind power works, what a wind farm looks like and where wind farms are usually built
- Section 3 (Wind power around the world) provides a brief summary of the global status of wind power and the support programs that have been used in countries where wind power has grown most rapidly
- Section 4 (The potential for wind power in NSW) looks at how much wind power could contribute to electricity generation in NSW and to the NSW economy
- Section 5 (Wind farm planning and approval) outlines the approval processes that apply to wind farms
- Section 6 (Community perspectives on wind farms) explores the varying perspectives on wind farms, both positive and negative
- Section 7 (Criticisms of wind farms) examines some of the main objections to wind farms in more detail and looks at ways they might be addressed
- Section 8 (Working with the community) offers suggestions on how wind farm proponents might improve their community engagement processes
- Section 9 (Supporting wind power in NSW) provides recommendations on how to capture the benefits of wind power for NSW while addressing community concerns.

In addition to this report, fact sheets that summarise key sections of the report for community groups and individuals are available from the Nature Conservation Council of NSW website at http://www.nccnsw.org.au.

2 What is wind power?

This section provides explanations of how wind power works (Section 2.1), what wind farms look like (Section 2.2), where wind farms are typically built (Section 2.3) and what is driving the global growth of wind power (Section 2.4).

2.1 How does wind power work?

Humans have used windmills and sailing vessels to capture the power of the wind for centuries, but it is only since the 1950s that we have started to use the wind to generate electricity (WWEA 2007b). Wind is the movement of air due to differences in air pressure, created by uneven heating of the Earth's surface. Air moves from areas of high pressure to areas of low pressure. The bigger the pressure difference, the faster the wind (SEDA 2002a).

Wind contains a lot of energy and the energy increases rapidly with wind speed. A doubling of wind speed creates an eightfold increase in available energy (WWEA 2007b). To capture the energy contained in wind, the modern wind power industry uses **wind turbines**. A typical wind turbine consists of a tower and foundation, supporting a nacelle (a housing for a gearbox and generator) and a rotor with three specially shaped blades. When the wind passes over the blades, their shape creates pressure differences and causes the rotor to turn. The rotor is attached to the generator, which creates electricity (SEDA 2002a; WWEA 2007b).

Wind turbines require a minimum wind speed before they start to generate electricity, usually around 2.5 to 4 metres per second (m/s). All wind turbines also have a maximum speed, usually around 25 to 35 m/s, when they will stop turning to prevent any damage to the machinery and blades (SEDA 2002a; WWEA 2007b).

Starfish Hill Wind Farm, South Australia
Photo courtesy of Tarong Energy and Auswind.

Wind turbines can only generate electricit between the speeds listed above. This means that wind farms do not generate as much electricity as they would if they were operating all the time. The capacity factor of a power station is a measure of the annual energy output divided by the theoretical maximum output if the power station was operating constantly. The capacity factor for Australian wind farms is typically between 30% and 40% (Auswind 2006b; MMA 2006). The global average capacity factor for wind power is about 24%, so Australia's wind resource is 'phenomenal' by world standards (GWEC & Greenpeace 2006, p.14 and p.43).

Each wind turbine has a rated power output expressed in watts. This is 'the maximum electrical power a generator will provide when running at optimum performance' (SEDA 2002a, p.20). Wind turbines installed in Australia today typically have a rated power output of 2 or 3 megawatts (MW) and a rotor diameter of around 80 metres. Overseas, wind turbines with power output of 5 MW and rotor diameter of over 100 metres have been developed (EWEA 2004). Wind turbines with a power output of 6 MW are considered feasible in the near future (WWEA 2007b).

Most of the focus of the wind power industry in Australia has been on large-scale wind turbines as a way of capturing economies of scale. However, small-scale wind turbines are also available that can be used at the domestic level or in small commercial applications. For example, Soma Power in NSW makes 400 watt and 1,000 watt wind turbines, which are suitable for domestic use. Most of the discussion in this report is of large-scale wind power, however small-scale wind power is considered where appropriate.

2.2 What does a wind farm look like?

A **wind farm** is the term used for a group of linked wind turbines at a particular location. Wind farms make use of the topography and landscape to capture as much of the wind's energy as possible at a particular location. One of the important characteristics of wind is that wind speeds tend to increase and become more reliable with height, so wind turbines are placed on tall towers to capture stronger, more reliable winds. In the case of the Taralga Wind Farm, which is under development in NSW, the towers will be 65 metres high and each blade will be 45 metres long. These towers are roughly the same height as the Sydney Opera House. With the addition of the blade, the wind turbines proposed for Taralga will reach to the height of a 33-storey building, making them very visible in the landscape.

As shown in the photo below of the Albany Wind Farm in Western Australia, wind turbines are usually painted white, which makes them stand out from the landscape. Wind turbines in a wind farm need to be spaced out so that they do not interfere with the wind received by other turbines. A general rule of thumb is that turbines should be at least five times the rotor diameter abreast and eight times the rotor diameter downwind of each other (SEDA 2002a). They are usually spaced in an irregular way to make them look more natural and to take advantage of local variations in wind speed.

Albany Wind Farm, Western Australia. Photo by Andrew Woodroffe, courtesy of Auswind.

The number of wind turbines in a wind farm is highly variable. In some locations, such as Kooragang Island in Newcastle, a single turbine has been installed. At the other end of the scale, the Wattle Point Wind Farm in South Australia has 55 wind turbines with a total capacity of 91 MW. The largest wind farm currently proposed for NSW – the Capital Wind Farm – would have 63 wind turbines, each with a capacity of 2.1 MW. The largest wind farm proposed for Australia – the Macarthur Wind Farm in western Victoria – would have 183 wind turbines, each with a capacity of 1.8 MW. The world's largest wind farm proposal is for a 1,500 MW wind farm called the Atlantic Array, which would be built off the coast of Devon in the United Kingdom and would contain at least 350 wind turbines (BBC 2007).

2.3 Where are wind farms built?

The power generated by a wind farm over its lifetime depends on the quality of the wind resource. Good sites for wind farms have 'high average wind speeds, consistent wind throughout the year, low turbulence levels [and] minimal wind shading in prevailing wind direction' (SEDA 2002a, p.51). Excellent wind power sites are those with an average annual wind speed of 8 m/s or more and a capacity factor of 35% or more (Saddler, Diesendorf & Denniss 2004).

Wind farms can still be viable at lower wind speeds and capacity factors but the cost of electricity from a wind farm is very sensitive to the quality of the wind resource. A 15% increase in wind speed adds 50% to the available energy, which greatly reduces the price of energy from the wind farm (AusWEA 2004a). In Australia, where electricity prices are low by world standards, this means that it is currently only viable to develop sites with very high quality wind resources.

In general, it gets windier away from the equator. This means that the southern latitudes of Western Australia, South Australia, Victoria and Tasmania have particularly good wind resources. However, regional conditions, such as the presence of hills, ridges and mountains, can greatly enhance the wind speed and create a suitable site in an area that would otherwise not be attractive (SEDA 2002a).

Coastal areas are more likely to have suitable conditions than inland areas because they are more exposed to the wind and to sea breezes from the ocean. Suitable inland sites tend to occur in elevated areas where wind speed is increased by the terrain (AusWEA 2004a; SEDA 2002a). Elevated terrain is an advantage in both coastal and inland areas because wind speed tends to increase with height. This means that excellent sites for wind farms are often highly visible in the local area, which creates possible conflicts with scenic values.

Wind farms can also be built offshore. The advantages of offshore wind farms are access to higher, more constant winds and avoidance of many of the land use conflicts that occur onshore. However, offshore wind farms are more expensive to build. By the end of 2006, offshore wind farms had grown to 2% of total installed wind capacity in the European Union (EWEA 2007). As yet, no offshore wind farms have been built or proposed in Australia. Offshore wind is not yet competitive in Australia as a result of our relatively low electricity prices, deeper oceans and the availability of numerous suitable onshore sites (AusWEA 2004a).

Whether onshore or offshore, it is preferable to build a wind farm close to the existing electricity transmission or distribution network so that it can be connected at a relatively low cost. This means that wind farms will often be built near cities or towns, rather than in very remote, unpopulated areas.

2.4 What is driving the growth in wind power?

As the former Sustainable Energy Development Authority (SEDA) put it:

> The benefits of wind energy are compelling: low greenhouse impact, stimulation of economic growth, job creation, enhanced diversity of electricity generation, and short development timeframes. The fuel is free, abundant and inexhaustible (SEDA 2002a, p.7).

An additional advantage, particularly important for Australia, is that wind farms use far less water than conventional coal-fired power stations. A wind farm uses about 0.004 litres per kWh compared to 1.90 litres per kWh for coal (AWEA 2007).

Most critically, wind power is a mature renewable energy technology with a relatively low cost and large available resource that can be rapidly developed in response to climate change. This explains its rapid growth around the world. The next section reviews the global status of wind power in more detail.

Case Study: Taralga Wind Farm

The Taralga Wind Farm site is approximately 140 km south west of Sydney, 38 km east of Crookwell and 35 km north of Goulburn. The wind farm will be built along ridgelines stretching about 11 km north to south. It will cover an area of 3,830 hectares, which incorporates both private land holdings and vacant Crown land. Landowners that are hosting wind turbines will be able to continue grazing activities on their land.

The original proposal was amended to reduce the number of turbines from 69 to 62. Potential total electricity generation capacity would be approximately 120MW.

The project was approved by the Land and Environment Court of NSW in February 2007, but construction has not yet commenced.

Source: Colin Liebmann, RES Southern Cross; DEH Referral Form

Case Study: Ben Lomond Wind Farm

The Ben Lomond Wind Project will be located in the Northern Tablelands region of NSW. It will be north of Armidale in the shires bordered by Guyra and Glenn Innes Severn Shire Councils. The project will cover a ridgeline area of approximately 1,000 hectares and comprises nine adjacent privately-owned rural landholdings. Cattle and sheep grazing will be able to continue at the site.

The project will comprise 64 turbines and have potential capacity of 106MW.

Development Approval has been granted but construction has yet to commence.

Source: DEH Referral Form

Case Study: Albany Wind Farm

Albany Wind Farm is located in Western Australia approximately 12 km south west of Albany city centre and is positioned on the coastline about 80 metres above the Southern Ocean. The site is a coastal reserve vested in the City of Albany. The wind farm consists of 12 turbines, each producing up to 1.84 MW of electricity. The combined output is up to 22 MW.

The wind farm was constructed between August 2000 and July 2001 and officially opened in October 2001 by the State Tourism Minister.

Source: Verve Energy; Business Council for Sustainable Energy.

3 Wind power around the world

This section provides a brief summary of the global wind power industry (Section 3.1), summarises the global status of wind power (Section 3.2) and identifies programs that support wind power in the countries with the highest use of wind power (Section 3.3).

3.1 The global wind power industry

The global wind power industry has grown at an annual rate of 28% over the last 10 years. It now employs around 120,000 people and has an annual turnover of more than US$14 billion (GWEC 2007b). In the past, wind power specialists like Vestas, Enercon and Suzlon Energy have dominated the industry. However, in recent years, major players from the conventional fossil fuel, power and finance sectors have invested in wind power, including Babcock and Brown, General Electric and Siemens (GWEC 2007b).

Many of the global players are active in Australia, either as wind farm owners and developers or as equipment suppliers. Vestas supplied all the turbines for the existing wind farms in NSW and has opened a blade manufacturing facility in Portland, Victoria.

3.2 The global status of wind power

The World Wind Energy Association estimates that 74 gigawatts (GW) of wind generation capacity were installed globally by the end of 2006 (WWEA 2007a). In approximate terms, this is enough wind generation capacity to supply all of the annual electricity demand in Queensland, New South Wales, Victoria and South Australia.[4] The global installed wind generation capacity grew by more than 25% in 2006 and is projected to grow to 160 GW by the end of 2010 (WWEA 2007a).

The top five countries in terms of installed wind capacity are shown in Table 1. At the end of 2006, Australia ranked 15th in installed wind capacity with 817 MW. Table 2 shows how this is distributed across the states. South Australia is the leader in installed wind capacity, followed by Western Australia and Victoria. NSW lags well behind these states with only 17 MW of installed wind capacity.

Ranking	*Country*	*Installed Wind Capacity (MW), 2006*
1	Germany	20,622
2	Spain	11,615
3	USA	11,603
4	India	6,270
5	Denmark	3,136
15	Australia	817

Table 1: Global installed wind capacity by country. Source: WWEA (2007a).

[4] Assuming an average global capacity factor of 30% and based on total electricity generation in the National Electricity Market (NEM) in 2005-06.

Ranking	State	Installed Wind Capacity (MW), 2006
1	South Australia	388
2	Western Australia	199
3	Victoria	134
4	Tasmania	67
5	NSW	17
6	Queensland	12

Table 2: Australian installed wind capacity by state. Source: Auswind (2007).

3.3 Global support for wind power

The relatively large amounts of wind power installed in countries like Germany, Spain and Denmark raises the question of what has been done to support wind power in these countries. Table 3 summarises measures used to support wind power in Germany, Spain and Denmark, which are the three largest users of wind power in terms of proportion of electricity generated. Further details are provided in case studies, following Table 3. The common factors across the three countries are:

- Higher electricity prices (particularly for fossil fuels)
- The availability of low-interest loans to wind farm developers
- Challenging renewable electricity targets
- Guaranteed access to the electricity network for wind farms
- Guaranteed payment of a premium price for wind power fed into the grid.

Australia has some of the lowest electricity prices in the world, does not provide low-interest loans to wind farm developers, has a relatively low national renewable energy target and does not pay a guaranteed premium rate for electricity from wind farms. This explains the relatively low uptake of wind power in Australia.

Country	*Measures to Support Wind Power*
Germany	Renewable energy target of 12.5% electricity by 2010 and 20% by 2020
	Low-interest loans for renewable energy projects
	Amendments to Federal Building Codes to allow wind farm development in undeveloped outskirts
	Grid operators are obliged to give grid access to wind farms and to purchase the electricity at premium prices
Spain	Renewable energy target of 30.3% of electricity from renewables by 2010, with a specific target of 20,155 MW for wind in 2010
	Low-interest loans for renewable energy projects
	Guaranteed access to the grid for renewable energy and purchase of electricity at premium prices
Denmark	Renewable energy target of 29% of electricity output by 2010
	Financial support for short-term research and development
	Tax credits for individuals who participate in wind energy cooperatives
	A carbon tax, increasing the price of fossil fuel energy
	Subsidies for wind turbines, paid as a premium on the electricity price received by wind farms
	Additional subsidies for onshore wind turbines installed as replacements for older or inconveniently-positioned turbines

Table 3: Measures used to support wind power in selected countries. Source: IEA (2007a).

Case Study: Renewable Energy Sources Act (2004) in Germany

The German Renewable Energy Sources Act of 2004 establishes renewable electricity targets of 12.5% by 2010 and 20% by 2020. It also obliges grid operators to give wind farms access to the grid. Wind farm developers must pay for the connection to the grid but the grid operator must pay for any reinforcement of the grid required to accept energy from the wind farm.

Grid operators must also pay a specified premium rate for electricity from wind farms over a period of 20 years. In 2004, new wind farms received about $140/MWh for their electricity. After a certain amount of electricity is generated, the payment decreases to $90/MWh. The tariffs are based on the actual cost of generating wind power in Germany. By comparison, the estimated cost of generating wind power in Australia is $60-80/MWh due to our higher quality wind resources. The German tariff for new wind farms is reduced by 2% each year to encourage ongoing cost reductions.

The Act increases the cost of electricity and this increased cost is borne by energy consumers.

Source: IEA (2007a).

Case Study: Low interest loans for renewable energy projects

The Spanish Government introduced a low interest loan scheme for renewable energy projects, including wind farms, in 2001. This $15 million scheme provides discounts of 2 to 5 percentage points on loans for investment in renewable energy. In addition, the Renewable Energy Plan 2000-2010 provided a financing line for renewable energy projects to finance up to 70% of the investment through low interest loans.

The German public bank Kreditanstalt für Wiederaufbau provides low-interest loans to specified renewable energy projects, including wind farms. Only private companies may apply. The credit term for these loans ranges between ten and twenty years. The interest rate is 2% below market level and there is a 50% lending limit.

Source: IEA (2007a).

4 The potential for wind power in NSW

This section discusses the quality of the wind resource in NSW (Section 4.1), identifies current and proposed wind farms in NSW (Section 4.2), examines how much electricity wind power could supply in NSW (Section 4.3), discusses the economics of wind power in NSW (Section 4.4) and identifies other possible economic contributions of wind power (Section 4.5).

4.1 Wind resources in NSW

According to the Global Wind Energy Council:

> Australia enjoys one of the best wind resources in the world, resulting in phenomenal capacity factors in many regions on predominately cleared open farmland. Australia offers good access to grid infrastructure and has well organized financial and legal services (GWEC 2007b).

The best wind resources in Australia are located in the southern latitudes, in Tasmania, Victoria, South Australia and the south of Western Australia. The NSW wind resource is more moderate (Diesendorf 2006) but still good in particular areas.

The best consistent wind in NSW is usually found very close to the coast or along the higher exposed parts of the Great Dividing Range (SEDA 2002a). However, local influences, including elevation, local topography and orientation to the prevailing winds, can all enhance the wind resource to such a degree that a wind farm becomes viable even where the background wind speeds are too low. Enhancement of the wind resource due to topography can be significant on the western side of the Great Dividing Range (SEDA 2002a).

The Sustainable Energy Development Authority (SEDA) developed the NSW Wind Atlas to provide an indicative map of average annual wind speeds across NSW. Wind speeds shown in the atlas are modelled at a height of 65 metres above the ground, which is around the height of a modern wind turbine (SEDA 2002b). The NSW Wind Atlas, shown in Figure 1, indicates that there is a good wind resource along most of the NSW coast, with the best wind speeds:

- Around Byron Bay
- Near Crowdy Bay National Park (between Port Macquarie and Forster)
- Between Forster and Nelson Bay
- Along the Central Coast and Lake Macquarie regions
- Along the South Coast, from Shellharbour to Bega, particularly between Batemans Bay and Bega.

Inland, the wind resource is more variable. The best resources are generally along the Great Dividing Range, around Tenterfield, Glen Innes, Armidale, Walcha, Coolah, between Orange and Lithgow (where the Blayney and Hampton Wind Farms are located), Crookwell (where the Crookwell Wind Farm is located) and the Snowy Mountains. In addition, the coastal resource between Batemans Bay and Bega extends well inland, to Braidwood and Ando. There is also a good wind resource around Swan Hill on the border with Victoria.

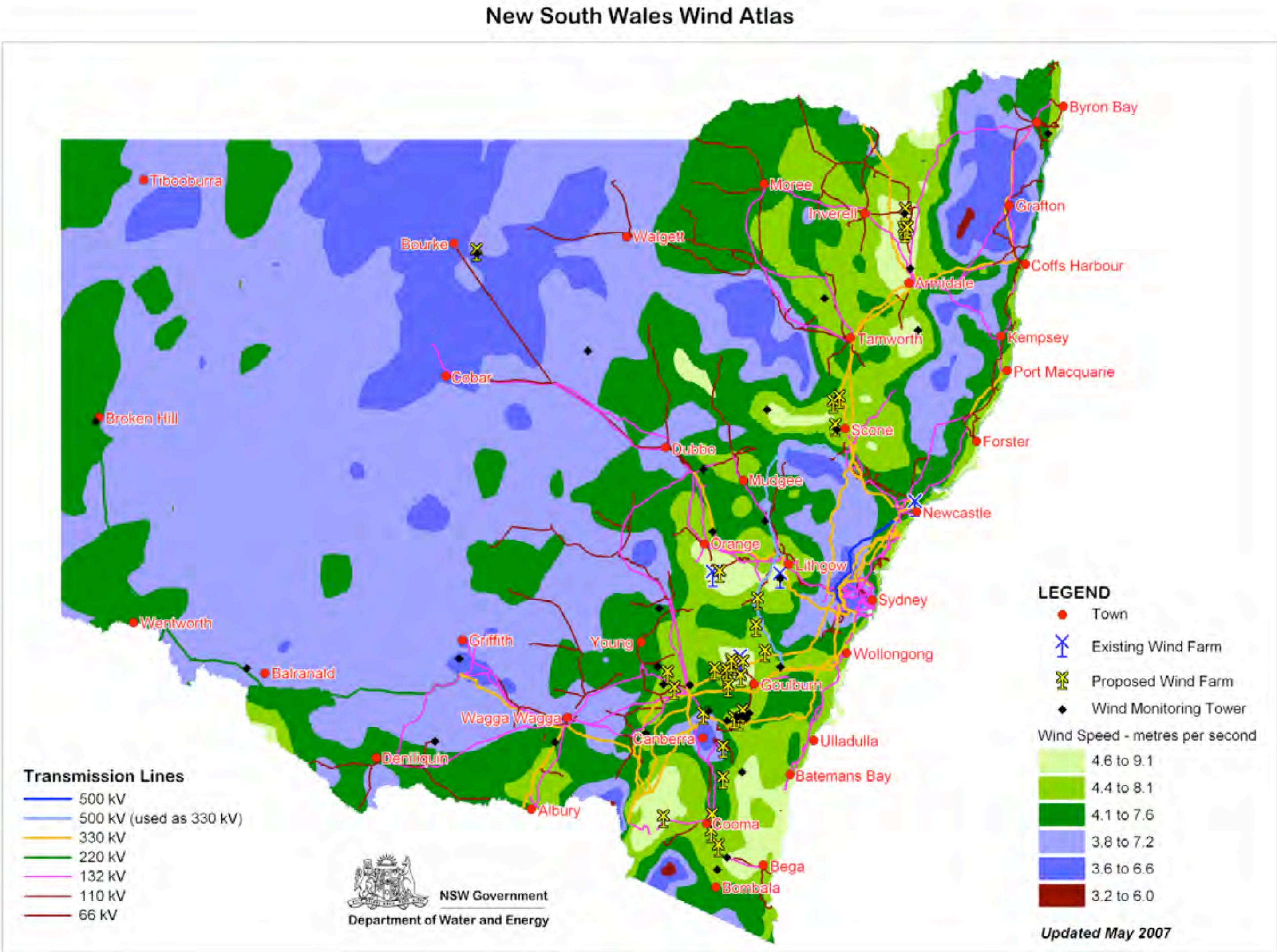

Figure 1: The NSW Wind Atlas, showing current and proposed wind farms in NSW. Courtesy of the NSW Department of Water and Energy.

SEDA (2002a) has estimated the potential capacity for wind power in NSW at well over 1,000 MW, far greater than the 17 MW currently installed. This may be a low estimate – Auswind already lists proposed wind farms on its website that have a total capacity of 1,193 MW (Auswind 2007). No doubt, as the industry develops, additional proposals will come forward.

Case Study: Wind resources at Taralga and Ben Lomond

Taralga: According to the NSW Wind Atlas produced by the former Sustainable Energy Development Authority, Taralga Wind Farm will be well positioned in an area susceptible to high average wind speeds. In addition, planning documents indicate that the farm will be built along a ridgeline to ensure smaller local features, such as hills (which are not represented on the Wind Atlas), do not adversely affect the wind flows. Average wind speeds are between approximately 4.5 and 9.0 metres per second in this area. 'Good' sites are considered to have annual mean wind speeds of 7 m/s.

Ben Lomond: Ben Lomond is also sited in an area that experiences high wind speeds (similar to Taralga). The wind farm will be built along a ridgeline on the Great Dividing Range to optimise exposure to the wind. According to the NSW Wind Atlas, ridges can serve to 'concentrate and speed the wind up'. The topography is described as 'undulating' and no outstanding features are described which could compromise the wind flow. Land use in the area is largely agricultural grazing, with large, cleared, open spaces reducing friction between the land and wind, resulting in fast wind speeds.

Source: NSW Wind Atlas; DEH Referral Forms.

4.2 Current and proposed wind farms in NSW

Figure 1 shows the locations of the three wind farms that are currently operating in NSW. A single wind turbine is also operating at Kooragang Island, near Newcastle. The existing wind farms are all located to take advantage of good wind resources along the Great Dividing Range. Table 4 provides more details on the operating wind farms in NSW, including their owner, year of establishment, the number of turbines and the total size.

Table 5 lists current wind farm proposals for NSW, identified by Auswind. Proposed wind farm sites are also shown in Figure 1. The table gives the location, the owner or developer, the total size and the project status, i.e. whether it has planning approval, is seeking approval, is undertaking feasibility studies or has been suspended. As can be seen, 428 MW of additional wind power is already approved for NSW and a total of 1,175 MW is proposed. The table is based on public announcements and may not be comprehensive or have accurate details for all projects where changes have not been publicly announced.

Project and location	*Owner / Developer*	*Year established*	*Turbine Size*	*Number of turbines*	*Total size (MW)*
Kooragang Island, Newcastle	EnergyAustralia	1997	600kW	1	0.6
Crookwell	Eraring Energy	1998	600kW	8	4.8
Blayney	Eraring Energy	2000	660kW	15	9.9
Hampton	Hampton Wind Park Comany	2001	660kW	2	1.32
Total					17

Table 4: Details of operating wind farms in NSW. Source: Auswind (2007).

Project and location	*Owner / Developer*	*Total Size (MW)*	*Status*
Crookwell II (Crookwell)	TME Australia	92	Planning Approved
Snowy Plains Wind Farm, near Berridale	EPURON Pty Ltd	30	Planning Approved
Taralga Wind Farm	RES Southern Cross	108	Planning Approved
Gunning Wind Farm	Delta Energy	62	Planning Approved
Cullerin Wind Farm, east of Gunning	EPURON Pty Ltd	30	Planning Approved
Ben Lomond Wind Farm, north of Armidale	Energreen	106	Planning Approved
Sub-total		***428***	***Planning Approved***
Capital Bungendore	Renewable Power Ventures	126	Seeking Approval
Black Springs Wind Farm, near Oberon	Wind Corporation Australia Limited	18.9	Seeking Approval
Liverpool Range	Macquarie Generation	6.6	Seeking Approval
Conroys Gap Wind Farm, west of Yass	EPURON Pty Ltd	30	Seeking Approval
Sub-total		***182***	***Seeking Approval***
Cooma	Pacific Hydro	100	Feasibility
Lord Howe Island	NA	0.3	Feasibility
Spring Hill, north of Canberra	ACTEW AGL	10	Feasibility
Murrurundi	GHG & GREP	35	Feasibility
Rock Flat Creek	Pacific Hydro	100	Feasibility
Evandale, west of Goulburn	EPURON Pty Ltd	30	Feasibility
Paling Yards	TME Australia	90	Feasibility
Sub-total		***365***	***Feasibility***
Southern Highlands	ANZ Infrastructure Services	30	Project Suspended
Woodlawn/Tarago	Collex/ Acciona Energy/ ActewAGL/ ANZ Inf.Services	50	Project Suspended
Molonglo, near Queanbeyan	Acciona Energy	120	Project Suspended
Total		***1,175***	

Table 5: Details of proposed wind farms in NSW. Source: Auswind (2007) and additional research.

4.3 How much electricity can wind supply?

The amount of electricity that wind can supply in NSW depends on the installed wind farm capacity and the capacity factors for individual wind farms. The 17 MW currently installed in NSW generates about 45 GWh per year, which is enough electricity to power about 5,000 households (Diesendorf 2005). The average capacity factor for NSW is generally estimated to be around 30%. This is lower than the southern states; for example, Victoria has an average capacity factor of around 37% for current wind farms, declining to around 33% by the time 1,000 MW of wind power is installed (MMA 2006). However, the capacity factor is high by global standards, where installed wind farms have capacity factors ranging from 18% to 40%. In fact, Germany, which has the largest amount of installed wind power in the world, had an average capacity factor in 2003 of only 18% (EWEA 2005). It is therefore reasonable to assume that wind power will be very viable in NSW.

If all of the wind farms currently proposed for NSW were built, the installed capacity would increase to 1,210 MW. Assuming an average capacity factor of 30%, these wind farms would generate 3,180 GWh per year. This amounts to about 4% of annual electricity consumption in NSW in 2005-06 (NEMMCO 2006a).

Could wind power supply even more than this? Based on the European experience, it seems highly likely that the available wind resource in NSW is sufficient to allow economic development of additional wind farms, beyond the 1,210 MW currently proposed. However, because wind is a variable energy source, there are technical limits on how much wind power it is possible to use in a particular electricity network. Clearly, it is not possible to have 100% wind power without some sort of energy storage or backup, because the power would go off when the wind stopped blowing. In addition, fluctuations in energy supply can cause problems for management of the electricity network and these problems are likely to grow as the proportion of wind power in the network increases (Macintosh & Downie 2006).

Numerous studies have examined exactly how much wind power it is possible to accommodate in an electricity network without substantial changes to the network. The Sustainable Development Commission (2005, p.26) in the UK claims that:

> It is generally considered that up to 20% wind capacity penetration is possible on a large electricity network without posing any serious technical or practical problems.

In Denmark, where wind supplies about 18% of annual electricity consumption, the installed wind capacity makes up even more than 20% of total capacity. However, electricity networks in Europe are more interconnected than those in Australia due to higher densities of residential, commercial and industrial development. Australia's electricity network may be less able to cope than those in Europe.

An Australian study estimated that the National Electricity Market could readily accept wind power capacity equal to 50% of the minimum electricity demand as long as wind farms were built progressively, were widely and evenly dispersed, used advanced wind turbine technology to remotely monitor and control wind farm output and were supported by advanced wind forecasting techniques. This means that the NEM could readily accommodate 8,400 MW of wind power, of which 3,100 MW could be built in NSW, as long as the NSW wind farms are brought on line gradually, are spread relatively evenly from north to south and include coastal and inland developments (Outhred 2003). At these levels, wind could supply 8,150 GWh per year, or about 10% of total electricity consumption in NSW, and would reduce greenhouse gas emissions from electricity by a similar amount.

An even greater contribution by wind power in NSW could be feasible with appropriate modifications to the electricity network, such as those considered by the

Wind Energy Policy Working Group for the Ministerial Council on Energy (WEPWG 2005). Research on how much wind can already be integrated into the NEM and how greater amounts could be accommodated is ongoing (Barker & Outhred 2006). Diesendorf (2006) argues that wind power could feasibly generate at least 20% of Australia's electricity within a few decades.

4.4 Economic viability of wind power

It is clear from the discussion in Section 4.1 that NSW has a high quality wind resource by global standards and that this is unlikely to be the limiting factor in the development of wind power in NSW. Further, the discussion in Section 4.3 indicated that at least 3,100 MW of wind power could be built in NSW without causing major problems for the electricity grid, as long as wind farms are planned appropriately and spread out fairly evenly across the state. However, it is also important to consider the economic viability of wind power.

The estimated cost of generating wind power is $60-80/MWh. By comparison, electricity generation from coal costs about $31-40/MWh and from natural gas power stations costs $37-44/MWh (RDGWG 2006). This means that wind power is currently unable to compete directly with fossil fuels on cost. This is the main reason why so little wind power is currently used in NSW.

However, the costs quoted above do not include the cost of climate change. Power stations fuelled by coal and natural gas create greenhouse gas emissions that contribute to climate change. Wind power does not create significant greenhouse gas emissions. While attributing a cost to future climate change is a difficult and contentious task, the Stern Review of the Economics of Climate Change recently estimated that the social cost of greenhouse gas emissions is US$85 per tonne of CO_2, which is about A$110 per tonne of CO_2 (Stern 2007). This is based on an estimate of how much climate change will cost us if we continue on a business as usual path without reducing emissions. In other words, the Stern estimate says that every tonne of greenhouse gas emitted from a coal or gas-fired power station is responsible for an additional cost of $110 due to climate change.

In NSW, 1.068 tonnes of greenhouse gas are emitted for every MWh of electricity generated (AGO 2006). This means that the additional cost of climate change for current electricity generation in NSW is $117/MWh. Wind power avoids most of this additional cost. As a result, when the cost of climate change is taken into account, wind power costs significantly less than power generated from fossil fuels.

Unfortunately, the full cost of climate change is still not recognised in electricity markets. However, several programs at the Australian Government and NSW Government level provide support to improve the market viability of wind power. These programs are starting to incorporate the cost of climate change into electricity markets.

The Australian Government's Mandatory Renewable Energy Target (MRET) has been an important source of support for wind power. Under this program, renewable energy power stations are able to create Renewable Energy Certificates (RECs). One REC is created for every MWh of renewable energy generated. Under the MRET scheme, electricity retailers and other large wholesale purchasers of electricity must surrender sufficient RECs each year to meet a series of annual targets. This means that RECs have a market value so wind farm owners can sell both their electricity and the associated RECs. If the RECs are worth enough, then wind farm owners can sell their electricity at a price that can compete with coal and still make a profit.

When the MRET scheme began, the price of RECs was around $40/MWh. At these levels, wind farms were very competitive with power from coal-fired power stations and there was significant wind farm investment. However, the price of RECs fell substantially to around $14/MWh when it became apparent that there was already sufficient investment in renewable energy to meet the relatively low targets established under the MRET scheme. As of April 2007, REC prices have recovered to around $29/MWh (TFS 2007), which may be enough to encourage further wind farm investment at sites with an excellent wind resource.

The NSW Government has also provided support for wind power through its Greenhouse Gas Reduction Scheme (GGAS). This scheme establishes greenhouse gas reduction targets for electricity retailers and certain other parties that buy or sell electricity in NSW. To meet their targets, retailers must buy or generate NSW Greenhouse Abatement Certificates (NGACs). Similar to RECs, wind farms can create NGACs when they generate renewable electricity. Each NGAC represents one tonne of greenhouse gas reduction. In NSW, one MWh of wind power replacing one MWh of power from the electricity grid will reduce greenhouse gas emissions by a little over a tonne, so the price of an NGAC in $/tonne is roughly equivalent to the price in $/MWh.

NGAC prices started at around $10 or $11/tonne in 2003, climbed to around $15/tonne in mid-2006 and have now fallen to a little over $12/tonne (TFS 2007). At these prices, there is little incentive for wind farms to generate NGACs, as RECs are worth more.

In response to the fall in REC prices, the NSW Government has introduced the NSW Renewable Energy Target (NRET). The NRET scheme will operate in a similar way to the MRET scheme but with higher renewable energy targets of 10% by 2010 and 15% by 2020, focused on NSW only (NSW Government 2006). The scheme is due to commence in 2007, with the first target set for 2008. The NRET scheme is likely to act as a strong stimulus for greater investment in wind in NSW once it commences. However, as noted in Section 1, environment groups are concerned that the target is too low and that there may be double counting of renewable energy projects established in other States. Many of the wind farms that are currently approved for NSW are on hold until the scheme commences and precise rules are worked out.[5]

Another potential source of support for wind power is a possible national emissions trading scheme, which would put a price on greenhouse gas emissions. Such a scheme would increase the cost of non-renewable energy while having no impact on the cost of renewable energy. A carbon tax would have a similar impact. If the price on greenhouse gas emissions is high enough under an emissions trading scheme or a carbon tax, wind power could become competitive with coal-fired power. At a price of around $30/tonne of greenhouse gas, wind power would be very competitive in good locations.

A Prime Ministerial Task Group on Emissions Trading is currently considering whether the Australian Government should introduce a national emissions trading scheme and is due to report in May 2007 (Task Group on Emissions Trading 2007). If the Australian Government does not introduce a scheme, the States and Territories intend to introduce their own scheme by the end of 2010 (Council for the Australian Federation 2007).

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[5] Environment groups have called for a much stronger renewable energy target of 25% by 2020 for NSW (NCC et al 2006). Such a target would encourage even stronger investment in wind power in NSW. There is potential for the NSW Government to consider such a target as part of its promised review of the renewable energy targets prior to their inclusion in legislation.

In addition to these mandatory schemes, wind farms can benefit from voluntary schemes, such as Green Power. A wind farm owner can enter into an agreement to sell the output from their wind farm to a retailer, who then sells that power at a premium price as part of an accredited Green Power product. The premium price may be enough to make a wind farm economically viable. The contracts under which wind farm owners sell their energy to Green Power retailers are usually not publicly available. However, for example, all of the electricity generated at Verve Energy's Albany Wind Farm is sold to Synergy in Western Australia for use in its accredited Green Power product called NaturalPower. The price of NaturalPower is 3 cents per kWh more than standard electricity. If all of the extra price is returned to the wind farm, the wind farm would receive a premium of $30/MWh for its electricity, making it competitive with fossil fuel-fired power stations in Western Australia.

It is also important to realise that the cost of wind power has fallen by 75% over the last three decades (Mallon & Reardon 2004) and is expected to continue to fall in the future as a result of economies of scale and technological development. The same cannot be said for fossil fuel technologies; natural gas generation is expected to become more expensive through to 2020 and coal generation is expected to remain stable in cost (Mallon & Reardon 2004). As a result, wind power is likely to become more competitive with time. Mallon and Reardon (2004) estimate that wind power will be able to compete economically with natural gas between 2008 and 2015 and with coal after 2016, even without considering the cost of climate change.

Case Study: Status of NSW wind farms

Comments received during interviews with proponents of both the Ben Lomond and Taralga Wind Farms indicate that the construction of wind farms in NSW has stalled after obtaining planning approval.

According to Colin Liebmann of RES Southern Cross, 'six farms in NSW have been approved (with a total output of 350MW)' but 'lack of a support program has hindered development'. Richard Finlay-Jones of Energreen (proponents of the Ben Lomond wind farm) agreed and indicated that although 'negotiations with power companies are underway…nothing will be happening in the near future.'

Developers are awaiting details of the NSW Government's Renewable Energy Target, due to come into force in 2007 with the first interim target in 2008. According to Colin Liebmann, scheduling the construction phase of the Taralga site is 'subject to the new target'. He also said that the wind power industry in NSW is experiencing uncertainty and proponents are 'having to look at other markets, such as other (Australian) states and New Zealand.'

Source: Colin Liebmann, RES Southern Cross; Richard Finlay-Jones, Energreen

4.5 The potential economic contribution of wind power

In addition to its contribution to greenhouse gas reduction, wind power could make some important contributions to the NSW economy. Wind power provides employment, there may be potential to manufacture wind farm components in NSW and there could be potential to export components to other countries, particularly in Asia.

In 2005, the Australian Wind Energy Association estimated that almost 1,000 people were employed by the wind power industry in Australia, including 345 manufacturing jobs, 374 construction jobs, 120 operations and maintenance jobs and 157 other jobs in, for example, project development and financing (Auswind 2005).

There are an estimated 17 manufacturing jobs in NSW at present, spread between two manufacturers of small wind turbines – Comet Windmills and Soma Power

(Auswind 2005). Comet Windmills makes windmills mainly for farm use and Soma Power makes small wind generators (up to 1 kW). Neither is involved in large-scale wind farm development. Most of the manufacturing jobs in Australia are currently located in three plants:

- Keppel Prince Engineering in Portland, Victoria, which manufactures towers for the wind turbines
- Air Ride Technology in Millicent, South Australia, which also manufactures wind towers
- The Vestas blade factory in Portland, Victoria (Auswind 2005; Diesendorf 2006).

With these and other factories, wind farms in Australia have about 50% Australian content (Diesendorf 2006). Wind power expansion in NSW could make establishing additional manufacturing in Australia viable and increase the local content and jobs. Correspondingly, it could become viable to export wind turbine components to markets around the world. Given Australia's position in Asia, there could be potential to supply Asian markets, which are growing rapidly. Led by China and India, installed wind power capacity in Asia grew by 53% in 2006, reaching 10,600 MW. The Asian market is expected to have the fastest growth over the next few years (GWEC 2007a). Smart Australian businesses could position themselves to take advantage of this growth, given some initial support.

Auswind estimates that the average wind farm creates 0.75 construction job years per MW and 0.12 permanent full-time jobs in operations and maintenance (Auswind 2005). Based on these figures, construction of the 1,193 MW currently proposed for NSW would create 895 construction job years[6] and 143 permanent jobs. Expansion to 3,100 MW would create an additional 1,418 construction job years and 227 permanent jobs. All of these jobs would be located in NSW.

In addition to job creation, wind power contributes directly to the economy through capital investment, amounting to about $1.7 billion in Australia with potential for much more (Auswind 2006c). The wind industry also pays money directly to farmers who host wind turbines on their land, providing an important source of income.

Case Study: Economic contribution of wind farms

The Assessment of the Development Application for the Taralga wind farm indicates that between 20 and 40 personnel would be employed during the 16-month construction period. Thereafter, six staff would be employed to conduct ongoing maintenance work and the site would be monitored remotely with additional staff on-call to address any issues.

Regarding manufacturing, it is possible that the towers may be manufactured in Australia. However, it is likely that other parts would need to be imported.

Some manufacturing of parts for the Ben Lomond wind farm may be undertaken in Australia. Blades could be manufactured in Victoria and towers in South Australia. Further employment would be created during construction. For example, local contractors would be employed for tower installation, large vehicle hire, provision of gravel and concrete and engineering expertise.
Source: NSW Department of Planning (2005); Colin Liebmann, RES Southern Cross; Richard Finlay-Jones, Energreen

[6] 'Construction job years' is a standard way of expressing jobs in the construction industry. If a project creates 100 construction job years, that means it will employ 100 people for one year, or 50 people for 2 years, or 200 people for six months, and so on.

5 Wind farm planning and approval

This section briefly introduces the Australian Wind Energy Association's Best Practice Guidelines for wind farm development (Section 5.1). It also provides detail on the development approval processes for wind farms (Section 5.2), as these processes provide the community with their main opportunity to get involved.

5.1 Best Practice Guidelines

The Australian Wind Energy Association has developed Best Practice Guidelines for wind farm development (Auswind 2006a). These guidelines identify seven stages in the development of a wind farm:

1. Site Selection: At this stage, the proponent looks for a site with a good potential wind resource, suitable topography for a wind farm, appropriate zoning and land use, and low environmental and social impacts. The proponent begins consultation with landowners, the local council, the Department of Planning and possibly the wider community. Under the Draft National Assessment Framework for Wind Farms and Landscape Values (Planisphere 2007b), the proponent would also undertake a preliminary landscape assessment at this stage to assist with site selection.[7]

2. Project Feasibility: Once one or more sites are identified, the proponent undertakes feasibility studies to check that the wind resource is sufficient to support a wind farm. They enter into discussion with landowners to secure availability of preferred sites and consult with the community and other stakeholders, including electricity network operators.

3. Project Detailed Assessment: If the feasibility studies indicate that development of the wind farm is feasible, the proponent commissions more detailed assessments of all of the relevant issues to prepare for submitting a Development Application and Environmental Assessment. Under the Draft National Assessment Framework for Wind Farms and Landscape Values (Planisphere 2007b), this would include a full landscape assessment, modelling and assessment of the impact of the wind farm on landscape values and identification of management and mitigation measures.

4. Development Application: The proponent applies for development approval from the Minister for Planning (usually) or the local council (for small wind farms). The Australian Government may also need to approve the wind farm under the Environment Protection and Biodiversity Conservation Act 1999.

5. Construction: If the wind farm is approved, the proponent can commence construction. The proponent must comply with any conditions of the development consent and all relevant environmental laws and regulations.

6. Wind Farm Operation: Once built, the wind farm may operate for 20 to 30 years or more, with regular maintenance to ensure safe and efficient operation.

7. Decommissioning: Eventually, a wind farm may need to be decommissioned, although it is more likely that the wind farm will be upgraded with newer turbines as technology improves, allowing continued operation at the site.

[7] See Section 7.1 for a more detailed discussion of the Draft National Assessment Framework for Wind Farms and Landscape Values.

Further detail on all stages of the wind farm development process is available in Appendix A. Section 5.2 provides further detail on the development approval stage of the process, as this is usually the stage where the community has most opportunity for involvement.

5.2 Development approval

Like all developments, wind farms are subject to environmental and planning laws and regulations. The Department of Planning manages the planning system in NSW, and is responsible for assessment of most wind farm development applications. The Australian Government may also have a role in approval of wind farms under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). Further details are provided below.

5.2.1 Australian Government approvals

Under the EPBC Act, an action requires approval from the Australian Government Environment Minister if the action has, will have, or is likely to have, a significant impact on a matter of national environmental significance (DEH 2006a). Matters of national environmental significance are:

- Listed threatened species and ecological communities
- Migratory species protected under international agreements
- Ramsar wetlands of international importance
- The Commonwealth marine environment
- World Heritage properties
- National Heritage places
- Nuclear actions (DEH 2006a).

Wind farms have the potential to impact on threatened and migratory species through impacts of birds or bats with wind turbines. Wind farms could also impact on Ramsar wetlands, World Heritage properties and National Heritage places if they are sited near any of these. If a wind farm has potential to impact on any of these matters of national environmental significance, the proponent must refer it to the Minister for a decision on whether the wind farm requires assessment and approval under the EPBC Act (DEH 2006a).

If the wind farm does require Australian Government approval, an assessment of the impact of the development on national environmental significance is required. Under a bilateral agreement between the Australian Government and the NSW Government, this assessment can be conducted as part of the NSW environmental assessment process (Department of the Environment and Water Resources 2007a). The Minister for Environment and Water Resources then makes a decision based on the assessment provided.

In July 2006, Macintosh and Downie (2006) identified approximately 60 wind farm referrals under the EPBC Act, of which 44 did not require Australian Government approval, nine did not require approval if they met specific conditions and seven required approval. Of the seven, three were approved with conditions, three were awaiting a final decision and one was initially rejected before being approved with conditions.

Between July 2000 and 2 May 2007, eight wind farm proposals located in NSW were referred to the Australian Government under the EPBC Act. None were identified as requiring Australian Government approval (Department of the Environment and Water Resources 2007b).

Case Study: Bald Hills Wind Farm

The Bald Hills Wind Farm proposed for South Gippsland, Victoria, would have 52 turbines and a total size of 104 MW. A development application was submitted to the Victorian Government for approval in 2002. After environmental assessment processes, the wind farm was approved by the Victorian Government in August 2004.

The wind farm was also referred to the Australian Government for a decision on whether approval was required under the EPBC Act. In August 2002, the Australian Government determined that the wind farm was a controlled action, meaning that it required approval under the EPBC Act as a consequence of its potential impacts on listed threatened species and communities and listed migratory species. Species of particular concern were the Orange-bellied Parrot, Swift Parrot and White-Bellied Sea Eagle.

In April 2006, the Federal Environment Minister (Senator Ian Campbell) controversially denied the wind farm approval because of the small possibility that it could cause 'up to one bird death per year' for the Orange-bellied Parrot. The proponent began proceedings in the Federal Court to appeal this decision before reaching an agreement with the Minister to resubmit their proposal with new information. The proponent resubmitted the proposal to the Minister with additional information in September 2006. It was approved by the Minister, subject to conditions, in December 2006.

5.2.2 NSW Government approvals

Wind farms located in NSW are subject to the requirements of the NSW *Environmental Planning and Assessment Act 1979* and associated regulations and environmental planning instruments, including State Environmental Planning Policies, Regional Environmental Plans and Local Environmental Plans.

Under State Environmental Planning Policy (Major Projects) 2005, a wind farm is determined to be a State Significant Development if it has a capital investment value of more than $30 million or is located in an environmentally sensitive area of state significance. In 2002, SEDA estimated that the capital cost of a wind farm in NSW is around $1.8 million per MW of installed power (SEDA 2002a). Based on this, any wind farm with a planned capacity of more than 16 MW would be considered a State Significant Development. Of 20 proposed wind farms on the Auswind website (Auswind 2007), only three are smaller than 16 MW in size – the other 17 would be State Significant Development. State Significant Developments are assessed under Part 3A of the Environmental Planning and Assessment Act and require approval by the NSW Minister for Planning.

Under Part 3A, the proponent needs to submit a Development Application to the Department of Planning and is then provided with the requirements for an Environmental Assessment, which will identify key issues to be addressed and the level of assessment required. The proponent must then prepare an Environmental Assessment to meet these requirements. The Environmental Assessment is lodged with the Department of Planning and, if it meets the requirements, is publicly exhibited. Submissions are invited from the public (DIPNR 2005).

After the exhibition period, the proponent is provided with all submissions and a summary of issues raised, and is asked to respond to these issues and modify the project as appropriate. The Department of Planning prepares an Assessment Report and the Minister makes a decision either to reject, approve with conditions or approve the project (DIPNR 2005). Under certain circumstances, proponents and objectors can appeal the Minister's decision through the Land and Environment Court (NSW Department of Planning 2006).[8]

5.2.3 Local Government approval

Smaller wind farm proposals, with capital investment of less than $30 million, will usually be assessed by the local council under Part 4 of the Environmental Planning and Assessment Act. Proponents will need to check that the Local Environmental Plan and any Development Control Plan covering the site allow development of wind farms, with or without consent. Several councils in NSW have developed Development Control Plans with specific conditions relating to wind power, including Oberon, Dungog, Upper Lachlan, Goulburn Mulwaree and Lithgow (DEH 2006b). If consent is required, the proponent will need to prepare a Development Application to the local council.

Wind farms with a capacity of more than 30 MW are designated development under Schedule 3 of the Environmental Planning and Assessment Regulation 2000, which means that the proponent must prepare an Environmental Impact Statement and advertise the application.[9] In practice, if a wind farm is greater than 30 MW then it will likely be a State Significant Development and will be assessed by the Department of Planning.

This means that local councils will mainly deal with small wind farms that only require preparation of a Statement of Environmental Effects to accompany the Development Application. The local council decides whether to approve, reject or approve the application with conditions.

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[8] A proponent can appeal to the Land and Environment Court within three months of receiving notification of the determination. An objector is someone who has made a submission under Section 75H of the Environmental Planning and Assessment Act objecting to an application for approval of a project. Objectors may appeal a decision within 28 days of the notice of determination, unless a Concept Plan has already been approved for the project, the project is deemed to be critical infrastructure or there has been an inquiry or expert panel report.

[9] An Environmental Impact Statement, required under Part 4 of the Act, is different to the Environmental Assessment required under Part 3A of the Act. The environmental assessment requirements under Part 3A of the Act are far more discretionary than the requirements for developments under Part 4 and Part 3A removes the development from the need to gain other approvals and apply with other State Environmental Planning Policies.

Case Study: Planning and approval process for Taralga Wind Farm (108 MW)

The Land and Environment Court of NSW provides a concise summary of the planning and approval process for this development. The proposal for Taralga Wind Farm was subject to the Mulwaree Local Environment Plan (LEP) 1995 and Development Control Plan (DCP) 1995. The original Development Application was submitted to the Upper Lachlan Shire Council in November 2004. An EIS (Environmental Impact Statement) accompanied the proposal written by RES Southern Cross (the wind farm proponent).

The development required the following:

- An environment Protection Licence from the NSW Department of Environment and Conservation
- A permit from the Department of Natural Resources for proposed work near the Wollondilly River
- A consent from the Upper Lachlan Shire Council for proposed works relating to a public road
- A consent from the Department of Lands for work relating to a Crown Road.

Approval from each of these bodies was received. The proposal was not referred to the Commonwealth Minister as the EIS indicated the farm would not have National Environmental Significance.

Both the EIS and development application were publicly exhibited. In addition, landholders were made aware of the application and it was advertised in the local newspaper. Submissions and petitions both in support of and objection to the proposal were received.

In March 2005, RES Southern Cross reduced the number of turbines it was seeking from 69 to 62 as it did not have landowner's consent for those 7 turbines.

In January 2006, the Minister for Planning approved the project subject to a range of conditions of consent and this decision was advertised in two local newspapers.

The Taralga Landscape Guardians appealed against the verdict in the NSW Land and Environment Court. The judge that considered the appeal drew attention to 'the conflict between the geographically narrower concerns of the Guardians and the broader public good of increasing the supply of renewable energy' and 'concluded that, on balance, the broader public good must prevail'. Consequently, the appeal was rejected and permission was granted for the development of 62 turbines as per the proposal.

Source: Taralga Landscape Guardians Inc v Minister for Planning and RES Southern Cross Pty Ltd [2007] NSWLEC59.

6 Community perspectives on wind farms

Community opinion on wind farm development is mixed. This section briefly summarises recent social research identifying majority community support for wind farms (Section 6.1) and identifies critics of wind farms in NSW (Section 6.2).

6.1 Support for wind farms

In 2006, an AC Nielsen poll conducted for the Australian Wind Energy Association found the following:

- 84% of respondents believed that wind power was an environmentally friendly source of energy
- 83% believed it was natural and clean
- 77% agreed or strongly agreed that governments should look at setting up more wind farms in Australia
- 75% agreed or strongly agreed that the Australian Government should do more to support wind energy as a way of reducing greenhouse gas emissions (ACNielsen 2006).

More recently, the Climate Institute published research showing that:

- 81% of respondents agreed or strongly agreed that Australia should be a world leader in clean energy (solar, wind and geothermal) use
- More than 80% supported a policy that would require 25% of electricity generation to come from clean energy like wind and solar by 2020 (The Climate Institute 2007).

This and other polling paints a picture of majority support by the Australian public for renewable energy in general and wind farms in particular, as an important response to climate change.

In at least one case in Australia, the community has supported wind power so strongly that they are establishing their own community wind farm. The Hepburn Renewable Energy Association, a non-government community organisation, is developing Australia's first community-owned wind farm in collaboration with Future Energy Pty Ltd. The approved wind farm will comprise two wind turbines rated at 2 MW each and will be located near Daylesford in Victoria. The wind farm will be owned by a cooperative made up of members of the local community (HREA 2007).

Case Study: Benefits of Taralga Wind Farm

It is estimated that the Taralga Wind Farm will generate electricity equivalent to the average annual consumption of at least 29,160 households whilst avoiding emissions of at least 192,860 tonnes of carbon dioxide equivalent per annum. The proposal may also contribute to avoidance of losses from the electricity grid by providing electricity closer to the end users.

During construction there would be a temporary workforce varying between 20 and 40 personnel over the 16-month construction period. Six staff would be employed for conducting routine maintenance work on an ongoing basis over the life of the wind farm.

Other benefits, such as the potential for the wind farm to attract tourists, are also possible.

Source: NSW Department of Planning, Planning Report (2005)

6.2 Critics of wind farms

While the research cited above indicates majority support for wind farms, this support is by no means universal. In each of the above examples, 15 to 25% of respondents did not agree with the positive statements about renewable energy and wind power. This is a significant minority.

It is also important to note that many people expressing support for wind power, particularly those in urban areas, may never live near a proposed wind farm site and may not have as clear an understanding of the local impact of wind farms. Although wind farm opponents are a minority, they may have legitimate concerns that need to be considered.

Critics of wind farms may oppose wind farms in general, or may only oppose a wind farm at a specific site. One general critic of wind farms is the Australian Government's Agriculture Minister, Peter McGauran, who has stated that:

> Wind farms don't live up to the hype that they are an environmental saviour and a serious alternate energy source and the effect they can have on their neighbours are so serious it means they should not be allowed to get away with the exaggerated claims, their claims are fraudulent (ABC 2006).

Wind energy has been criticised in the media for displacing other low-emission technologies, such as hydroelectricity and gas, rather than coal power. It has also been criticised for its low capacity factor compared to coal-fired power stations and concerns have been raised about the potential of wind turbines to spark bushfires (Molonglo Landscape Guardians 2007).

The community groups that have formed in opposition to specific wind farm proposals raise more specific concerns. In NSW, these groups include:

- The Molonglo Landscape Guardians, who oppose a proposal by Acciona Energy for a wind farm on the Molonglo Ridges, near Queanbeyan
- The Spring Range Community Landscape Guardians, who oppose the installation of wind turbines on Mt Spring and adjoining hills in the Canberra region
- The Taralga Landscape Guardians, who unsuccessfully appealed against the approval of the Taralga Wind Farm in the NSW Land and Environment Court

- The Parkesbourne-Mummel Landscape Guardians, who oppose the Evandale Wind Farm proposal, west of Goulburn.

Generally, members of these groups live near the proposed wind farm site and would be directly affected by the development. As an example of the concerns raised by community groups, the boxed text below provides a case study on the Taralga Wind Farm. This was the first wind farm in NSW to be the subject of an Objector's appeal against the Minister's approval in the NSW Land and Environment Court. Section 7 provides a more complete consideration of the criticisms levelled at wind farms.

Case Study: Objections to Taralga Wind Farm

During the exhibition of the Environmental Impact Statement for the Taralga Wind Farm, a total of 221 submissions were received from the community. Of these, 171 stated that they objected to the proposal and 30 stated that they supported the proposal. Two petitions were also received – one with 168 signatures supporting the development and one with 113 signatures opposing the development.

Numerous issues were raised by the submissions. The issues raised in more than 20 submissions, in order, were:

- Visual impact
- Adverse impact on rural character
- Negative effect on property prices
- Community division
- Deterrence of tourists due to negative impact on landscape
- Noise
- Inefficient energy production
- Flora and fauna impacts, particularly on birds and bats
- Heritage was not adequately considered
- Shadow flicker
- Secrecy of process
- Impact on neighbouring land use
- Inequitable distribution of benefit (landholders receiving all of the benefit).

According to the Taralga Landscape Guardians, the wind turbines are 'alien industrial structures which destroy the historical context and landscape setting of the village'.

Sources: NSW Department of Planning, Planning Report (2005) and Taralga Landscape Guardians Inc v Minister for Planning and RES Southern Cross Pty Ltd [2007] NSWLEC59.

7 Criticisms of wind farms

This section considers the general and specific criticisms levelled at wind farms in NSW in more detail. Where these criticisms have merit, it explores ways in which proponents can manage or reduce negative impacts. The specific issues considered are impacts on visual amenity and landscape values (Section 7.1), impacts on property prices (Section 7.2), tourism impacts (Section 7.3), noise (Section 7.4), technical issues associated with wind farms (Section 7.5), threats to biodiversity (Section 7.6), fire risk (Section 7.7) and social and cultural impacts (Section 7.8).

7.1 Impacts on visual amenity and landscape values

The following quotation provides a useful introduction to the idea of landscape values:

> Landscape values are values about places that are held by communities. These might be visual, cultural, spiritual, environmental, based on memories, perceptions or different ideas about what is 'beautiful'. Understanding landscape values involves identifying essential characteristics of the landscape and working with communities to understand the meaning of the landscape to them (Planisphere 2007b, p.9).

The impact of wind turbines on visual amenity and landscape values is arguably the most contentious and divisive issue associated with wind farm development. For some, wind turbines are 'dynamic visual sculptures' (SEDA 2002a), while for others they are 'alien industrial structures' and a 'blight' on the landscape (Taralga Landscape Guardians Inc v Minister for Planning and RES Southern Cross Pty Ltd [2007] NSWLEC59).

Those who see wind farms as a positive element in the landscape may raise the following:

- Aesthetics, including the clean lines of the turbines, their sleek aerodynamic and sculptural forms, their sense of order and their modern design
- Symbolic value as an example of sustainable electricity production and an example of humans working in harmony with nature
- Functional value, deriving from their ability to provide a public good (renewable electricity) in response to climate change
- Their value as an alternative to other means of electricity production that may have a more negative impact, such as coal mines and power stations (Planisphere 2007a).

Those who see wind farms as a negative element are concerned with the intrusion of industrial structures into coastal or rural landscapes, their impacts on the scenery and on tourism, and their effect on the character of a landscape. As the best sites for wind farms are usually in exposed, elevated areas, they tend to be highly visible in the surrounding landscape and this is a concern for those who value that landscape as it is. Concerns have grown as the size of wind turbines and the number of turbines in a wind farm has increased.

Specific concerns have been raised about shadow flicker or strobe effects that arise when turbine blades pass across the sun, causing a flickering shadow. In practice, this is not likely to be an issue in NSW as the separation distance required for noise mitigation is sufficient to prevent shadow flicker impacts on dwellings (SEDA 2002a).

On the broader question of aesthetics, there is no right or wrong answer. There is some evidence from overseas that concerns about the visual impact of wind farms ease over time once the wind farm is operating (Warren et al 2005). However, this does not mean that concerns about the visual impact of wind farms are not valid and wind farm developers need to be particularly sensitive to these concerns.

The easiest way to address impacts on visual amenity is to avoid locations that have high scenic values or landscape values. This raises the question of how landscape values can be identified and assessed. The Australian Wind Energy Association and Australian Council of National Trusts have developed a Draft National Assessment Framework to assess the impact of a wind farm on landscape values and design ways to reduce the impact (Planisphere 2007b). This Framework is intended to help wind farm developers to improve the siting and design of wind farms so that their impacts on landscape values are minimised.

The Framework identifies the following steps in the assessment and management of impacts on landscape values:

- Step 1: Assess the Landscape Values
    - Step 1A: Preliminary Landscape Assessment to inform pre-feasibility studies. This involves identifying known highly significant landscapes near the proposed site and initial community engagement.
    - Step 1B: Full Landscape Assessment to document as fully as possible the landscape values of the area, who holds these values and their significance to the community. This stage informs the preparation of a Development Application and requires significant community engagement.
- Step 2: Describe and Model the Wind Farm in the Landscape. This involves depicting the wind farm as it will appear in the landscape, as accurately as possible. It may involve maps, digital terrain models, photographic montages and video modeling.
- Step 3: Assess the Impacts of the Wind Farm on Landscape Values, including both positive and negative impacts. Community input at this stage is critical. Impacts may be ranked, using various methods, and their acceptability assessed.
- Step 4: Develop Management and Mitigation Measures to avoid, mitigate or minimise any identified impacts. Again, community input is essential (Planisphere 2007b).

Some of the possible mitigation measures identified in the framework include:

- Changes to the location of the wind farm as a whole
- Changes to siting of turbines within the proposed wind farm site
- Changes to the scale, size, height of turbines
- Changes to location or siting of ancillary infrastructure
- Design of turbines (including colours, materials, logos, lights)
- On-site landscaping
- Off-site landscaping (Planisphere 2007b).

One strategy that shows particular promise is to reduce the scale of wind farms. The Parliamentary Commissioner for the Environment in New Zealand has recommended investment in smaller-scale distributed wind farms as a way of reducing visual impacts and community conflict (Parliamentary Commissioner for the Environment 2006). This may mean investing in more domestic-scale wind power, as well as the use of smaller wind turbines in commercial-scale wind farms. At certain sites, it may not be appropriate to use the largest available turbines.

For some opponents of wind farms, particularly those directly affected by a specific wind farm proposal, these actions will not go far enough. For them, the visual and other impacts of wind farms outweigh any benefits and cannot be mitigated. Here, it is important to consider the public interest. The judge that considered the appeal by the Taralga Landscape Guardians against the Taralga Wind Farm considered 'the conflict between the geographically narrower concerns of the Guardians and the broader public good of increasing the supply of renewable energy' and 'concluded that, on balance, the broader public good must prevail' (Taralga Landscape Guardians Inc v Minister for Planning and RES Southern Cross Pty Ltd [2007] NSWLEC59). It is important to remember that climate change threatens landscapes around Australia and around the world. Objections to particular wind farms need to be considered against this context.

It is also important to consider the visual impact of wind farms against the visual impacts of alternatives, including coal mines, coal-fired power stations and long-distance transmission lines to take power from centralised power stations to points of demand. Arguably, these alternatives can be more disruptive to the landscape than wind farms.

Nevertheless, wind farm proponents can undoubtedly do more to avoid sites with high scenic value and to work closely with communities to ensure that wind farms are welcome in the landscape. Local communities that understand the benefits of wind power and are comfortable with the visual impacts of wind turbines have welcomed wind farms in many parts of Australia, such as Esperance (see boxed text).

Case Study: The Festival of the Wind, Esperance, Western Australia

Esperance in Western Australia gets about 22% of its electricity from the Ten Mile Lagoon Wind Farm and Nine Mile Beach Wind Farm. The community initiated a biennial Festival of the Wind to celebrate the positive energy that wind brings to Esperance, through themed arts and events. The 2007 festival was the fifth and attracted crowds of 3,000 to major events.

7.2 Impact on property prices

Related to the visual impact of wind farms are concerns about the impact of wind farms on property prices for adjacent properties or those that are visually impacted. Properties that are hosting wind turbines may actually increase in value due to the guaranteed income stream from the wind turbines, so few concerns have been raised about these properties.

Macintosh and Downie (2006) review the available evidence on the impact of wind farms on property prices, including surveys and transaction-based studies. While there have been few studies in Australia, evidence from overseas indicates that wind farms are unlikely to have a significant negative impact on property prices. For example, Masters research by Hoen (2006) in Madison County, New York found that wind farm visibility had no measurable impact on property transaction values, even for properties within a mile of a wind farm that had been sold immediately following the announcement and construction of the wind farm. Hoen (2006) also showed that other studies demonstrating price impacts suffered from statistical flaws.

A more recent study in Cornwall found that:

> Despite initial evidence that there was an effect, when they investigated more closely, there were generally other factors which were more significant than the presence of a wind farm. Insofar as there was any impact on prices, the results seem to show that it is most noticeable for terraced and semi-detached houses, with there being a significant impact on properties located within a mile of a wind farm. The effect seems much less marked – if at all – for detached houses (Dent & Sims 2007).

Based on current research, it is fair to say that impacts on property prices are uncertain, but likely to be small, particularly if the wind farm is sited appropriately. As with visual impact, any small, temporary impacts on private interests need to be balanced against the broader public interest. Proponents need to be aware of possible impacts on property prices and choose sites that are likely to have the least impact.

7.3 Tourism

One of the reasons cited by the Taralga Landscape Guardians for their opposition to the Taralga Wind Farm was that it would significantly diminish the attractiveness of Taralga village as a tourist destination. This concern about deterrence of tourists is linked to concerns about the visual impact of wind farms. While it is possible that wind farms in inappropriate locations could deter some tourists, there is little evidence that this is happening in practice. In fact, wind farms have become tourist attractions in many parts of Australia (AusWEA 2004c; Carlton 2002).

The Albany Wind Farm and wind farms around Esperance in Western Australia are publicised as local tourist attractions and have interpretive panels to allow self-guided tours. The Toora Wind Farm in Victoria has a Windmill Café that attracts tourist groups. There are also commercial tours of the Woolnorth Wind Farm in Tasmania, the Codrington Wind Farm in Victoria and the Challicum Hills Wind Farm in Victoria. Wind farms are relatively new additions to the landscape and people are curious about how they look and how they work, so they are natural tourist attractions.

Case Study: Tourism at Albany Wind Farm

The Albany Wind Farm is considered by many to be an outstanding tourist attraction. It was opened by the State's Minister for Tourism in 2001 and has been featured on the Channel 7 TV Show 'The Great Outdoors'. Since its opening, approximately 100,000 people have visited the farm each year.

In 2005, the farm's Interpretation Panels Project was unveiled. The project provides education at the site about wind power technology and its links with traditional Aboriginal culture. Recognising the potential economic benefits to be derived from tourism at the wind farm, the WA State Government contributed $80,000 to the project. This is part of a wider partnership between the State Government, City of Albany and Western Power.

Wind farms in NSW could tap into the existing tourism market in wind farm locations. The Ben Lomond and Taralga areas already attract significant numbers of tourists and the experience in Albany suggests that the wind farms could actually boost tourism.

It is evident that people are curious about wind technology. As occurred in Albany, education can be introduced to enhance the visitor experience and provide information on cultural, technological and sustainability issues. The natural beauty of the areas can also be utilised by development of pedestrian tracks to encourage walking at the site. Support for such projects could be sought from State Government.

Source: Auswind

7.4 Noise

Wind turbines are rotating machinery and necessarily create some noise when they are operating (which is about 30% of the time). The noise is made up of mechanical and electrical noise and aerodynamic noise (GWEC & Greenpeace 2006). The mechanical and electrical noise sounds something like a car running, while the aerodynamic noise is a whooshing, rhythmic noise created by the movement of the blades through the air (SEDA 2002a).

The sources of the mechanical and electrical noise are all enclosed within the nacelle and noise from this source is usually reduced through appropriate component design and acoustic insulation. As a result, the dominant noise from wind turbines is the aerodynamic noise (SEDA 2002a).

The aerodynamic noise is created by the blades cutting through the air. The noise increases as wind speed increases, although not as fast as the increase in background noise from the wind. As a result, wind farms are likely to be most audible at wind speeds just above the speed at which the turbine starts generating (SEDA 2002a).

At a distance of 40 metres, the noise from a wind farm is equivalent to conversational speech (Macintosh & Downie 2006). At 350 metres, a wind farm creates a level of noise that is roughly equivalent to the sound of a busy road 5 km away and a little more than the sound of a quiet bedroom (AusWEA 2004b). At greater distances, noise levels will be even lower. Table 6 gives indicative noise levels for a range of sources and activities, including a wind farm at 350 metres.

Source/activity	*Indicative noise level dB(A)*
Threshold of pain	140
Jet aircraft at 250m	105
Pneumatic drill at 7m	95
Truck at 48 kph at 100m	65
Busy general office	60
Car at 64 kph at 100m	55
Wind development at 350m	35-45
Quiet bedroom	35
Rural night-time background	20-40

Table 6: Indicative noise levels for a range of activities and sources. Source: UK Sustainable Development Commission (2005)

Allowable noise from all developments is regulated under environmental laws and allowable limits are usually related to background noise levels at nearby properties. Wind farm proponents undertake extensive background monitoring of noise levels as part of the design of wind farms. Due to the nature of the noise from wind turbines, allowable noise levels are often set slightly above the background level, given that the noise will only be audible for short periods of time (when turbine noise exceeds background noise) (AusWEA 2004b). The Government of South Australia has developed Environmental Noise Guidelines for wind farms that are commonly used in assessing noise from wind farms around Australia. These guidelines indicate that if the noise generated by a wind farm does not exceed the background noise by more than 5 dB(A) the impact will be marginal and acceptable (EPA 2003).

Most wind farms will rarely create noise above the background level at nearby properties, particularly when there is an appropriate buffer zone.[10] Noise above the background level may occur at particular wind speeds but this should be for relatively short periods and may not be perceived as negative. However, the perception of noise is subjective and some people may find even this small amount of noise annoying. In these cases, specific noise proofing measures, or even purchase of nearby properties, may be appropriate. As with visual impacts, a move towards smaller-scale wind farms would help to reduce negative noise impacts.

[10] The size of the buffer zone depends on factors such as local topography, the character and level of local background noise and the size of the development (Auswind 2006a).

Case Study: Noise from the Taralga Wind Farm

The proposed Taralga Wind Farm is required to comply with a 35 dB(A) noise limit at adjacent dwellings. There are 11 dwellings located within about 1 km of a turbine – seven of these are on properties that are hosting turbines. In the Land and Environment Court judgment relating to the wind farm, the judge required RES Southern Cross to take a precautionary approach to the possibility of problem noise at nearby dwellings. The judgment modified the conditions of approval to require some additional noise mitigation measures at five properties and to require RES Southern Cross to purchase two properties if so desired by the property owners. This is evidence of how seriously the Court takes noise issues and how important it is for wind farm proponents to take a precautionary approach to noise impacts.

Source: Taralga Landscape Guardians Inc v Minister for Planning and RES Southern Cross Pty Ltd [2007] NSWLEC59.

7.5 Technical issues

Wind power has been criticised on technical grounds as inefficient, expensive, unreliable, unable to reduce greenhouse gas emissions and unable to provide baseload power (Diesendorf 2006; Macintosh & Downie 2006). It is worth considering each of these criticisms in turn.

When critics argue that wind farms are inefficient they are usually referring to the relatively low capacity factor for wind farms compared to other types of power stations. Wind farms have a capacity factor of 18 to 40%, while a large baseload coal-fired power station might have a capacity factor of 85% (Macintosh & Downie 2006). However, this does not mean that wind farms are inefficient. In fact, they convert a larger proportion of the available fuel (wind) into power than coal-fired power stations do (Diesendorf 2006). It is not efficiency that is a problem but the impact of the capacity factor on the economics of wind power. Wind farms are unable to earn money when the wind is not blowing. This is reflected in the price of electricity from wind farms.

This leads to criticisms that wind is expensive. As discussed in Section 4.4, wind power is only more expensive than power from fossil fuels when the cost of climate change is excluded. As soon as the cost of climate change is factored into the price of electricity from fossil fuels, wind power becomes very competitive. In fact, wind power is one of the least expensive ways to reduce emissions from electricity, after improvements in energy efficiency. At present, and even at much higher penetration, wind power adds very little to the cost of electricity at the end user (Macintosh & Downie 2006). If NSW sourced 10% of its electricity from wind by 2020 (and another 15% from other renewable sources), it is estimated that electricity prices would only increase by 1 cent per kWh or $10/MWh (NCC et al 2006). This would mean that NSW prices would remain among the cheapest in Australia.

When critics call wind farms unreliable, they are generally referring to the variable nature of wind power and its impact on electricity networks. Macintosh and Downie (2006) consider this issue in detail and conclude that current measures in place to manage variability in electricity networks are more than sufficient to deal with the variability of wind power. Greater penetration of wind could lead to an increase in the need for services to manage variability, however this would add only a small amount to the cost of wind power. Strategic distribution of wind farms throughout the network can decrease overall variability by accessing different wind regimes. In addition, wind forecasting can help to predict and manage variability.

As discussed in Section 4.3, existing electricity networks could readily accommodate as much as 10% wind power and it is likely that more would be possible with appropriate changes to the network. While wind power can create local network problems in weaker parts of the network, these problems are manageable.

It has been argued that wind power is unable to significantly reduce greenhouse gas emissions because it displaces other low-emission sources from the electricity market, rather than coal power. Macintosh and Downie (2006) point out that the main renewable energy sources in Australia, hydroelectricity and wind, are usually dispatched first in the National Electricity Market because of the way they bid their demand into the market. It is only the additional demand after the wind and hydro power has been sent out that is met by fossil fuel power stations. This means that most wind farms will directly displace fossil fuel power and directly reduce greenhouse gas emissions. It is more likely that wind power will displace electricity from natural gas power stations at low penetrations. However, as penetration increases, wind power starts to displace a greater proportion of coal power as well (MMA 2006).

The energy used to manufacture and construct wind turbines, which mainly comes from fossil fuels, slightly reduces the net saving in greenhouse gas emissions. However, it only takes a wind farm three to seven months to generate enough emission-free energy to pay back the emissions generated during its construction. It will then operate for 20 to 30 years or more, reducing emissions the whole time (Diesendorf 2006).

Finally, critics argue that wind power should not be pursued because it is unable to provide continuous, baseload power. It is true that no individual wind farm can provide continuous power. However, a series of wind farms spread throughout a network can provide power on a much more regular basis, because the wind is likely to be blowing at one of the wind farm locations (Diesendorf 2006). When wind power makes up a small proportion of electricity generation, the variability does not matter. As penetration increases, it may become more significant but can be managed by ensuring there is a good mix of geographically dispersed wind farms and other energy sources in the network. The use of smaller-scale, distributed wind farms can also help with this issue.

7.6 Biodiversity

Wind farms can have impacts on biodiversity through disturbance of species and habitats that exist at the site during construction and operation. Any such impacts are considered as part of the environmental assessment processes during approval and approval will not be provided where impacts are unmanageable. In practice, most wind farms occupy cleared agricultural land and avoid areas with high biodiversity value. However, wind farm proponents need to investigate the potential for impacts on local biodiversity at particular sites.

Of more concern is the potential for wind farms to kill birds and bats as a result of collisions with the blades or towers. Mortality rates from collisions with wind turbines appear to be low – typically less than five birds and five bats per turbine per year (Macintosh & Downie 2006). To put this in context, Table 7 lists the main causes of bird deaths in the United States and the estimated deaths per year. These causes of bird mortality far outweigh mortality from wind farms.[11]

In Australia, land clearing and climate change will be much greater threats to birds and bats than wind farms. However, particular sites that are close to important

[11] A 2001 study found that about 33,000 birds died globally due to 15,000 operating wind turbines – mostly from older, faster rotating machines, which are being phased out (GWEC & Greenpeace 2006).

habitats or migratory paths may need to be avoided. Again this issue is considered in detail in environmental assessment procedures and wind farms that are inappropriately sited are unlikely to be approved.

Cause	*Estimated deaths per year*
Utility transmission and distribution lines	130-174 million
Collision with road vehicles	60-80 million
Collision with buildings	100-1,000 million
Telecommunications towers	40-50 million
Agricultural pesticides	67 million
Cats	39 million

Table 7: Main causes of bird deaths in the United States. Source: GWEC and Greenpeace (2006)

7.7 Fire risk

Some groups have argued that wind farms constitute a fire risk due to the risk of lightning strikes and the possibility of sparks coming from the turbine during operation. The Australia Institute examined this issue through a survey of 40 of the 41 wind farm operators in Australia. They found that:

> Only two of the 40 operators reported a fire at any time during the life of the wind farm. The first occurred at Ten Mile Lagoon in Western Australia in the mid-1990s and the second at Lake Bonney in South Australia in 2006. Neither fire spread beyond the relevant turbine [and] the fire in Western Australia occurred with technology that is now redundant (Macintosh & Downie 2006).

Neither of the known fires sparked a bushfire.

Wind turbines use lighting protection systems that minimise any fire risk from lightning strikes. The Lake Bonney fire was caused by an electrical fault during maintenance. Firefighters were called by the wind farm operator and attended the scene to ensure that the fire did not spread. From the available evidence, it appears that fires at wind farms are very rare and that the risk of any fire sparking a bushfire is even lower due to the siting of wind farms in open areas and the monitoring of the site by the wind farm operator.

7.8 Social and cultural impacts

Like many developments, wind farms have the potential to create social and cultural impacts if they infringe on culturally significant sites or areas with significant heritage value. Wind farm proponents need to comply with legislation and regulations protecting cultural heritage and should seek to avoid culturally-sensitive areas where possible.

Other social impacts are possible if the wind farm divides the community, as was the case in Taralga. When some residents support the project and others oppose it, tensions can occur. The benefits accruing to landowners that host the turbines are another possible source of tension. Good, early community consultation is the best way to reduce tensions. Consultation is discussed in more detail in Section 8.

Wind farms only take up a very small amount of land, so impacts on other land uses are minimal and wind turbines can co-exist with many land uses. It has been estimated that if wind power supplied 10% of the electricity in NSW, 35 medium-sized wind farms would be needed[12], occupying about 400 square kilometres, which is an area equal to less than one per cent of the pasture land in NSW (NCC et al 2006). Grazing and farming would still be possible on much of this land. Of course, some land uses are not compatible with wind farms, including urban development, forests and sensitive activities such as airports and some communications facilities (SEDA 2002a).

[12] Assuming 2 MW turbines and 45 turbines per wind farm.

8 Working with the community

When wind farms become contentious, it is often because the wind farm developer has not worked closely with the affected community to understand and address their concerns. This section considers existing approaches to community consultation about wind farms and ways that consultation might be improved. Section 8.1 discusses community consultation requirements for wind farms, Section 8.2 discusses current best-practice community consultation and Section 8.3 explores how wind farm proponents might go further in engaging the community.

8.1 Community consultation requirements for wind farms

The new planning measures introduced in 2005 mean that most wind farm projects are assessed by the NSW Minister for Planning under Part 3A of the Environmental Planning and Assessment Act. This means that wind farm proponents need to undertake specified community consultation processes, including preparation and public exhibition of an Environmental Assessment and preparation of a response to issues raised in public submissions. In addition to the opportunity to make submissions on the Environmental Assessment, the community has access to:

- The development application for the project
- The Director-General's requirements for the environmental assessment
- The proponent's Environmental Assessment
- The proponents response to issues raised in public submissions
- The Director-General's Assessment Report and recommendations
- The Minister's determination and any conditions.

Under Section 75L of the Environmental Planning and Assessment Act, members of the community that have made a submission objecting to the development application may also have the right to appeal the approval of a wind farm in the NSW Land and Environment Court (see discussion in Section 5.2.2).

The Environmental Defender's Office NSW has criticised the consultation processes under Part 3A of the Act as follows:

> In effect, Part 3A of the Environmental Planning and Assessment Act 1979…dramatically reduces the involvement of the community in the original decision making process and seeks to reduce any risk of concerned individuals or groups delaying or preventing significant development, by limiting the grounds on which, or the circumstances in which, they can seek merits or judicial review. Instead, the Minister for Planning and Director General, Department of Planning maintain the power to make all key decisions regarding significant development, with advice from 'expert panels', limited input from other key agencies and little opportunity for effective criticism where the bureaucracy 'gets it wrong' (Ratcliff, Wood & Higginson 2007).

For wind farm developers, this means that meeting the minimum consultation requirements under Part 3A may not be sufficient to properly engage the community and understand their concerns. The need to go beyond the minimum consultation requirements is also indicated by the case studies below.

Case Study: Proponent perceptions of the consultation process for the Taralga Wind Farm

The proponent for the Taralga Wind Farm, RES Southern Cross, followed the public consultation requirements for a State Significant Development, including preparation and exhibition of an Environmental Impact Statement and response to submissions. There were also three public meetings, an open day and letter drops of a series of newsletters about the project to ensure the whole community was informed. The proponents made themselves available for media interviews for the local radio station and newspaper.

Initial approaches were made to the landholders at the preferred site, who generally saw the development as a positive step against climate change and an extra source of revenue. Many of these landholders were older and wanted to work less on the land.

RES Southern Cross felt that they had chosen a rural, isolated site with a limited number of houses nearby. Due to the nature of the site and the positive experiences with landholders, they expected few objections.

RES Southern Cross felt that the amount of information available to residents was comprehensive. They have learned a lot from the consultation process at Taralga and feel they could have improved on it by carrying out a community attitudes survey early on. This would have allowed them to demonstrate the actual breadth of community views and possibly would have avoided some of the debate about he extent of community support or otherwise for the project.

Source: Colin Liebmann, RES Southern Cross

Case Study: Community perceptions of the consultation process for the Taralga Wind Farm

Catherine Gross undertook field work with 12 Taralga residents in May 2005, while the development application for the Taralga Wind Farm was being assessed by the NSW Government (Gross 2007). Some relevant findings are as follows.

- 'Many people thought that there had not been a consultation process at all, with the proponent presenting a completed wind farm as a *fait accompli*, which in reality was an information provision rather than a consultation process'
- 'The process by which people were notified of the wind farm varied, some receiving a generalised information flyer promoting a public meeting, others being contacted by the proponent and others hearing by word-of-mouth or through the local region newspaper'
- Negotiations with landholders began up to four years before other residents heard about the wind farm and there were concerns about the secrecy
- The ability to submit on the Environmental Impact Statement was not seen as a true consultation process allowing real participation
- Two public meetings were held, but interviewees felt that the first was too late in the process and was only used to provide information and the second was taken over by opponents, making it hard to get balanced information
- 'None of the interviewees felt that the process allowed people's voice to be heard, views to be expressed, or debate and discussion to be enabled'
- 'The adequacy, timeliness, scope, objectivity and availability of information provided by the proponent were significant issues for the majority of interviewees'. Many felt the Environmental Impact Statement lacked important detail and that too little information was available before this.
- 'There was a strong and general dissatisfaction with the lack of response to the formal submissions, either to acknowledge receipt of the submission or to respond regarding the concern itself'.

Source: Gross (2007, pp.2731-2732).

8.2 Current best-practice consultation

To address some of the concerns raised in the case studies above, consultation needs to go much further than the minimum requirements. In recognition of this, Auswind has included a Community and Stakeholder Engagement Framework as part of its Best Practice Guidelines for implementation of wind energy projects (Auswind 2006a). The Framework identifies five key principles of consultation:

1. Focus

- Consultation will be purpose-driven
- The type of consultation methods chosen will be appropriate for the task
- There is a clear statement about what the consultation aims to achieve
- There is a clear statement about the role of the proponent and the role of participants in the consultation

- The proponent will focus consultation activities to ensure robust and effective input into their decision-making process
- There is appropriate internal coordination to ensure corporate ownership of the consultation.

2. Inclusive

- The way that the consultation is set up and implemented encourages the participation of people who are affected by or interested in the decision
- Groups and individuals that are affected by or interested in the decision regarding a wind farm development will be given equal opportunity to participate in the consultation
- The type of consultation or engagement will be sensitive to the needs of individuals and groups to maximise their ability to contribute
- The proponent will actively seek out people for consultation.

3. Responsive

- There is a commitment to consider views and respond to participants
- Consultation will be transparent. All people involved will have a clear understanding of how their feedback and comments are to be used.
- The proponent will maintain openness during the consultation process and be willing to consider new ideas.
- There is respect for the diverse range of interests that may be represented during a consultation
- All reasonable attempts will be made to resolve conflicts.

4. Open and transparent provision of information

- Information relating to the consultation program will be readily available to allow participants to make informed and timely contributions
- Information relating to the consultation process can be accessed easily by those involved before key decisions are made
- Relevant information will be presented in an easily understood format
- Confidential or commercial details about an issue may not be disclosed to the public.

5. Timely feedback and evaluation

- Participants will receive timely feedback about the outcomes of the consultation, and how the final decision was reached
- If a difference occurs between the inputs into the consultation and the final decision, the reasons for this will be clearly documented
- The consultation process will be documented to provide:
  - Clear evidence of the activities that were undertaken
  - The input that was received

- The decisions that were made.

These principles, and the other information contained in the Framework provide a strong foundation for community engagement that goes well beyond the minimum requirements. Auswind is developing the Auswind Accreditation Scheme, which will assess wind farm developers against the Best Practice Guidelines, including the consultation and engagement framework. Complying wind farm developers will be accredited and will be regularly audited to ensure continued compliance. Once this scheme commences, communities affected by wind farm development will be able to hold wind farm developers accountable against the principles listed above. This is likely to lead to improved consultation outcomes.

8.3 Going further

The International Association for Public Participation has developed a Public Participation Spectrum that identifies five levels of participation with increasing levels of public impact:

- Inform: to provide the public with balanced and objective information to assist them in understanding the problem, alternatives, opportunities and/or solutions (e.g. through fact sheets and web sites)
- Consult: to obtain public feedback on analysis, alternatives and/or decisions (e.g. through public comment, focus groups, surveys, public meetings)
- Involve: to work directly with the public throughout the process to ensure that public concerns and aspirations are consistently understood and considered (e.g. through workshops or deliberative polling)
- Collaborate: to partner with the public in each aspect of the decision including the development of alternatives and the identification of the preferred solution (e.g. through Citizen Advisory Committees and participatory decision-making)
- Empower: to place final decision-making in the hands of the public (e.g. through citizen juries and ballots) (IAP2 2007).

The minimum consultation requirements discussed in Section 8.1 are at the 'consult' level in the IAP2 Spectrum. The best-practice framework discussed in Section 8.2 encourages proponents to reach the 'involve' level. However, wind farm proponents could choose to go further to the 'collaborate' or 'empower' level. This would involve establishment of Citizen Advisory Panels or citizens' juries, perhaps with randomly selected members of the affected community, who would provide advice or even a final decision.

A Citizen Advisory Panel would bring together citizens from the affected community to provide advice to the proponent. The citizens would act as a conduit to the rest of the community and could help the proponent to understand community sentiment. The Panel would be kept up to date on all project developments and could even be compensated for their time. A Panel of this sort could help to confer legitimacy on a wind farm proposal.

A citizens' jury would go further by encouraging a group of randomly selected citizens to make a decision on whether the wind farm should go ahead, and under what conditions. Like the jury in a court case, the citizens' jury hears evidence from experts and reaches their own decision. Such an approach has great legitimacy but carries a higher level of risk for the proponent.

Another model for community engagement that is receiving increasing attention is for the community to actually own the wind farm, through a cooperative. The Hepburn Renewable Energy Association is establishing the first community-owned wind farm in Australia, working with Future Energy Pty Ltd (HREA 2007). Community ownership ensures that the community is involved in decision-making from the outset and that revenues from the wind farm are shared fairly amongst the community, rather than all going to the small number of landholders that host wind turbines. This can ease community tensions and increase community acceptance of wind farms (Parliamentary Commissioner for the Environment 2006).

Case Study: Engagement processes for Ben Lomond Wind Farm

Energreen, proponent for the Ben Lomond Wind Farm, sought participation rather than consultation in their engagement with the local community. Consultation implies a one-way flow of information to obtain community views, whereas participation implies multi-flow communication and decision-making. A participatory approach is more likely to generate community support.

Richard Finlay-Jones, who led the engagement process, has developed some principles for participatory engagement.

- Start early
- Make your intentions very clear to all stakeholders from the start
- Why are you there?
- What are you doing?
- Provide all information (good and bad) as soon as it comes to hand
- Seek input and suggestions from community stakeholders
- Become a member of the community
- Take part in local activities and events (Country Women's Association, Bush Fire Brigade, fetes, shows, fairs)
- Budget for time and resources
- Develop local champions and local ownership
- Be aware of local politics/factions
- Be yourself, be honest and be there often
- Face-to-face is better than newsletters
- Describe the limitations on the flexibility of the project
- Discuss the implications of changes and modifications to project design
- Provide clear timeframes and deadlines for the development application and project schedule.

Richard spent a lot of time with the local population. He was there with 'monotonous regularity'. Energreen sought feedback from the community via surveys, used the media to get information out and sent out some newsletters, but most of the engagement was face-to-face. Informal workshops were held and there were meetings every six months with all the landholders. Landholders were taken to a wind farm site so that they could see and hear a wind farm for themselves.

Richard stressed the importance of starting consultation early, at the site assessment stage. He also stressed the need to use multiple engagement methods and to provide a consistent contact with the community.

Partly as a result of the consultation processes, the Ben Lomond Wind Farm has enjoyed a high level of support in the local community, with no objections to the development application.

Source: Richard Finlay-Jones, Energreen

9 Supporting wind power in NSW

The discussion in this report demonstrates that NSW has the potential to expand its use of wind power as a cost-effective way of responding to climate change. NSW could get at least 10% of its electricity from wind power with appropriate government support and careful planning to ensure relatively even distribution of wind farms. Available research indicates that the majority of Australians support the expansion of wind power.

Many of the criticisms of wind power appear to be misplaced. However, some are valid and need to be carefully considered by wind farm proponents. These valid concerns include the impacts on visual amenity and landscape values, noise impacts and potential impacts on biodiversity at specific sites. The wind power industry is pursuing several approaches to improve its identification and management of impacts of wind farms, including an accreditation program for wind farms that comply with Best Practice Guidelines and the development of a National Assessment Framework for wind farms and landscape values. Where there are still objections to wind farms, it is important to weigh these against the negative impacts of climate change.

The key conclusion of this report is that the greenhouse and other benefits of an expansion of wind power in NSW outweigh the narrower concerns of those who object to specific wind farm proposals. This does not mean that those concerns should be ignored; rather, they need to be sensitively addressed.

If there is to be an expansion of wind power in NSW, there will be a need for government support to address barriers to growth. Section 9.1 outlines the main barriers to growth identified in this report and Section 9.2 suggest responses that can help to overcome these barriers.

9.1 Barriers to growth

The size of the NSW wind resource and the technical ability of the grid to accept wind power do not appear to be barriers to further development of wind power in NSW at present. The National Electricity Market could readily accept as much as 3,100 MW of wind farms located in NSW, which would be enough to generate about 10% of NSW electricity consumption. Even more could be accommodated with modifications to the electricity network.

At present, it is the narrowly defined economics of electricity generation that is preventing further growth of wind power. Until the cost of climate change is incorporated into the cost of electricity generation, it will be very difficult for wind power to compete directly with fossil fuel power. Government action is needed to incorporate the cost of climate change into energy markets and to provide direct support for wind power in the interim.

At present, there is a gap in the availability of a suitable support program for wind. Now that the Australian Government's Mandatory Renewable Energy Target has essentially been achieved, there is insufficient incentive under this program for wind farm development. The NSW Renewable Energy Target will take over from MRET, but there is a gap at present before the NRET commences. The first interim target under the NRET scheme is scheduled for 2008. Until that time, wind farm developers are holding off construction on approved wind farms.

However, there is no guarantee that the NRET will stimulate growth of the wind power industry in NSW. Under the proposed rules for NRET, renewable energy projects outside NSW are eligible. If better wind farm sites are available elsewhere in

Australia, these sites may provide much of the electricity required under NRET. There is also concern that these projects would be double counted, as they may be included under other renewable energy targets. The NSW Government should consider ways in which NRET could be used to stimulate investment in renewable energy within NSW. This will become increasingly important as wind farm penetration increases and the need to geographically disperse wind farms increases.

Emissions trading may eventually provide an additional motivation for wind farm development, however it is unlikely that any scheme will be in place before 2010 and initial carbon prices would probably be too low to encourage wind farm development. Energy efficiency projects are the most likely to benefit from the initial stages of an emissions trading scheme.

Grid management issues may become a barrier if wind power continues to increase its share of electricity generation. Planning authorities may need to consider the geographic dispersal of wind farms in deciding on approvals, as dispersed wind farms will assist with grid management. Grid reinforcement and investment in ancillary services and backup may be required in the future if wind power grows beyond about 10% of electricity generation.

There is some evidence that the complexity of approval processes in NSW and the opposition from particular communities is acting as a barrier to further growth of wind power. Some wind farm developers are looking interstate or overseas to jurisdictions with more streamlined approval processes and greater support for renewable energy. This could act as a barrier to growth of wind power in NSW.

Finally, there is a risk that community opposition to wind farms may grow if wind farm proponents fail to appropriately engage the community, from the site selection stage onwards. Community engagement needs to go beyond the minimum requirements of Part 3A of the Environmental Planning and Assessment Act and offer genuine engagement.

9.2 Recommended actions

In light of the barriers to growth discussed above, this section recommends actions that can be taken by various parties to facilitate the growth of appropriate wind power in NSW. Recommended actions have been grouped into technical actions, economic actions, those associated with the planning and approval system and those associated with community engagement.

9.2.1 Technical

The main technical barrier to growth of wind power in NSW is the ability of the National Electricity Market to accommodate variable wind power. The main technical actions required to address this are as follows:

- The NSW Government should support research into advanced wind turbine technologies that allow remote monitoring and control of wind farm output and wind farm proponents should seek to use these technologies where feasible
- The NSW Government should support the development of advanced wind forecasting techniques
- The NSW Government should undertake a study to identify high-priority areas for wind farm development, based on available wind resources and the needs of the electricity grid

- Wind farm proponents should seek to develop wind farms in different parts of the grid to existing wind farms or proposed wind farms.

9.2.2 Economics

The main economic barrier to further growth of wind power is the failure to incorporate the cost of climate change into electricity generation costs. The following actions are recommended:

- The NSW Government should continue to support the development of an Australian emissions trading scheme as a way of starting to incorporate the cost of climate change into the cost of electricity generation
- In the interim, the NSW Government should provide specific support to renewable energy by adopting a target of generating 25% of NSW electricity use from renewable sources by 2020. A higher target would provide greater stimulus for wind power in NSW.
- The NSW Government should require that all of the new renewable energy needed to meet the NSW Renewable Energy Target is obtained from generators located in NSW. This will help to build the NSW wind power industry specifically.
- The NSW Government should also ensure that renewable energy projects counted towards the NSW Renewable Energy Target are not counted towards other state targets.
- In the legislation establishing the NSW Renewable Energy Target, the NSW Government should also establish guaranteed access to the grid for wind farms and specify a premium feed-in tariff for wind power.

9.2.3 Planning and approval

The more streamlined planning and approval processes for wind farms under Part 3A of the Environmental Planning and Assessment Act will likely smooth the way for future wind farm development. However, this may be to the detriment of community engagement. The following actions are recommended:

- The NSW Department of Planning should require wind farm proponents to comply with Auswind's Best Practice Guidelines as one of the requirements for the Environmental Assessment and as a consent condition on any approvals. This should include specific requirements to comply with the best-practice consultation framework.
- Auswind should incorporate the National Assessment Framework on wind farms and landscape values into its Best Practice Guidelines once the Framework is finalised. Compliance with this framework should be an accreditation requirement for wind farm developers.

The planning and approval system can also be used to address some of the technical issues discussed above. The following action is recommended:

- The NSW Department of Planning should consider the geographic distribution of existing and approved wind farms when making decisions on proposed wind farms. Wind farms that provide geographic dispersion to assist with management of variability should be given preference.

9.2.4 Community engagement

To improve the quality of community engagement, the following actions are recommended:

- Wind farm proponents should comply with the best-practice consultation framework in Auswind's Best Practice Guidelines as a minimum requirement
- Community engagement should commences from the initial selection of possible sites and should continue throughout the process
- Wind farm proponents should seek participation, rather than consultation
- Wind farm proponents should consider the use of more innovative engagement processes to support greater participation in wind farm decisions. A Citizen Advisory Panel that has input on decisions throughout the life of the project is a recommended model.
- The wind industry (e.g. Auswind) should consider the potential of small-scale wind power and community-owned wind farms as a way of easing tensions over wind farm proposals
- The NSW Government should produce a community guide on how to establish a community-owned wind farm
- Residents of affected communities should seek to become fully informed about the advantages and disadvantages of wind farms and to participate in available engagement approaches in the public interest
- Interested communities should investigate the potential to initiate their own community-owned wind farms.

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