Flyers Creek Wind Farm Pty Ltd

Flyers Creek WIND FARM

Environmental Assessment

CHAPTER 2
Context and Alternatives

2. Project Context and Alternatives Considered

This chapter reviews:

- the global, national, state and local context for wind energy developments
- the proponent's role in Australian wind farm developments and their consideration of alternative sites
- the alternative design options that have been considered by Flyers Creek Wind Farm Pty Ltd for the Flyers Creek Wind Farm project.

2.1 Context for Wind Energy Developments

Wind energy has always been available for utilisation. While rural farm water supplies can often be supplemented using wind mills to extract subterranean water in Australia, wind has been little used for large scale electricity generation due to the abundance of Australia's fossil fuel resources. However, with mounting concerns over climate change arising from accumulating atmospheric greenhouse gases and unsustainable use of the world's finite resources of fossil fuels, there is a concerted global push to move to a more sustainable energy future. Part of this transition has included a substantive growth in wind energy's contribution across many parts of the world.

In 2007 the Intergovernmental Panel on Climate Change (IPCC) released its fourth assessment report (4AR). The 4AR provides comprehensive evidence of climate change, impacts and associated directions for mitigation of the social, environmental and economic costs.

The 4AR report of 2007 concluded that annual global greenhouse gas emissions have risen by 12.5% since 1990. Concentration of atmospheric carbon dioxide has reached the order of 390 ppm at 2010, up from the pre-industrial level of about 280 ppm and an increase of 39%. The size of the annual increase is also indicated to be currently growing at about two ppm per year. The increase in atmospheric carbon over time is primarily due to combustion of fossil fuels, coal, oil and gas and to a lesser extent to the reduction in the earth's biomass that temporarily stores carbon. The World Resources Institute (WRI) has estimated that about 61% of global greenhouse emissions in 2000 came from energy use (WRI, 2006).

The magnitude and consequences of the future climate changes arising from greenhouse gas emissions are difficult to accurately predict and are subject to ongoing review and updates. The uncertainty has led researchers to use reference scenarios representing various emission regimes and climate responses. The question is not whether change is occurring but the extent of the future changes arising, the extent that these can be attributed to anthropogenic influences and the nature and extent of responses required. The debate globally has moved from whether a response is required to what is the best mechanism to respond and the extent of the required response.

Potential responses include a variety of approaches including:

- diversification of energy generation sources to reduce overall greenhouse gas emissions
- improvements in efficiency of energy generation and energy use
- demand management to reduce our total consumption of energy
- adaptation to the changing climatic conditions

It is generally agreed that an effective response to enhanced climate change will require that all of the above approaches are adopted and to that end many initiatives have been promulgated globally and locally. The following sections provide a context for the role of wind energy developments.

2.1.1 Global growth of wind power developments

Wind power is one form of renewable energy which assists in the diversification of electricity generation sources and which can reduce the overall reliance on fossil fuels and reduce emissions of greenhouse gases per unit of electricity produced. Due to its proven technology it has been one of the more readily installed forms of renewable energy. Additionally it is less expensive than most other forms of renewable energy and better placed to address mitigation of enhanced climate change. As a consequence, wind energy development has experienced strong growth globally.

Wind energy is considered a mature form of power generation. The Global Wind Energy Council announced in February 2010 that the world's wind power capacity grew by 31% in 2009, adding 37.5 Gigawatts (GW) to bring total installations up to 157.9 GW. The top four wind energy nations in terms of installed capacity at the end of 2009 were United States (35,159 MW), Germany (25,777 MW), China (25,104 MW) and Spain (19,149 MW). Australia's total operating wind capacity at the end of 2009 was 1,712 MW, up 406 MW from 2008[1].

World Wind Energy Association WWEA (2009) estimated the worldwide capacity to be 152 GW in 2009 (the actual total capacity was 159GW) and predicted 190 GW by the end of 2010 (Figure 2.1). Based on strong growth during 2010 the prediction for total installed capacity at end of 2010 has now been increased to 203 GW representing 44 GW capacity added in 2010. With further accelerated development and improved policies to support wind energy development WWEA have indicated that a global capacity of more than 1,500 GW is possible by the year 2020. (WWEA, February 2009). Wind energy has experienced an average annual compounded growth rate of over 25% for over a decade, an extremely high and consistent growth rate matched by few other industries.

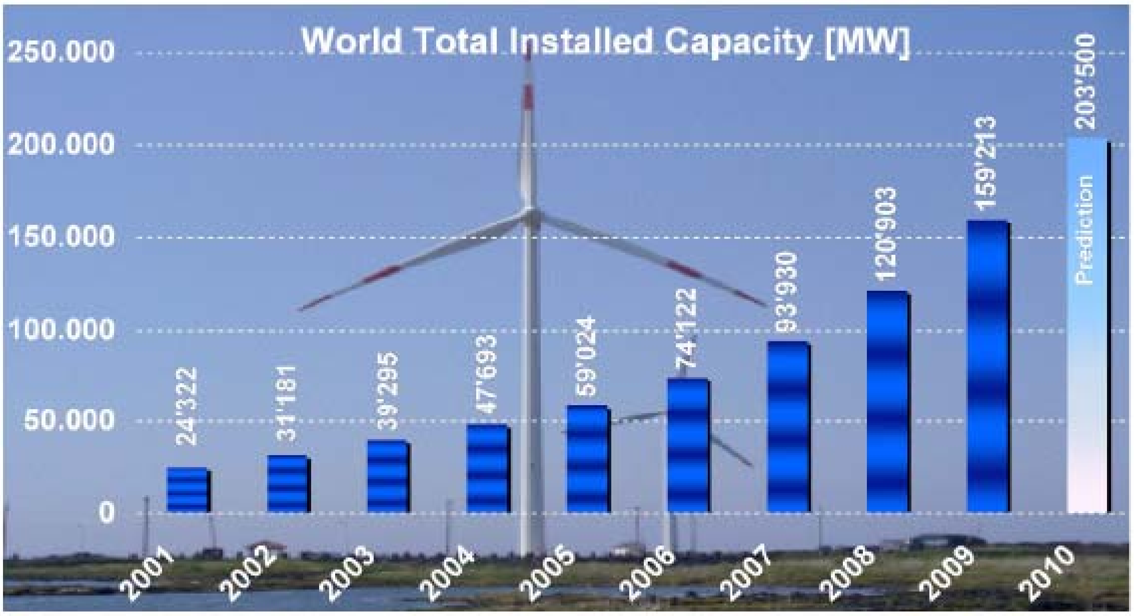
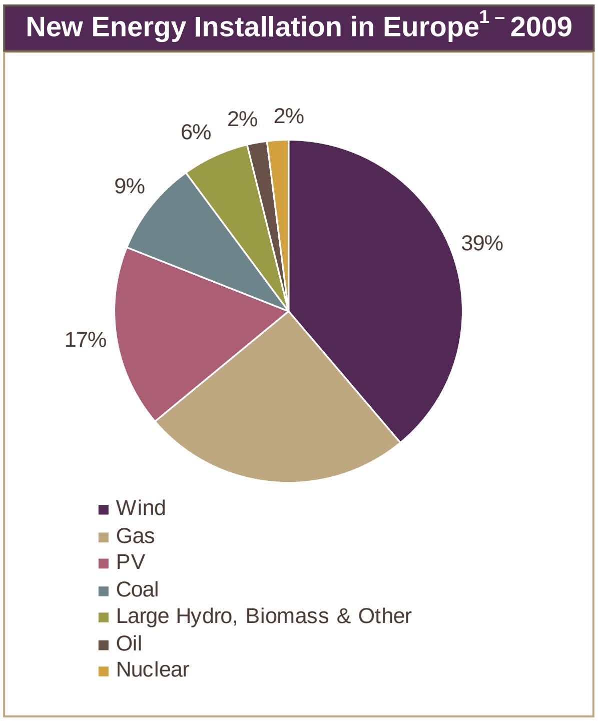
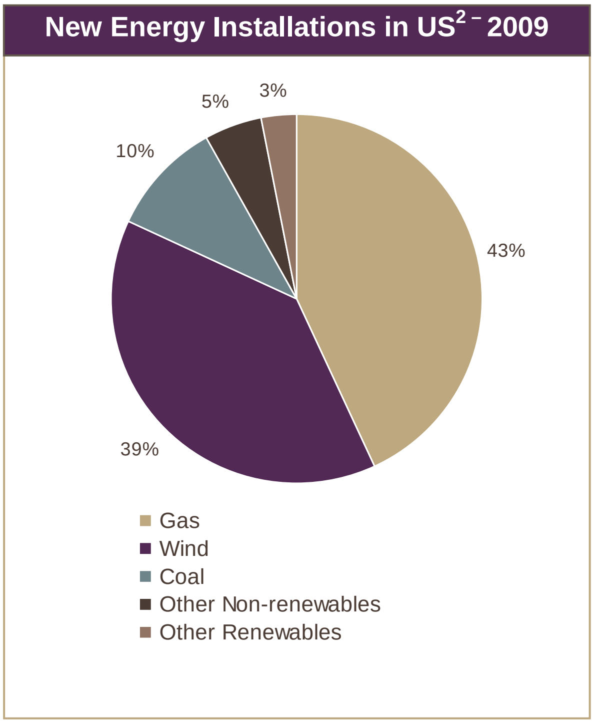


Figure 2.1 – Annual global growth in wind power generation (WWEA, 2010)

Investment in European wind farms continued to expand with 10163 MW of wind power capacity installed during 2009, making wind farms the leading form of new electricity installations for the second year running (Figure 2.2). Similarly, the U.S wind industry broke all previous records by installing nearly 10000 MW of new generating capacity in 2009 (enough to serve over 2.4 million homes) placing wind power neck and neck with natural gas as the leading sources of new electricity generation for the country. Growth in China was also very large and within a year or two it is expected that China will have the largest installed wind energy capacity of any country in the world.

[1] http://www.gwec.net/fileadmin/documents/PressReleases/PR_2010/Annex%20stats%20PR%202009.pdf





1. European Wind Energy Association: 2009 Industry Statistics
2. American Wind Energy Association: 2009 Annual report (% approximate)

Figure 2.2 – Wind energy was the leading technology for new electricity generation investment across Europe and the US in 2009

2.1.2 National context for electricity generation and emissions reduction

Australia has a relatively small proportion of the installed global wind energy capacity but has experienced a significant expansion of its wind generation capacity over the last decade. South Australia has taken the lead in the development of wind energy capacity and now generates nearly one fifth of its electricity from wind energy. Associated with the growth, South Australia has experienced greenhouse gas emission reductions from the stationary electricity sector of 7.5% in 2009, on top of a 7% reduction the previous year.[2] Despite this recent expansion in South Australia, the overall percentage of electricity produced from wind energy in Australia is much lower than is the case for many other overseas countries.

The Australian Bureau of Agricultural and Resource Economics (ABARE), located in Canberra, is an Australian government economic research organisation that undertakes economic research and analysis in the areas of agriculture, resources and energy. ABARE reported in "*Australian Energy National and State projections to 2029-30"* (March 2010) that Australia experienced a fourfold increase in electricity generation from 59 TWh in 1973-74 to 247 TWh in 2007-08. Furthermore, ABARE has forecast an increase to approximately 366 TWh by 2029-30.

Table 2.1 sets out Australia's current and projected electricity generation in relation to the energy source from which it is obtained. This table shows that 93% of Australia's electricity was generated from fossil fuel energy sources in 2007/08, with coal still the predominant fuel source (72%). Gas supplied a further 19% and oil 2%. Renewable energies (including hydro, bioenergy, wind and solar) account for around 7% (up from 6.5% for 2004-05) of electricity generated.

[2] Electricity Generation Report 2009, The Climate Group

Table 2.1 – Current and projected Australian electricity generation by fuel sources (Source: ABARE, 2010)

Energy Source	2007-08		2029-2030		Average annual Growth (%)
	TWh	%	TWh	%	
Fossil fuel, non-renewable energy sources					
Black coal	131	53	121	33	-0.6
Brown coal	47	19	36	10	-0.4
Oil	5	2	5	1	0.0
Gas	46	19	135	37	5.0
Sub-Totals	**229**	**93**	**297**	**81**	**1.2**
Non fossil fuel, renewable energy sources					
	TWh	%	TWh	%	%
Hydro	12	5	13	3	0.2
Wind	4	2	44	12	11.6
Bioenergy	2	<1	3	<1	2.3
Solar	<1	<1	4	1	17.4
Geothermal	<1	<1	6	2	18.4
Sub-Totals	**18**	**7**	**69**	**19**	**6.4**
TOTALS	**247**	**100**	**366**	**100**	**1.8**

ABARE (2010) indicates that 78% of renewable energy production in 2007-08 was provided by hydroelectricity and bioenergy. Wind, solar and geothermal accounted for the remaining 22%. Most solar energy was used for residential water heating and this represents <1% of final energy consumption in the residential sector. Renewable energy production increased by 15% in the seven years from 2001/02, with wind energy and photovoltaic electricity production experiencing the largest increases and hydroelectricity experiencing a fall in 2007-08, a decrease of 15% from 2001/02.

The total operating wind capacity at the end of 2009 was 1,712 MW, a 24% rise from 2008, equating to approximately 4,950 GWh of generated electricity annually. The capacity was associated with about 47 operating Australian wind farms, with a total of 834 operating turbines. South Australia had 50% of the total installed capacity with NSW having only about 10% of the total Australian installed capacity.

Electricity generation contributes an increasing proportion of Australia's greenhouse gas emissions from about 46.5% in 1990 to about 53.9% in 2010. In the context of increased global concerns regarding the consequences of enhanced climate change, there is considerable pressure for the electricity industry to reduce its contributions to the nation's greenhouse gas emissions particularly in terms of intensity of emissions from electricity generation.

In March, 2005 the Australian Greenhouse Office released a report entitled '*Climate Change, Risk and Vulnerability – Promoting an Efficient Response in Australia*'. The report indicates that "*our success in mitigating greenhouse gas emissions will determine the magnitude (and possibly the nature) of changes to which we must adapt*" and that "*adaptation is likely to be a progressively imperfect substitute for reducing global greenhouse emissions*".

The electricity industry has identified a range of measures to abate emissions including increased efficiency of generation, fuel switching particularly from coal to gas, increased renewable energy generation and greater efficiency in the usage of electricity. All of these measures will need to be adopted to achieve a significant mitigation in the growth of greenhouse gas emissions from the electricity industry.

In parallel to the above issues, global markets for oil and gas have recently shown significant price volatility and media articles are drawing greater attention to the finite life of oil and gas supplies and associated issues of pricing and supply security. A decline in the availability of oil or continued increase in its pricing is likely to be associated with a change in our energy consumption patterns. This may include increased utilisation of other primary energy sources, particularly coal and gas, renewable energy sources and possibly nuclear energy.

The most recent BP Global Energy Statistics released in June 2010 also indicated that the projected life of global coal reserves based on the proven reserves to production ratio (R/P) has dropped from 192 years (end of 2003) to 119 years (end of 2009) which constitutes a reduction of 73 years over only six years. The greenhouse gas emission and energy supply issues have resulted in increased effort being directed toward research into alternative fuels, new and more efficient energy technologies, carbon capture systems and debates on the merits of nuclear energy. Given the current availability of viable renewable energy technologies it appears likely that renewable energy technologies will play a greater role in delivering future energy supplies. Additionally, countries integrating renewable energy technologies will to some extent reduce the impacts of global price volatility on national economies.

In recent times, Australia's Federal and State governments have addressed electricity industry restructuring and have provided incentives for more environmentally and socially acceptable forms of generation. Over the last decade, the Federal Government, in conjunction with State Governments (Qld, NSW, Vic, SA and Tasmania) and electricity supply organisations, has implemented a competitive electricity market referred to as the National Electricity Market (NEM). Large scale wind farm projects aim to produce electricity from a renewable energy source for sale into the NEM.

The financial viability of renewable energy projects to participate in the NEM is supported by the Australian Government Renewable Energy Target (RET) scheme which has a mandatory target that by 2020, 20% of Australia's electricity supply will come from renewable sources. This suggests that in 2020, the amount of electricity coming from sources like solar, wind and geothermal will be around the same as all of Australia's current household electricity use (DCCEE, 2009).

The Large Scale Renewable Energy Target (LRET) scheme has been designed in cooperation with state and territory governments through the Council of Australian Governments (COAG) and aims to:

- increase large scale renewable electricity generation to 41,000 GWh in 2020
- provide an incentive to accelerate uptake of large scale renewable energy sources
- reduce red tape by bringing existing state-based targets into a single, national scheme.

The Australian Government had also proposed a Carbon Pollution Reduction Scheme (CPRS) to provide incentives to reduce greenhouse gas emissions by setting a carbon price. If implemented, the CPRS could have also improved the competitiveness of renewable energy technologies in the market over time. As an initial measure, the national RET scheme will accelerate deployment of renewable energy technologies by providing a guaranteed market for renewable energy. The RET was intended to conclude in 2030, at which time the CPRS, or a 'Carbon Tax', had been expected to be the primary driver of renewable energy. The applicable mechanisms for 2030 are at this stage unknown but it is likely that the need for additional renewable energy generation will only increase and regulatory and market mechanisms are likely to be directed to supporting such technologies.

2.1.3 State context for electricity generation and emissions reduction

The NSW Government has an active program to deliver reductions in greenhouse gas emissions in NSW. As part of this program, it created the Sustainable Energy Development Authority (SEDA) which was subsequently combined with the Ministry of Energy and Utilities to form the Department of Energy, Utilities and Sustainability (DEUS) and in April 2007 merged in the new Department of Water and Environment (DWE). SEDA initiatives have included 'Greenpower' and 'Energy Smart' programs as well as various initiatives to support wind energy development in NSW. The $100 million NSW Renewable Energy Development Fund administered by the NSW Department of Environment and Climate Change provides support for demonstration and commercialisation activities.

The NSW Government has also introduced the NSW Greenhouse Gas Abatement Scheme (GGAS) that sets a target or "benchmark" for greenhouse gas emissions in NSW and a system for creation of NSW Greenhouse Abatement Certificates (NGACs) that can provide a financial benefit to generators for reducing emissions. The financial penalty for benchmark participants that do not reduce their greenhouse gas emissions or buy enough abatement certificates to lower their attributable emissions towards their greenhouse benchmark has decreased from $10.50 when the scheme was introduced in 2003 to about $6 in October 2010 for each tonne of $CO_{2\text{-}e}$ by which a benchmark participant's attributable emissions exceeded its benchmark. Over the first seven years of the scheme's operation, GGAS is reported to have reduced or offset over 90 million tonnes of greenhouse gas emissions since it began in 2003.

The development of Flyers Creek Wind Farm is considered to be consistent with the National and State Government objectives for sustainable production of electricity and abatement of greenhouse gas emissions as wind energy generation of electricity emits no greenhouse gases.

Wind integration in the NEM refers to the ability of wind farms to connect to, and operate within the NEM in a way that is consistent with the daily operation and short term security of the NEM. Due to rapid growth rates in electricity produced from wind energy and the variability in the wind energy resource, wind energy integration in many countries has received considerable attention to insure the developments do not adversely impact the security and reliability of electricity supplies.

Due to the variability of its energy source, wind generation was originally defined by the National Electricity Code as being '*intermittent generation'* and as such was previously considered to be *'non-scheduled'* generating units. However, a few years ago AEMO changed the National Electricity Rules such that all new variable generators >30 MW would be required to register under a new classification of *"Semi-Scheduled Generator"*, submit and receive dispatch information in a similar manner to scheduled generating units, and limit their output at times to maintain secure network limits.

Review of issues concerning the entry of increased proportions of renewable energy generation (particularly variable and non-scheduled generation such as wind) into the NEM has led to investigations and improvements in wind generation forecasting to enable improved scheduling of electricity generation. AEMO's wind energy forecasting system is very accurate as can be seen in Figure 2.3 below which shows wind energy generation forecasting accuracies of 97% one hour ahead of time and 99+% five minutes ahead of time. Such high accuracy enables AEMO to operate the NEM in a reliable and secure manner even with 1700+MW of operating wind farms.

In addition, control systems have been updated to manage the effect of variable generation on network flows and modelling of wind energy fluctuations, system demand changes and response mechanisms. Arrangements for regulation frequency control ancillary services (FCAS) and review of code connection procedures has also received significant consideration to address the evolving NEM restructuring.

NSW has a large electricity demand and strong transmission system that has significant capacity to integrate a significant additional proportion of renewable energy which is largely untapped today.

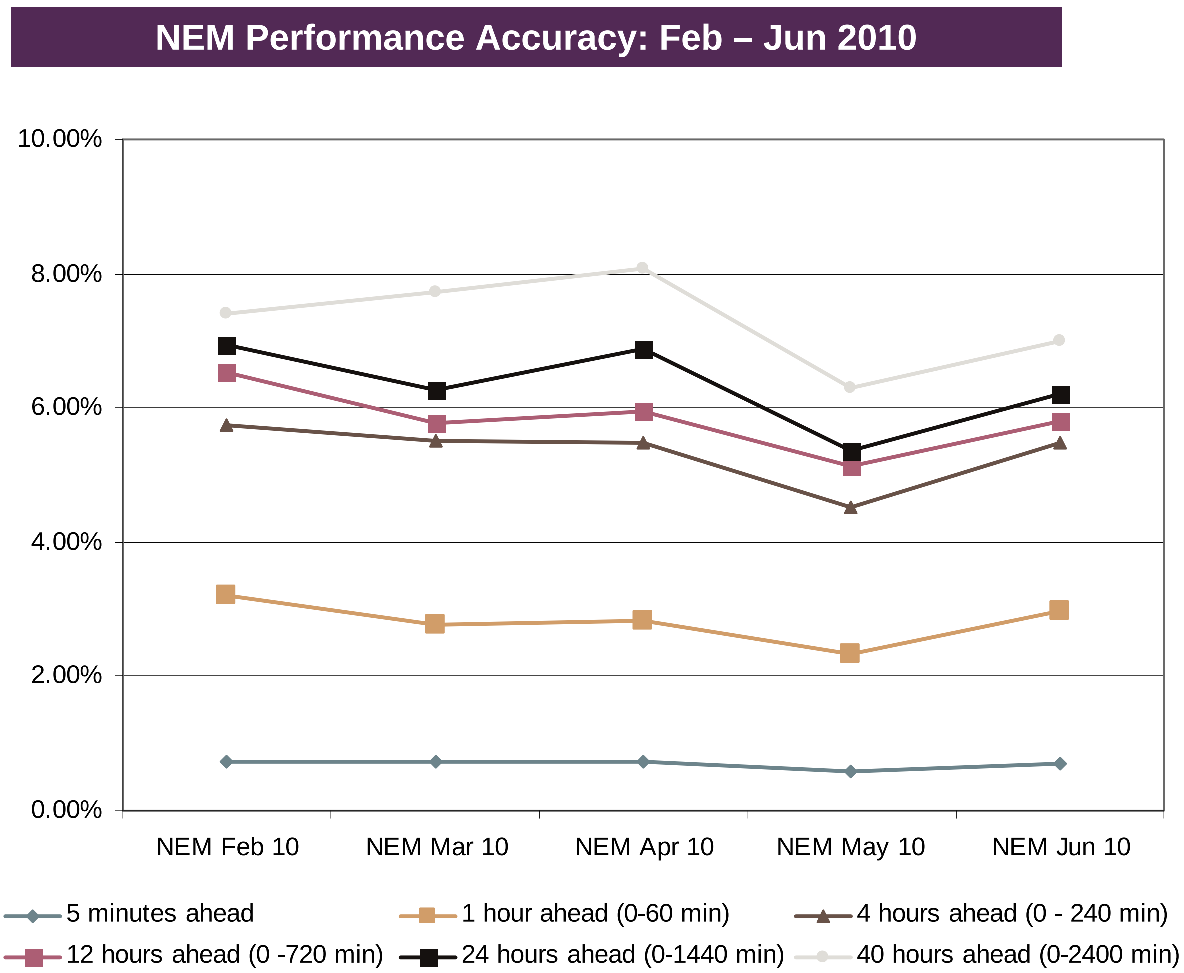


Figure 2.3 – Wind energy generation forecasting accuracies – Normalised mean absolute percentage error (Source: AEMO, 2010)

2.2 Flyers Creek Wind Farm Consideration of Feasible Alternatives

In proposing the Flyers Creek Wind Farm project, the proponent recognises the broad government and community support for development of renewable energy projects, but is also aware of the need to ensure that wind farm developments are appropriately planned and fully consider the environmental and social issues associated with their development. Based on its review of feasible renewable energy options, Flyers Creek Wind Farm Pty Ltd's parent company, Infigen Energy, has focussed its efforts on wind energy projects as being the most cost effective and commercially viable form of renewable energy generation.

Flyers Creek Wind Farm Pty Ltd is committed to developing successful projects in an environmentally and socially acceptable manner. This document outlines the measures to be adopted for this project to mitigate the project's potential environmental impacts.

The following sections review aspects considered by Flyers Creek Wind Farm Pty Ltd in the planning of the Flyers Creek Wind Farm project including:

- reasons for the decision to develop a wind power project
- reasons for the selection of the Flyers Creek Wind Farm site over a range of possible sites
- potential design variants of the project at the Flyers Creek Wind Farm site and associated transmission infrastructure
- the impact of tender process on the project description

2.2.1 Renewable energy generation options considered by proponent

In Australia, the development of wind power has a number of advantages in terms of the existence of a favourable energy source, mature and proven technology, and a significant cost of generation advantage over other forms of renewable energy generation such as solar and hydro power. Solar based electricity generation is significantly more expensive per unit of power produced than wind generation and is currently only developed at much smaller scales than that currently occurring for wind energy projects. In the case of hydro-electric power developments, Australia has limited opportunities for further development due to lack of water resources and even existing assets have been recently constrained by extended drought conditions. Geothermal, tidal, current and wave power system technologies are much less mature than wind energy systems and are still basically in the prototype stage of their development.

Implementation of wind energy depends on access to a suitable wind resource, landowner agreements, the ability to deliver the power to the grid cost effectively and the ability to obtain the necessary approvals. Flyers Creek Wind Farm Pty Ltd has secured the landowner agreements for the Flyers Creek Wind Farm and has indicated that there is potential for connection to the existing Country Energy grid infrastructure and is now seeking the required planning approval for its development.

Flyers Creek Wind Farm Pty Ltd’s parent company, Infigen Energy, has a diverse involvement in a range of wind energy projects in Australia, the United States and Europe. Australian examples are shown in Table 1.1. The combined experience gained from these projects provides Flyers Creek Wind Farm Pty Ltd with the resources to confidently develop, construct and operate new wind farm developments.

Alternative wind farm sites

The proponent continues to undertake systematic processes to identify suitable wind farm sites and to assess their relative merits. This process has included identification of potential sites with suitable wind energy resources, transmission infrastructure and potentially acceptable environmental and social impacts. The preferred sites have been further evaluated in terms of technical, environmental, social and commercial factors relating to their potential development.

Alternately, as in the case of the Flyers Creek project, landowners interested in investigating the feasibility of a wind farm in their district approached Infigen Energy directly. They indicated that they, and a number of their neighbours, were interested hosting a wind energy project. Therefore, in a sense, the Flyers Creek Wind Farm is a “community wind farm” since it was the local community that initiated the project.

The proponent performed an initial feasibility study which identified the following advantages for the Flyers Creek project site:

1. Good probability of a strong wind resource
2. Availability of an appropriate voltage transmission line near the site with generation capacity
3. Presence of the popular Blayney wind farm indicated that the district was used to, and comfortable with, the concept of a wind farm
4. Blayney Shire was generally supportive of wind energy development (and feature the Blayney wind farm on their logo)

Sophisticated wind resource modelling was commissioned for the Flyers Creek site and surrounding Shires. The wind resource modelling predicted a very good wind resource for the ridgelines within the Flyers Creek project site.

In addition, a detailed assessment of other potential wind farm sites in the wind resource modelling area was also conducted with respect to grid connection options and environmental suitability. The result was the Flyers Creek project site was the most appropriate and suitable wind farm site in the wind resource modelling area. On that basis, Flyers Creek Wind Farm Pty Ltd decided to conduct more detailed investigations of technical, environmental and financial viability of a wind farm on the site.

The above process has involved detailed assessment of several potential wind farm sites.

Following the decision to proceed with further investigation of the Flyers Creek Wind Farm, the following actions have been implemented by Flyers Creek Wind Farm Pty Ltd:

- negotiations were undertaken to secure leases with relevant landowners to enable further planning studies and to seek approval for the construction and operation of a wind farm
- on site wind energy resource assessment was undertaken using three 80 metre wind monitoring masts installed by the proponent
- initiation of the planning process and conduct of a planning focus meeting in October 2008 that involved the Blayney Shire Council, NSW Department of Planning and other key agencies and stakeholders including a tour of the site
- environmental impact studies undertaken
- consultation with nearby neighbours to the wind farm and with other stakeholders
- the project description modified to address the outcomes of the studies and consultation process
- preparation of this Environmental Assessment to support the Project Application

Design options considered for the Flyers Creek Wind Farm project

The preliminary planning studies have reviewed a range of variations to the conceptual design for the wind farm and the associated grid connection. Consideration of these design options was undertaken in the context of environmental, social and commercial impacts for the proponent and stakeholders.

The overall objective of the conceptual design stage was to identify the size of the project that could deliver significant savings in greenhouse gas emissions while being commercially viable and socially and environmentally acceptable. The proposed design is described in Chapter 3 of this Environmental Assessment. The variables that have been considered during formulation of the Flyers Creek Wind Farm project are outlined below. Further refinement of the design and project detail, such as micrositing of some infrastructure, is also expected following the gaining of project approval, as part of the final design stage, prior to commencement of construction. The final design will be subject to review by the either the Approval Authority or the Principal Certifying Authority at the Construction Certificate stage of development. The final design will be consistent with the planning approval.

Key variables considered in the wind farm design formulation included:

- properties to be included and scale of the project
- number of turbines and turbine layout
- type and size of turbines to be considered, including hub height, turbine diameter and operating mode
- site access arrangements
- interconnection arrangements for turbines
- substation and facilities building location
- grid connection arrangements
- construction methods and location of temporary facilities

Properties and layout

The site’s wind energy resource distribution largely determines the suitability of individual turbine sites and sophisticated wind analysis software is used to optimise the overall layout for the site. The optimised layout is then reviewed in terms of practicality and important site constraints such as ease of access, minimisation of environmental impacts such as impact of native vegetation and potential amenity impact on neighbours.

The properties to be included were largely based on the available wind energy resources, agreement of landowners and suitability and spacing of turbine locations to allow interconnection of turbines to form a single project.

The number of turbines is influenced by the extent of the energy resource available at the site and the ability to export the power. In addition, the required spacing affects the number of turbines that can be suitably accommodated at a wind farm site. Spacing is itself related to the size of the turbines, orientation of the layout to the prevailing winds and environmental considerations. While 30 to 40 turbine sites were initially considered at the stage of the Planning Focus Meeting in October 2008, this has been increased to a possible 44 sites with the inclusion of several additional properties; however, not all of the sites shown in this document may be developed. The increased number of turbine sites addressed by this Environmental Assessment has followed discussions with the landowners, surveys of potential sites and confidence that the 132 kV line to which the wind farm will be connected is able to accommodate the wind farm's maximum output.

Review of the site's energy characteristics and commercially available wind turbine equipment indicated that a wind turbine with an 80 to 100 metre hub height and 44 to 55 metre blade length is suitable and commercially viable. A lower hub height would marginally decrease the visibility of the wind farm over the taller structures, but would also greatly reduce the electrical generation and economic returns from the project. The benefits of the additional energy generated and potential emissions savings were considered to warrant use of tower structures of at least 80 metres in height which are now effectively the minimum hub height for modern, commercial wind turbines.

Turbine selection

Consistent with the trend in recent years, larger megawatt class wind turbines are finding increasing use in Australia as well as overseas. This trend is a direct result of improved design of wind turbine components and the development of more advanced electrical technologies that has enabled larger turbines to successfully connect into electricity transmission grids. The use of larger turbines has also resulted in reduced costs of wind energy compared to other renewable technologies as well as providing environmental advantages due to the fact that fewer turbines need to be constructed to achieve a given generation capacity. However, there are generally limits to the size that can be installed and the design process seeks to optimise the turbine for the site characteristics.

Turbines considered for the Flyers Creek Wind Farm project range from two to three MW generation capacity, have 80 to 100 metre hub heights and blade lengths of 44 to 55 metres. As stated elsewhere, no matter which turbine model is selected, a maximum height of 150 metres from ground level to the top of the blade tip will not be exceeded. The indicative wind turbine selected for this planning application, the GE 2.5MW WTG, has a hub height of 85 metres, a blade length of 50 metres for a total height of 135 metres.

Site access

Due to the likely turbine placements in separate groupings, there are differing options for access by Restricted Access Vehicles (RAVs) to each of the turbine groups in different parts of the project area. The traffic assessment (Chapter 13) provides a review of viable alternative site access routes and indicates that the most suitable route is via Errowanbang Road and Gap Road.

Issues of grade, road surface curvature and local traffic conflicts have influenced the selection of the preferred route. Use of the selected access route is assessed as minimising disturbance to neighbours and traffic on local roads and for the existing residences.

Where possible, access routes to the turbine sites will use existing property tracks that can be upgraded without appreciable soil disturbance or clearing. The actual locations of the new tracks have been chosen to minimise the length of new tracks, ensure suitable grades, provide adequate curvature on bends and avoid areas of sensitive vegetation, fauna habitat or archaeological sensitivity.

Electrical collection system

The collection system is the arrangement of cables and overhead lines that are used to connect the wind farm to the substation. Both underground cables and overhead lines have been considered for the collection system.

The interconnection of turbines within clusters of the wind farm will use underground cables. The underground cables between turbines are favoured due to the elevated locations of the turbines and visual impact considerations. For longer distances between clusters, overhead cables are proposed to minimise ground disturbance and avoidance of environmentally sensitive areas such as creeks and drains. A similar electrical collection system is in operation today at the Capital Wind Farm.

The location of the substation and associated buildings will be on the north-western side of the project area and in a location where due consideration is given to the visual impact of the substation on public viewpoints and local residences. The substation will export power to a new 10 to 12 kilometre section of 132 kV transmission line that will connect to the existing 132 kV Country Energy transmission line between Orange and Cadia Mine. The chosen location will provide relatively easy access from local roads during construction and operation.

The proposed layout also includes a 33 kV overhead transmission line to transfer power from the southern turbine groups to the substation.

Grid connection

Issues related to integration of the wind farm into the NEM are discussed in Section 2.1.3. As mentioned in that section, NSW is well placed to integrate the wind farm's output into the NEM.

The site is near to an existing 132 kV transmission line operated by Country Energy which has sufficient capacity to enable connection of the Flyers Creek Wind Farm based on a preliminary grid connection study commissioned by the proponent. A Connection enquiry has been lodged with Country Energy and connection investigations have started. The wind farm grid connection option is further described in Section 3.6 of the Environmental Assessment.

Further information on the alternatives considered by the project and potential impacts is included in the following Chapters.

Construction alternatives

A range of alternatives has been considered for the construction phase of the project as discussed below. These have included:

- transport routes to site for equipment and materials and access alternatives, entry points and on-site routes
- on-site versus off-site sourcing of concrete and road base materials
- construction methods

A range of options have been assessed for transport to the site and on-site access arrangements. These are discussed in Chapter 13 which includes a detailed review of access options. The chosen option involves a single safe RAV entry to the site from the Mid Western Highway via Errowanbang and Gap Roads. The actual arrangements and any conditions for access require confirmation with Blayney Shire Council and the development of the project Traffic Management Plan.

It is likely that concrete will be supplied from an established batch plant in Orange or Blayney due to their proximity to site. That would involve a fleet of concrete agitator trucks cycling between Orange or Blayney and the site during the pouring of the turbine and substation footings involving transport operations on about 50 days during the construction period. The alternative of using an on-site batch plant would avoid the need for passage of concrete agitator trucks on public roads during concrete pouring and may be necessary if the travel time to site is too lengthy for the agitator trucks. The contractor, once appointed, will assess the viability of the options for installing an on site batch plant against sourcing concrete from nearby commercial centres. If wanting to establish a temporary on-site plant the contractor would need to identify suitable locations, obtain landowners agreement, assess the impacts and obtain approval for the facility.

The formation of the access tracks will require a significant amount of road base material which could be supplied from on-site or off-site locations. Subject to material suitability, some road surfacing gravel may be sourced from within the project site. Gravel quarries have previously been operated at the southern end of the wind farm site. The construction phase will involve transport of gravel to locations where it can be spread along the access tracks.

There are limited options for variation in construction methods. The type of crane to be used may be a track based crawler crane that will be able to access all the turbine sites including the sites with steep access or a conventional rubber wheel mounted crane that would require a slightly higher standard of access track for reaching all sites. Depending on the nature of the individual turbine site it may be necessary to vary the construction procedures particularly where the site is constrained by factors such as adjacent sensitive vegetation and/or steep slopes. This is discussed in more detail in Chapter 3.

For some turbine sites minor clearing of trees may be required for the installation of turbines, this will involve selective pruning, coppicing, or if necessary, removal of specifically identified trees, to allow laydown and assembly of turbine blades on the ground. Alternatively the normal hardstand area requirements may be reduced to avoid clearing sensitive vegetation. This could involve delivery of individual components to the turbine site as required for erection of the turbine rather than laying all components on the hardstand ready for erection. Overall, there will be an objective to avoid removal of mature native trees and particularly those with conservation significance through their vegetation community association and/or where they provide roost habitat for avifauna.

As far as possible the construction period will be limited to minimise any impact on the local community and to enable completion of the wind farm and commencement of the supply of electricity from the available renewable energy resource as soon as practicable.