13. Greenhouse Issues

This chapter of the EA addresses the importance of greenhouse gas emissions reduction and the role of the Capital Wind Farm project in Australia's efforts to curtail emissions.

13.1 Reasons for Reducing Greenhouse Gas Emissions

The Intergovernmental Panel on Climate Change (IPCC) was established in 1988, by the World Metrological Organisation (WMO) and the United Nations Environment Programme (UNEP) in recognition of the problem of potential enhanced global climate change.

In 2001, the IPCC published the Third Assessment Report *"Climate Change 2001"* that shows that atmospheric carbon dioxide concentrations are 30% higher today than in pre-industrial times. The consensus among scientists is that the observed warming in surface temperature over the past 100 years is exceptional and unlikely to be explained solely by natural causes. The burning of fossil fuel is attributed to be the greatest contributor to the increase in atmospheric carbon dioxide.

While the magnitude and consequences of the changes arising from greenhouse gas emissions are more difficult to predict and subject to ongoing review and debate, there has been a significant global response to the issue. Concerns over changes to climate patterns, more erratic weather conditions and biodiversity impacts have lead to development of measures such as the Kyoto Protocol and Emissions Trading Schemes.

It is within a global context that the Commonwealth Government of Australia has put in place policies and measures to reduce Australia's greenhouse gas emissions and their effect.

13.2 Australian Greenhouse Gas Emissions and the Government's Response

Australia's rate of greenhouse gas emissions per unit of GDP are amongst the highest in the world. The Federal Government has stated its commitment to meeting the target agreed to at Kyoto of limiting emissions to 108% of 1990 levels over the period 2008 to 2012. It has backed that commitment by implementing a range of initiatives to support achievement of the goal.

Australia's greenhouse gas emissions arise from a variety of sources. Figure 13.1 shows the contribution of the respective sectors of the economy to Australia's total greenhouse gas emissions. It clearly indicates that 'stationary energy' accounts for a large part of the total greenhouse gas emissions, e.g. 48% in 2002 (Australian Greenhouse Office (1), 2002).

Furthermore, the proportion of greenhouse gas emissions from the stationary energy sector can be seen to be showing a significant increase and by 2002 was about 30% above 1990 levels, while combined emissions of all other sectors have decreased. The increase in total greenhouse gas emissions has been considerably abated by changed land use practices, but if stationary energy emissions continue to grow at recent rates then Australia's target 0f 108% of 1990 emissions will be exceeded.

Electricity generation contributes a large part of the emissions from stationary energy and in 2002 accounted for 69% of stationary energy and represented 33% of total national emissions. Moreover, emissions from electricity generation increased by 41% between 1990 and 2002 (Australian Greenhouse Office (1), 2002) and their proportion of national greenhouse gas emissions is forecast to exceed 35% by 2010, as shown in Figure 13.2.

Figure 13.1 – Net CO2-equivalent emissions by sector, 1990-2002 (Australian Greenhouse Office (2), 2002)

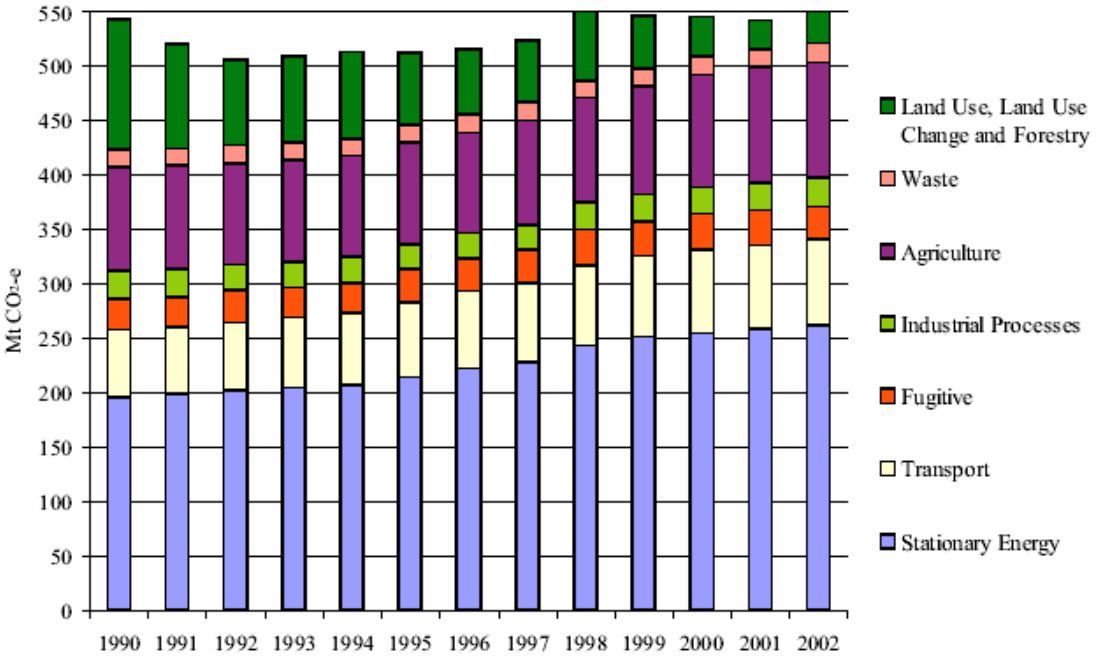
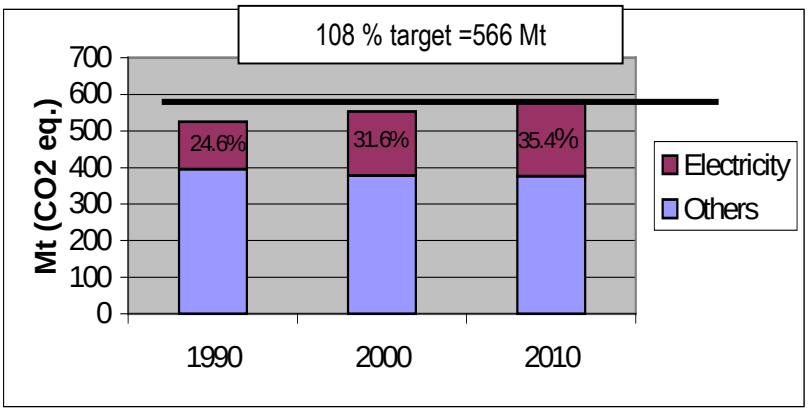


Figure 13.2 – Proportion of Australia's Greenhouse Gas Emissions caused by Electricity Generation (Kyoto Accounting)



The Electricity Supply Industry's large contribution to Australia's greenhouse gas emissions requires a significant response by the industry. The development of renewable energy forms of generation represents an important component of the industry's response.

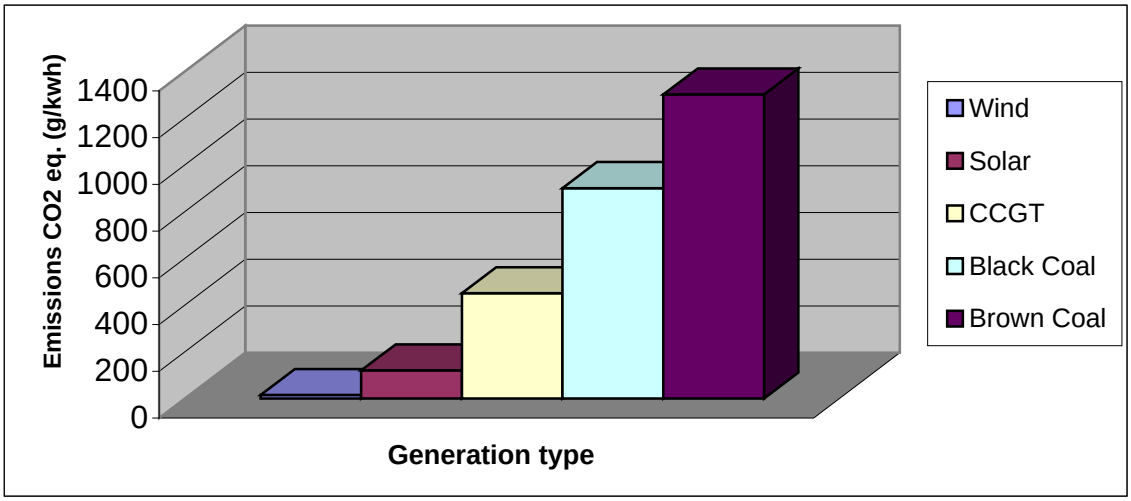
The Federal Government's measures to support emissions reduction and increased renewable energy generation include the Mandated Renewable Energy Target (MRET), the Renewable Energy Action Agenda, National Greenpower Accreditation Program, Renewable Energy Showcase Program, Renewable Energy Commercialisation Program, to mention but a few.

In particular, the Federal Government has sought to assist the funding of renewable energy industry development and commercialisation through the introduction of the Mandatory Renewable Energy Target (MRET) that aims for an additional 9,500 GWh/year of energy from renewable resources by 2010. The MRET initiative has potential to deliver national greenhouse gas emission savings of up to

7.5 Mt/year and the Capital Wind Farm could fulfil about 4 to 5% of this objective. The Federal Government's 2004 MRET Review report recommended an increase in the MRET to 20,000 GWh/year by 2020, however the recommendation was not adopted. Since that time, the ratification of the Kyoto Protocol and increased focus on the climate change issue is causing State and Federal governments to monitor the issues and further explore suitable responses.

Figure 13.3 clearly shows that generation from wind energy is associated with much lower greenhouse gas emissions than the various fossil fuel generation types (coal fired power stations and combined cycle gas turbines (CCGTs)). Where wind energy displaces generation that uses fossil fuels then a net saving in emissions is achieved.

Figure 13.3 - Comparison of Greenhouse Gas Emissions for different generation types (g/kWh CO_2 eq.)



The New South Wales Government has also been active in supporting reduction of greenhouse gas emissions and supports the development of appropriate renewable energy projects. Initiatives promoted by the New South Wales Department of Energy, Utilities and Sustainability (DEUS) and the NSW Greenhouse Gas Abatement Scheme are evidence of the State Government's commitment in this area.

13.3 Wind Technology and Life Cycle Analysis of Emissions

A life cycle analysis of the emissions arising from a development takes account of the emissions due to manufacture of component parts, construction activities, operations and maintenance and eventual decommissioning and disposal or materials recovery. Wind farm developments have the following life cycle emission characteristics:

- Greenhouse gas emissions on a life-cycle basis are around 10 to 15 kg/MWh.
- Only about one third of the wind farm's lifetime emissions occur during the operation of the wind farm.
- About two thirds of emissions occur due to the manufacture, delivery and construction of parts that are used to build a wind farm. These emissions are likely to be from steel production, chemical processes, machining and assembly and transportation.
- Emissions from a wind farm are much lower than other electricity generating systems.
- Where the wind farm displaces other fossil fuel generation systems there may be net savings in greenhouse gas emissions.

An analysis of the greenhouse gas emissions of a wind farm project over the project's lifecycle is provided in Table 13.1 based on a plant in the USA.

Table 13. 1 - Greenhouse Gas Emissions for Project Stages of a United States Wind Farm

Process	Emissions (tonnes $C0_2$/GWh)	% of total
Materials Production	8.3	58.0
Materials Transportation	0.8	5.6
On-Site Construction on Assembly	0.8	5.6
Operations & Maintenance	4.0	28.0
Decommissioning & Dismantlement	0.4	2.8
TOTAL	**14.4**	**100**

(White & Kulcinski, 1998)

13.4 Estimation of Greenhouse Gas Emission Savings of the Capital Wind Farm

The proposed wind farm will have an output capacity of about 132 megawatts and over a full year could provide the electrical power output equivalent to the annual consumption of about 80,000 households This has been based on the Australian Greenhouse Office (AGO, 2004) estimate that Sydney households use an average 5,000 kWh per year.

Additionally, the generation from the wind farm can deliver a significant benefit through savings in greenhouse gas emissions. While the wind farm is generating it has the potential to displace other electricity generators that compete for supply to the NEM. Where the other generators produce electricity from fossil fuels and their production is fully or partly replaced by the wind farm's output then there are net savings in the greenhouse gas emissions produced from the NEM's operations. The generators supplying the NEM are predominantly large coal fired power stations and to a lesser extent large hydro and gas fired generators. There is also export and import of power between NSW and other states.

The NSW Pool Coefficient is a publicly available indicator of the average emissions intensity of electricity sourced from the electricity grid in NSW. It represents the emissions of greenhouse gases (in tonnes of carbon dioxide equivalent) per megawatt hour of electricity supplied from the 'pool' of major power stations serving the NSW electricity grid. In 2006, the Pool Coefficient has a value of 0.929 (tonnes CO_2-e/MWh) and forecasts indicate an increase to 0.94 to 0.96 by 2009 by which time the Capital Wind Farm could be operating.

Based on displacement of the equivalent generation to that produced by the wind farm and using the forecast NSW Pool Coefficient (2009) as an indicator of the emissions intensity for the displaced generation then the wind farm's output could over a year displace electricity production that would have otherwise produced about 390,000 tonnes of greenhouse gases for the year.

The actual level of emissions savings depends on a range of factors but most importantly the types and amounts of generation that are displaced relative to the wind farm contribution. Wind Energy generation will generally be taken up by the NEM and marginal price generators will be displaced. Given the dominance of large coal fired generators in NSW there is a reasonable potential that they could be displaced. In practice the emission savings may be less or more than the 390,000 tonnes predicted by the above method, but they are still likely to be significant.

Emission savings of 390,000 tonnes of greenhouse gases each year represent about 9.75 million tonnes over a 25 year life compared to electricity produced by the NSW 'pool' of generators. Alternatively, the Capital Wind Farm could on average, offset emissions of around 1,068 tonnes CO_2-e/day. At this rate, the wind farm will over a very short time achieve more emissions savings than is involved in the production of the wind farm components and their transport to the site and construction.

The land on which the wind farm is to be constructed is mostly cleared and used for farming and there will be minor clearing of trees necessary to construct this project. Any effect on the mostly exotic

grasses will be temporary and localised and the net greenhouse gas effect will be negligible. Measures have been incorporated into the project to protect areas of ecologically significant vegetation and for tree planting at a number of locations, which to some extent offset the minor clearing involved for the project's construction..

13.5 Summary on Greenhouse

The electricity produced by the proposed Capital Wind Farm will be fed into the electricity supply grid to provide a proportion of the community's power needs. Increased generation of electricity using wind energy can result in net savings of Greenhouse Gas Emissions for the Electricity Supply Industry.

In respect to greenhouse gas emissions there is significant literature that shows that:

- Wind farms are in the class of what is considered to be the most benign of generation technologies and with one of the lowest possible greenhouse gas impacts;
- Wind farms have substantially lower greenhouse gas emissions than existing electricity generating plant;
- Due to the nature of the wind turbine itself there is little opportunity to make other than very marginal gains in their greenhouse efficiency through changes in construction methods or transportation.

Overall the development of wind farm projects is considered by Renewable Power ventures to be a viable commercial enterprise that can assist improvement of the greenhouse emission intensity of Australia's electricity generation operations and improve environmental performance and social responsibility in Australia's energy use.