Wind Power and Other Renewables
by Alan Moran

IPA Submission to the Review of the Renewable Energy (Electricity) Act 2000

Introduction

Asking the Questions on Climate Control

In relation to combating the supposed global warming trend, environmentalists are fond of saying, 'If nuclear is the answer, we are asking the wrong question'. The answer favoured by the greenhouse warriors range from a draconian reduction of energy usage to adopting the Kyoto emission levels of 'greenhouse gases', primarily carbon dioxide.

But implementing the Kyoto agreement can never be more than a very hesitant move to first base. Full implementation of the Kyoto agreement would have only a trivial effect on the build-up of global CO_2 levels. It would delay any possible effects, adverse or otherwise, by only four years. In other words it would put back a forecast 2 ºC rise in global temperature from 2100 (under business-as-usual) to 2104.

The pain in achieving even the apparently modest Kyoto goal is now being seen across a great many nations. In Australia's case, it involves limiting (carbon dioxide) emission increases to 8 per cent above the 1990 levels by 2010. This is unattainable under the original definition of net emissions since given that our present output would be 23 per cent above the 1990 level. Relatively recent revisions to the basis on which Australia counts its net emissions fortuitously puts us only a few percentage points above the Kyoto target.

Whether any measures to reduce greenhouse gas emissions are appropriate may be beyond the remit of the Review. However, it is worth noting that, notwithstanding two centuries of global industrialisation (with an acceleration over the past fifty years) global climate change has been negligible. NASA's satellite data, available since 1978, shows only a miniscule upward climate trend. Over a longer period, data also shows little long term trend, though considerable perturbations over the shorter term. The Appendix illustrates this for Adelaide.

Australia's Regulatory Response

Australia's approach to Kyoto involves fostering four sorts of power: wind; certain small-scale hydro schemes; biomass from waste; and solar thermal and photovoltaics. To promote the shift away from high-carbon fuels, Australia issues green energy certificates to these eligible sources of generation. The certificates are readily tradeable and unused ones can be 'banked' for future usage.

There are two schemes currently in operation:

- the Mandatory Renewable Energy Target (MRET); and
- the voluntary 'Green Power' sales

The MRET scheme requires 2 per cent of 'additional' electricity by 2010 to come from the approved green sources. This is estimated to be 9,500 GWhs (equivalent to about 1 per cent of the total electricity usage by 2010). Direct users and retailers are allocated shares of this and the penalty for non-compliance is $40 per MWh (4 cents per kWh); for many firms this is up to $57 per MWh in after-tax terms. Moreover, firms may pay a premium on the $40 per MWh (although at present they can meet their needs at a discount) since non-compliant companies are likely to face unwelcome publicity.

The Green Power scheme is based on the consumer opting to pay a premium (commonly $1 per week) for an additional percentage of green power to come from certified green sources over and above those falling within the MRET obligations.

A recent audit[1] estimated that about 70 per cent of green energy used the MRET subsidy.

Not all electricity is equal

Though homogeneous, electricity has different values depending on the location and type of the power source. Some sources are more useable and others involve additional costs.

Electricity that is generated close to markets is more valuable than that which relies on long distance transmission. Transmission lines themselves are expensive and power is lost in the course of transmission. The delivered value of the product itself is reduced further when the supply justifies only a low capacity transmission line with consequent low scale economies and increased average losses in the transport process.

Similarly, the mode of generation is important. The most valuable power is the fast-start plant, such as hydro, which in Australia may be worth on average, say, $70 MWh because it can be immediately turned on and off to meet high price contingencies. Other power is worth less. In the eastern Australian states, flat contracts–the staple fare–offered by coal base-loaders are presently trading at a little under $40 per MWh.

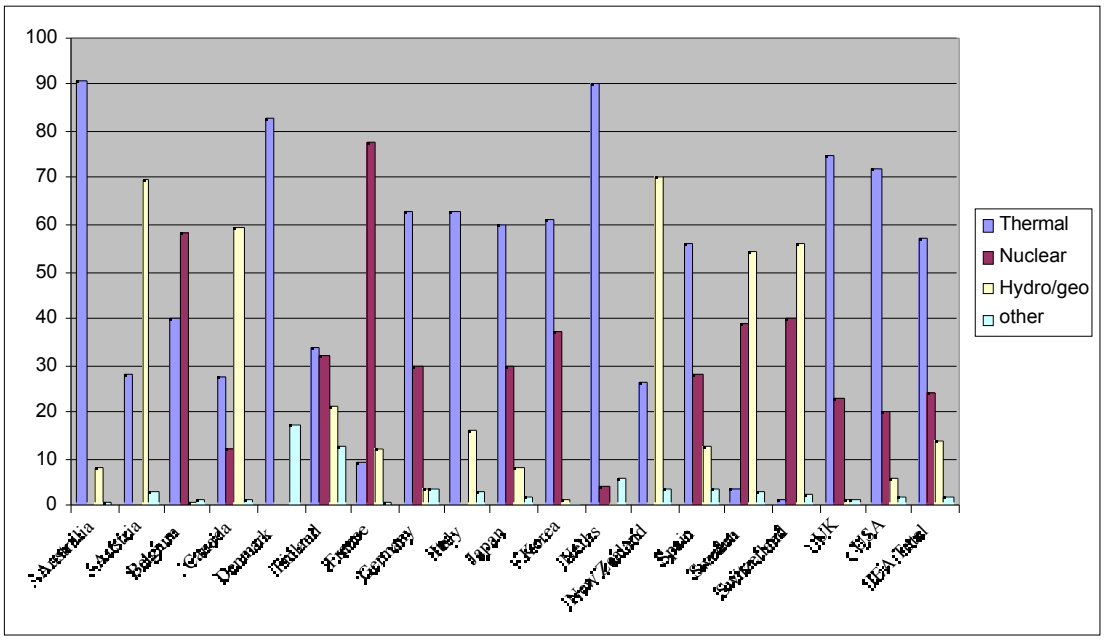
All of this is crucial to the prospects of unconventional energy sources competing with conventional sources.

[1] National Green Power Annual Audit, March 2002, SEDA, March 2002.

Renewable energy in perspective

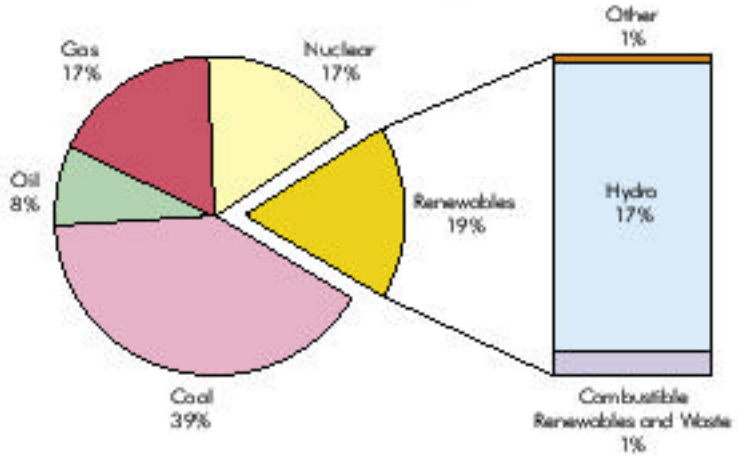
In the OECD area, thermal, hydro/geothermal and nuclear are respectively responsible for 57, 14 and 24 per cent of electricity generation. The "other" category which includes wind is responsible for only 2.2 per cent of electricity. The only countries with a share of "other" above five per cent are Denmark, with 17 per cent, most of which is wind, Finland (12 per cent), with mainly wood by-products and little wind, and the Netherlands, 5.9 per cent. Chart 1 illustrates this

Chart 1 OECD Energy Shares



The global share of renewables in electricity is illustrated in Chart 2 below. This shows the "exotic" renewables share, mainly wind, falls within the one per cent "other" category.

Chart 2 Global share of renewables



Source: International Energy Agency, Renewables in Global Energy Supply, Nov 2002.

The European Union has set the pace on the development and installation of renewable sources of energy. A Directive in 2001 specified a considerable increase in renewable energy which is slated to increase its market share from 14 per cent in 1997 to 22 per cent in 2010. The following table illustrates the requirement set for each member state.

Table 1 EU Renewable Energy Shares

	RES-E TWh 1997	RES-E % 1997	RES-E % 2010
Belgium	0,86	1,1	6,0
Denmark	3,21	8,7	29,0
Germany	24,91	4,5	12,5
Greece	3,94	8,6	20,1
Spain	37,15	19,9	29,4
France	66,00	15,0	21,0
Ireland	0,84	3,6	13,2
Italy	46,46	16,0	25,0
Luxembourg	0,14	2,1	5,7
Netherlands	3,45	3,5	9,0
Austria	39,05	70,0	78,1
Portugal	14,30	38,5	39,0
Finland	19,03	24,7	31,5
Sweden	72,03	49,1	60,0
United Kingdom	7,04	1,7	10,0
Community	**338,41**	**13,9%**	**22%**

Some countries have adopted targets that exceed those of the Directive. Germany, for example, has committed itself to a 22 per cent target, compared to its EU obligation of 12.5 per cent.

In announcing the Directive Olivier Deleuze, the Secretary responsible for Energy and Sustainable Development said, “In Bonn, Europe has saved the Kyoto Protocol. Now, it has to give to itself the means to achieve it”. The EU is therefore to pursue its manifest destiny. And it will do so without recruiting the politically incorrect nuclear option. The Union defines renewable energy sources as all the non fossil ones, entailing, in alphabetical order, biogases, biomass, geothermal, hydro-power, landfill gas, sewage treatment plant gas, solar and wind.

Wind is the most prospective form of unconventional power that is available in any quantity. Installations in Europe in 2002 were as follows

Table 2 Installed wind capacity in the European Union, MW

Country	Installed by end 2002
Austria	139
Italy	785
Belgium	44
Luxembourg	16
Denmark	2,880
Netherlands	688
Finland	41
Portugal	194
France	145
Spain	3,830
Germany	12,001
Sweden	328
Greece	276
United Kingdom	552
Ireland	137
EU TOTAL	**23,056**

SOURCE: ***EWEA***.

Notwithstanding wind's currently small contribution, there has been a rapid increase in new installations of wind generators across the world. In all cases, this has been on the back of hefty subsidies. These include offering a premium price (Germany, Spain, Italy) tax credits (US), tradeable credits (Italy, UK, Australia) and capital grants (Greece, Sweden).

Denmark has been the stand-out case with up to 13 per cent of its electricity coming from a total of over 6,000 wind turbines. But this share of the total is likely to be pared back by a new government keen to address electricity costs which, as a result of existing energy policy, are three times the Australian level. Moreover, the need for fast start follow-on capacity to offset the oscillations in availability of the wind power was reportedly taxing the abilities of the Nordpool system in spite of its considerable hydro capacity.

Denmark has created a major industry out of wind farming. There are about 4,000 people employed in its turbine factories and about 10,000 jobs with suppliers.

Germany and the US are other major users, with Germany boasting 9,000 MW (1.5 per cent of total electricity-generating capacity) and the US with 2,500 MW. The latter figure is 0.2 per cent of total capacity in the US, but wind actually provided only 0.13 per cent in terms of energy because of its low availability.

The issue of meeting the targets set for the exotic renewables is the cost. Recent estimates from around the world put wind costs (in Australian cents/kWh) as follows:

Table 3 Estimated Wind Power Costs (cents/kwh)

Germany	15
Spain	10.7
USA	9.8
Italy	16.9
Ireland	6.2
UK old	5.5
UK new	8.6
Australia	7.5

Source: Sinclair Knight Metz

Costs of Unconventional Low Carbon Energy Sources

The exotic energy supplies are far more expensive than conventional ones. The general range of costs of generation in Australia are broadly as follows:

Table 4 Australian East Coast Generation Costs

Generation Type	Cost of Generation (cents/kWh)
Advanced brown coal	3.3
Advanced black coal	3.7
Conventional brown coal	4.0
Gas	4.0
Wind	7.5-8.5
Biomass	8.0-9.0
Solar	10+

The Sustainable Energy Development Authority (SEDA) of NSW, in its submission to the state regulator, IPART, pulled together a compendium of decentralised options that have been proposed or implemented for meeting electricity demand in the state.

Table 5 NSW Costs of Decentralised Power (cents/kWh)

forestry waste	6.1
food and ag waste	8.6
bagasse	5.3
landfill gas	5.3
sewage gas	6.6
small hydro	6.8
large hydro	5.0
micro hydro	10.2
wind	11.9-33.0
solar voltaic	73.5
solar hot water	7.2
tidal	20.5
geothermal, acquifier	19.2
geothermal, hot rock	15.6
solar thermal	23.9
photovoltaic for remotes	146.4

Source: SEDA Feb 2002

The NSW wind projects are apparently more expensive than those generally used.

Only certain waste products, landfill and sewage gas, and some hydro schemes offer generation at costs that approach competitive levels. All of these are relatively limited in their availability.

Solar hot water is the next cheapest and would be highly competitive if users could rely on it totally and thereby avoid the costs of wires bringing energy to them. However, solar hot waters can only operate when the sun is shining. This means that solar water heaters are capable of supplying only about half the hot water of a household (more in northern Australia). At $3,000 plus, these installations cost over three times as much as conventional water heaters. However, the cost to the householder is offset by half their energy being free. Costs to users are also defrayed by subsidies.

One subsidy is a capital grant. This is available for only for installations where there is no reticulated natural gas on hand. Where natural gas is available, solar water heaters offer a negative greenhouse gas saving compared to gas water heaters. This is due to the considerably greater carbon dioxide emissions from supplementary electricity (partly because the electricity is mainly generated by coal with a lower heat:carbon ratio than gas, but largely due to the loss in generation and transmission from electricity). Where reticulated gas is not available, solar water heaters attract a (State) government subsidy of about $500.

However, the fact that these units have a negative saving effect for greenhouse purposes has not prevented them attracting a subsidy from the Commonwealth's

Mandatory Renewable Energy Target (MRET). MRET imposes a target on each electricity retailer for designated renewables. This is controlled by tradeable Renewable Energy Certificates (RECs). RECs, presently set to total 9,500 GWhs by 2010 in line with obligations accepted by the Commonwealth post Kyoto, are deemed for each new hot water installation. The largest producer, Solahart has contracted to Energex those RECs it acquires on sale to the household. To the household this is equivalent to a subsidy of about $1000. The irony of providing a subsidy to promote increased greenhouse gas emissions is apparently lost on the authorities.

Notwithstanding the double whammy of subsidies for solar water heaters, these still prove to be uncompetitive sources of hot water compared with conventional water heaters, except in those remote areas where electricity is particularly expensive.

Growth in Wind Generation in Australia

Apart from some specific situations in remote areas, none of the unconventional sources provide energy cost-competitively with the conventional sources, which is of course why they are unconventional. At issue is whether they could become cost-effective with technology and scale-led economies.

According to work by Redding[2], there are some 270 projects completed, underway or planned with eligibility for Renewable Energy Certificates. These account for a little under 4,000 MW capacity–(Australia's total current electricity capacity is about 42,000 MW)–though only 338 MW had been commissioned as at the end of last year. The categories of projects identified are:

Table 6 Planned Projects Eligible for Renewable Energy Certificates

	Number of Projects	Capacity MW	2010 Projected annual generation GWH
Wind	74	2257	8000
Hydro	61	681	3000
Sugar, biomass	47	763	3950
Landfill gas	46	187	1300
Municipal wastewater	14	26	170
Solar	23	35	590
Plantation/ crops	1	10	60
TOTAL	270	3989	17220

Based on these data, annual generation, if all proposed projects proceeded, is estimated at 17,220 GWh by 2010. This is almost twice the 9,500 GWh level required by Commonwealth legislation, (the NSW requirement for SEDA-accredited Green Power is estimated to add a further 1000 GWh to this by 2010). Clearly the

[2] Redding, G., (Sinclair, Knight Merz) *Where is renewable energy going in Australia?*, Address to ESAA 8th Renewable and Sustainable Power Conference, August 2002.

foreshadowed level of development will not occur without subsidies and, therefore, a mandated lift in the required usage of new renewable sources of energy.

At the present time renewable energy supplies under MRET can be contracted at $35 per MWh. (i.e. under the $40 penalty ceiling). With the average contract for "flat" energy costing $40/MWh, this implies current provision at around $75 per MWh. Using an average cost of capital at 8.6 per cent, some Australian sites are estimated to be capable of producing electricity below $70 per MWh but these are mainly in Tasmania and isolated (and scenically valued) Victorian coastal sites. Many of these sites are also fortuitously located close to major transmission lines. However, the availability of these less costly sites is rapidly being depleted.

Costs of Moving Out of Conventional Energy

Considerable costs are involved in the supply of the additional 9,500 GWh of new renewable electricity required by the Commonwealth in Australia by 2010. This level amounts to about 4 per cent of electricity by 2010, half the level of the EU and below the US (where the target is 6 per cent). Wind will clearly be the major source of this "additional energy".

For Australia, with a penalty of $40 per MWh, (indexed for inflation) even the 2 per cent "additional energy" target would mean an annual tax on energy of up to $380 million, with the funds largely diverted to high-cost, mainly wind, solutions. On top of this there would be an additional $40 million for the NSW measures and further sums representing the subsidies for installation of solar facilities.

With the committed and planned wind and other developments exhausting the lower cost opportunities, each additional 9500 GWh would require another $380 million per annum if capped at $40/MWh. It is likely that a doubling of the requirement would fail to bring in a further 9,500 GWh at the $40 per MWh subsidy. Ecogeneration, the green industry's magazine, is calling for the subsidy to apply to 33,800 GWh of additional renewable energy. This level would mean and annual cost of $1352 million, equivalent to 14 per cent of electricity and an increased cost of electricity of over 15 per cent per annum. It is, however, unlikely that such a take-up would occur at the $40/MWh subsidy. The estimated costs would be doubled if, as proposed by the wind industry, the subsidy were to be doubled to $80/MWh.

These illustrative costs of present and potential commitments do not take into account the further costs that grid managers are required to incur to accommodate the low quality of wind and some other exotic renewable energy sources. Such costs involve ensuring the availability of additional very fast-start generation which is necessary to combat the unreliable energy flows from the subsidised sources.

Concluding comments

There is no doubt that the growth of wind generation has been rapid.

But the fact remains that wind supplies a trivial amount of the world's energy notwithstanding very substantial regulatory requirements and subsidies for its use.

There are a number of misconceptions that people will offer to support their case for wind power

1 The price is falling and in a few years it will be competitive as long as there is adequate demand to ensure scale economies

We are seeing improved efficiency in all sources of energy supply. Combined cycle is up 50% on the efficiency of a few years ago.

The thermal efficiency of gas generators (the amount of input that comes out as electricity) is now 50% plus when it was once only 35%. Brown and black coal generation has also improved their efficiencies. The gap between these sources and new renewables is not noticeably narrowing. And there are finite limits to the degree that wind efficiency can improve even in theory. This suggests that all economies are squeezed out with a further 30% improvement in the plant's use of the wind

2 Wind needs a subsidy to achieve critical mass.

This is a variation of the "infant industry" argument that says if only we offer early support to industry X - textiles, motor cars, chemicals and so on - we will reap rich dividends in the future. It is somewhat disappointing that the present Government included this as one of the justifications–along with saving the world–for the requirement that "2 per cent of additional energy" be supplied by exotic renewables.

The trouble is the notion fails both on deductive and empirical grounds. Industries dependent on government largess stay dependent on it and develop in truncated forms that lack resilience. Empirical evidence of this is that none of these happy outcomes occurred in the past. None of the children matured and Australian consumers were lumbered with unnecessary costs, costs we only started to shuck off 20 years ago (and they are still with us to some degree in cars and clothing).

3 All other innovations have been subsidised by government.

Actually we are hard pressed to think of any. Certainly not the telephone, the computer (IBM got nothing) the jet engine, the motor car, the tv. Certainly not man-made fibres, the airplane. The absence of examples of subsidised industries that have grown to maturity augurs ill for the hydrogen economy which may have been subjected to a $4.5 billion kiss of death in the latest Bush administration budget!

Some argue that the existing power stations needed subsidies to start with. Not so. Electricity was developed by private enterprise and gradually taken over by governments in a lot of countries like Australia. It is now shifting back to the private sector. And the biggest investment have been by private enterprise, e.g. US nuclear

Wind is intrinsically less efficient than a more concentrated form of solar energy, like coal or oil, or than nuclear energy. It is akin to harnessing a hundred cats to achieve the same pulling power as a horse. In theory it could be done but the logistics in terms of harnessing the cats to pull in the same direction would be colossal. And those means of organising the cats themselves use up an awful amount of energy.

So it is with windmills. We can get 150 2MW windmills developments to put out 300 MW, the same as a decent sized gas turbine. But it is far more complex than making use of a single source, fossilised solar energy–the decayed plants of previous eras.

Wind and other solar power has a long history of successfully providing power in isolated places for water pumping, telephones and so on. But wind power outside of some isolated places to which it is expensive to take grid based power will remain dependent on government regulations and subsidies.

ATTACHMENT

Adelaide annual mean temperature trend 1857 to 2002 adjusted for homogeneity by NASA Goddard Institute of Space Studies (GISS)