Submission No. 50

Inquiry into the development of the non-fossil fuel energy industry in Australia:

Case study into selected renewable energy sectors

Submission from **James Lyon**

Background

The Minister for Industry, Tourism and Resources has asked the Committee to undertake a comparative study of renewable energy sectors: solar, wave, tidal, geothermal, wind, bioenergy and hydrogen. The study is to examine the development of these sectors and their prospects for economically viable electricity generation, storage and transmission.

This submission is based mainly on experience and evidence from Victoria, but is more broadly applicable to the whole National Energy Market (NEM).

The author has appeared as an advocate for community groups opposing wind power developments and has made submissions to a number of government studies and planning panels.

Summary

This submission proposes that net greenhouse gas abatement should be included in the study's assessment of the economics of renewable energy generation. Australia has abundant low-cost fossil fuels and the primary, if not the only, reason for developing renewable energy sources is their potential for reducing national greenhouse gas emissions. An economic assessment of viable renewable energy sources must therefore take into account the cost per unit reduction of greenhouse gas emissions – basically, dollars per tonne of CO2 equivalent abatement.

A comparative study of renewable energy sources should estimate the relative greenhouse gas abatement impacts of increasing levels of renewable energy from various sources. In particular, the study should recognise the relatively small levels of greenhouse gas abatement attributable to wind energy, compared to the levels of greenhouse gas abatement that could result from equivalent generation from other renewable sources.

A comparative study of renewable energy sources should also consider the potential of the generators to respond to peak demands in the National Energy Market (NEM), and the economic impact of paying very high spot prices for electricity from renewable sources.

Renewable Generation in the Total Energy Mix

Coal fired generators currently provide some 90% of Victoria's electricity, and a similarly high proportion of all electricity generated in the National Energy Market (NEM). It's likely that coal-fired generation will provide a very substantial proportion of Australia's power for at least the next 10-20 years, and energy from renewable sources will provide a minor contribution, at most, though this may increase over time. Using ABARE figures, Victorian energy demand in 2009-2010 will be 218.9PJ, or about 60,806,000MWh,

By definition, all forms of renewable energy generation produce emission-free electricity, but different forms of renewable energy have differing impacts on the level of emissions from other generating sectors the electricity generation industry.

It is unlikely that wind energy can contribute more than 15-20% of total generating capacity because of difficulties in absorbing variable wind farm production into the electricity grid. Victoria's current generating capacity is about 9000MW, so the maximum wind energy generating capacity is about 1800MW. The "capacity factor" of wind farms should be estimated at about 30%, the approximate average level achieved by coastal wind farms in Victoria over several years. Thus, 1800MW of wind power capacity (ie 20% of total generating capacity) will contribute a maximum of about 4,730,000MWh per year to the NEM, approximately 8% of Victoria's demand.

Renewable Energy Generation and Greenhouse Gas Abatement

The greenhouse gas abatement impact of wind power depends on which other generators in the NEM are displaced when wind farms come online. It is known that additional marginal wind farm inputs will displace the most flexible generators in the grid first, notably hydro and fast-start gas generators. When coal fired power stations are displaced, it is likely that the generators will reduce their output rather than shut down, and may have to run in "spinning reserve" mode at less than maximum efficiency, and this mitigates any savings in greenhouse gas emissions attributable to the input of wind power. There are various estimates of the effect that a marginal MWh of wind energy will have on greenhouse gas emissions from the NEM as a whole.

- The South Australian Wind Power Study (ESIPC 2003) using a PLEXOS simulation model of the national grid found that one MWh of wind generation in South Australia reduced national CO2 emissions by 0.49 to 0.52 tonnes.
- Computer modeling by ESB National Grid, the independent Transmission System Operator of Ireland, used an analytic program called CREEP (Capacity Requirement Evaluation by Exact Probability) and an hourly Monte Carlo generation production simulation program called PROMOD. ESB found (February 2004) that the reduction in CO2 emissions varied from 0.331 to 0.590 tonnes per MWh of wind power generated, depending on the level of wind generation in the system.
- The *Policy and Planning Guidelines for Development of Wind Energy Facilities in Victoria* assume greenhouse gas displacement of 1.3 tonnes per MWh. This figure has been questioned repeatedly by planning panels and other critics, but Sustainability Victoria has never provided any empirical or other research to support the figure.
- A study for the Victorian Government by McLennan Magasanik Associates

(MMA) using computer modeling of the NEM found that the greenhouse gas abatement effect varied from 0.88 to 1.01 tonnes per MWh. The study noted that its findings regarding displacement of coal-fired generators needed to be viewed 'with caution'. The study found that the most significant component of greenhouse gas reduction was due to reduced imports of black-coal generated power from NSW, and associated transmission losses.

The first wind farms in Victoria were established some four years ago, with significant and ongoing subsidies via MRET, but to date there has been no empirical research into the effect on total greenhouse gas emissions. (Alternatively, such research may have been undertaken, but results have not been published.)

While the actual level of displacement can only be assessed by analyzing data from the NEM, it is clear that wind energy has very limited potential to contribute to base-load power. Wind farms will therefore do little to displace brown-coal fired generators which are the most greenhouse gas intensive producers in the NEM.

Other sources of renewable energy, such as tidal or geothermal, may be able to provide reliable base load power. If these sources can displace brown-coal generation, they may achieve greenhouse gas savings of around 1.6 tonnes of CO_2 per MWh of renewable energy generated.

Thus, for a given level of energy output, some forms of renewable energy have a much greater potential than others for reducing greenhouse gas emissions from the NEM as a whole. A comparative study of the economic viability of different types of renewable energy must account for this wide variation in greenhouse gas abatement potential - renewable energy only has value over other types of generation because of its potential for greenhouse gas abatement, and this will only have economic significance in a market that puts a (negative) value on carbon emissions.

Economics of Renewable Energy

Of the different forms of renewable energy under consideration - solar, wave, tidal, geothermal, wind, bioenergy and hydrogen – only wind energy is currently operating on a significant scale in Victoria.

It is possible to estimate the cost of wind generated electricity from information on capital cost and nominal generating capacity, which is usually provided in a wind farm's planning permit application. Applying discounted cash flow analysis and a range of input assumptions to past applications it is evident that the cost of electricity generated by wind farms in Victoria will generally be in the range of $68 to $82 per MWh. This compares with an average price on the NEM of around $40 per MWh.

Clearly, electricity from wind farms is much more expensive to generate than electricity from other sources in Victoria, and wind farms are economically viable only because of a government-mandated, consumer-paid subsidy under the Commonwealth MRET scheme and the new Victorian Government VRET scheme.

If significant amounts of wind energy are generated at times of peak electricity demand, it is possible that electricity from wind farms might yield a higher price than the NEM average. Though wind energy cannot be produced specifically in response to peak demands, the operation of the NEM means that all wind energy is accepted into the grid at all times, and wind farms can make extraordinary returns if the wind happens to blow when electricity prices peak. In practice, most wind farms have a supply contract with a single buyer taking all the output at an agreed price, so anomalies in the NEM may not add greatly to the economic viability of the wind energy sector. On the other hand, the ability to cash in on very high spot prices for electricity is key to the profitability of hydro-electricity generators. Ability to respond quickly to high spot prices could be a critical economic factor for other renewable energy sources, if they can offer flexible power output in response to consumer needs.

Given that all forms of renewable energy currently cost more than electricity from fossil fuel generators, their economic viability depends on:

- The level and structure of government or consumer funded subsidies for renewable energy (MRET and VRET are both government mandated consumer subsidies. "Greenpower" schemes are voluntary consumer subsidies for renewable energy, but the level of uptake is insignificant in terms of total electricity demand).
- The level and structure of government penalties for greenhouse gas production in the energy sector. (The adoption of an emissions trading scheme in Australia will, in effect, put a price on emissions and make renewable energy more economically attractive relative to CO_2 emitting generators. The imposition of a carbon tax would have the same effect.)
- The ability of a renewables sector to take advantage of high spot prices for electricity at peak times.

In addition, there are a number of external costs that should be considered in comparing the economic viability of renewable energy sources:

- The cost of additional infrastructure required to absorb the renewable energy into the grid
- The economic effect on other energy providers in the NEM.

There are several reasons why a government might want to mandate subsidies for renewable energy, but it is now clear that renewable energy subsidies are not a cost-effective greenhouse gas abatement policy. A Commonwealth Government review of the MRET scheme, "*Renewable Opportunities, A Review of the Operation of the Renewable Energy (Electricity) Act 2000*" concluded (Executive Summary p xviii) that "MRET is a relatively expensive abatement measure compared with a number of other Australian Government as well as some State and Territory government initiatives. In 2010, the cost of abatement to the economy arising from current MRET settings is expected to be about $32 per tonne CO_2-e." It was specifically noted that "The Review Panel recognises that MRET is not a 'least cost' abatement measure..." This is consistent with findings regarding wind power generation in Denmark, Germany and the UK - all countries that have invested heavily in renewables.

In adopting its own VRET scheme, the Victorian government is not primarily concerned with greenhouse gas abatement. Government policy statements have stressed the industry benefits of renewable energy (especially wind energy) in Victoria, not the environmental benefits. No attempt has been made to measure the extent of greenhouse gas reduction resulting from wind farms operating in the state.

If Australia adopts a carbon trading scheme, it is likely that this will supersede both federal and state schemes for mandated renewable energy. It would be inconsistent to introduce an emissions trading scheme to facilitate the market developing least-cost greenhouse gas abatement measures, and at the same time to mandate a subsidy for renewable energy because governments believe it is a good greenhouse gas abatement policy. As Mr Howard told parliament (March 2007), a national emissions trading scheme would entail the phase-out of mandatory renewable energy targets because they are incompatible with the notion of a national emissions trading scheme.

Australia is contemplating a "cap and trade" national emissions trading scheme. The effect on the economic viability of renewable energy sectors depends on the carbon price which emerges in response to "caps" on CO_2 production. Without a renewable energy subsidy, the carbon price would probably have to exceed $40 a tonne to make wind energy economically competitive with fossil-fuel generation. Other forms of renewable energy, such as solar or geo-thermal, may require an even higher carbon price to compete with fossil fueled generators, at least in the short term.

It's therefore unlikely that renewable energy would be economically viable under a national emissions trading scheme unless the caps are so stringent as to produce a very high carbon price. A number of established or feasible greenhouse gas abatement measures will reduce CO_2 emissions at a cost lower than $40 a tonne. Even with a carbon price at that high level, renewable energy would be among the last measures the market would adopt if it were seeking least-cost abatement.

There may be a case for government funding or subsidy of innovative renewable energy technology through an R&D or "infant industry" phase, but only if the technologies have some prospect of making a significant contribution to emissions reduction in the future. Arguably, some forms of solar or geothermal energy could be worthy of government funding, subject to ongoing audit of potential and actual performance in reducing greenhouse gas emissions.

Wind power generation, however, is now a relatively mature technology and is unlikely to achieve any breakthrough in generating efficiency or cost effectiveness. Government or private subsidies for wind power cannot be justified as support for R&D or for an "infant industry". Some gains may be made in wind power efficiency (eg through better wind forecasting and better supply-side management in the grid), but the existing wind farms should be sufficient to support that research effort without subsidizing further investment in the technology.

The extent to which a renewable energy generator can take advantage of high spot prices for electricity should be related to the generator's ability to supply electricity at times of peak demand. It is appropriate for hydro-electricity generators to take advantage of high spot prices because hydro-electric plants can in fact be powered up quickly to meet peak demands. It is not appropriate for wind power generators to be paid high spot prices simply because a period of high demand happens to correspond with a period of high winds.

In particular, the payment of high spot prices to a wind generator may be denying the operator of a flexible gas-fired plant the opportunity to benefit from a period of high demand. This anomaly in the NEM will have the effect of discouraging investment in highly efficient, low emission, peak-load generators while encouraging investment in expensive, unreliable and unresponsive wind farms.

Finally, some renewable energy sources (geothermal, wind) are available mainly in relatively remote locations and must incur additional costs to bring the electricity to where it's needed. A comparative economic study of renewable energy sources should take into account the external costs associated with integrating the electricity produced into the grid. The study should also consider the external costs imposed by energy sources of an intermittent nature (such as wind) which require other generating plant to cease production at short notice when the renewable source starts up, and to be on standby in case output from the renewable source falls.

Conclusions

1 An economic assessment of renewable energy sources must have regard to the effect on greenhouse gas emissions.

2 The most useful measure of the economics of greenhouse gas emissions is the cost per tonne of CO2 equivalent abatement.

3 Renewable energy sources will provide only part of the electricity generating capacity in the NEM, so an economic assessment of renewable energy sources must assess the net impact on greenhouse gas emissions from the whole energy sector, not just the marginal generating plant.

4 An economic assessment of renewable energy sources must have regard to the costs and benefits of renewable energy target schemes, subsidies, voluntary consumer subsidies, and emissions trading schemes

5 An economic assessment of renewable energy sources should consider the potential of the generators to respond to peak demands in the National Energy Market (NEM), and the economic impact of paying very high spot prices for electricity from renewable sources.

6 If a renewable energy sector cannot compete economically with fossil-fuel generators when a carbon price is imposed, it can only be economically viable if it receives a subsidy. Such subsidy should be essentially for R&D, and justified on the basis of potential to meet energy needs and/or emission reductions in the future.

7 Any renewable energy facility that receives any subsidy, government support or preferential treatment in the NEM must commission ongoing, independent, professional audits of its effects on emissions from the NEM as a whole.

8 In all cases, energy generating facilities must accurately measure, record and publish data on electricity produced, price received, and greenhouse gases emitted.

It must be stressed that the seriousness of climate change and the importance of reducing greenhouse gas emissions is such that we do not have the luxury of indulging in sub-optimal or ineffective policies.