Submission
No 95

INQUIRY INTO RURAL WIND FARMS

Organisation: Senergy Econnect Australia

Name: Mr Robert Holmes

Position: Managing Director

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General Purpose Standing Committee No. 5

Enquiry Into Rural Wind Farms

Submission: Senergy Econnect Australia

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	Name	Date
Prepared By	Hitesh Bavarva Tom Butler	21/8/09
Checked By	Tony Morton	21/8/09
Approved By	Robert Holmes	21/8/09

Senergy Econnect Australia
ABN: 89 103 102 138
Level 4, 607 Bourke Street, Melbourne VIC 3000
PO Box 16137 Collins Street West, Melbourne Vic 8007
Ph: +61 3 8628 9200 Fax: +61 3 8628 9200
www.senergyworld.com

senergy
alternative energy
econnect

Senergy Econnect Australia
PO Box 16137, Collins Street West
Australia, 8007

Level 4, 607 Bourke Street
Melbourne VIC, 3000

T: +61 (0)3 8628 9200
F: +61 (0)3 8628 9299
E: seasiapacific@senergyworld.com
W: www.senergyworld.com

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Submission to the General Purpose Standing Committee No. 5

Inquiry into Rural Wind Farms

Dear Committee Members,

Please find attached Senergy Econnect Australia's submission as requested to the Committees Inquiry Into Rural Wind Farms as requested publicly.

As your scope was broad we have provided the following within our capabilities and we hope that it provides the appropriate terms of reference requested and informs satisfactorily to the committee.

We thank you for this opportunity and look forward to further opportunities of this nature.

Yours sincerely,

Robert Holmes
Managing Director
Senergy Econnect Australia Pty Ltd
ABN 89 103 102 138

Submission

1: **The role of utility scale wind generation in:**

a. **Reducing greenhouse gas emissions generated by electricity production.**

b. **Producing off peak and base-load power.**

a: Reducing greenhouse gas emissions generated by electricity production:

Australia's greenhouse emissions per unit of GDP are amongst the highest in the world [1][2]. Although Australia's greenhouse gas emissions arise from various sources the stationary energy sector is known to be the largest emission sector and, in 2008, it contributed to 51 % of Australia's total greenhouse gas emissions [3]. The stationary energy sector includes emission from electricity generation and direct combustion (fuels consumed directly in the manufacturing, construction and commercial sectors and other sources such as domestic heating). Electricity generation contributes a large amount of emissions from the stationary energy sector and in Australia 77% of electricity generated originates from coal fired power stations consuming both brown and black coal [4] – a form of generation which has been proven to emit significant amounts of greenhouse gasses in the form of $C0_2$, nitrogen oxides and sulphur dioxides (the latter two being known sources of acid rain).

Given the contribution to global warming from traditional fossil fuel generators, Australia's electricity generation industry requires a major step forward in the form of significant and responsible actions to reduce greenhouse gas emissions. While alternative emission reduction methods, such as carbon sequestration or "emission free" fossil fuel generation, may be developed and applied in the long term, the renewable energy sector presents the best hope for an immediate response in the electricity generation sector. At present, only hydro and wind power are considered to be mature large-scale renewable generation technologies and the scope for any major additional hydro power in Australia is very limited. However, Australia has a significant, and untapped, wind energy resource, particularly around the southern coastlines of the continent.

Wind Farms help to reduce greenhouse gas emission by displacing generation from the traditional fossil fuel power stations. As per National Electricity Market (NEM) operation, electricity sold from wind farms is generally guaranteed of being dispatched as a running cost close to zero enables them to bid their energy for sale at zero dollars per MWh for relevant periods – a luxury that fossil fuel generators cannot afford. This action displaces the amount of electricity required to be dispatched from other sources as AEMO reduces generation from the generators who submitted the most expensive bid in the NEM. Thus, traditional generation is reduced by an amount equivalent to the amount generated by wind farms. As the majority of traditional generation is fossil fuel technology, the overall result is a reduction in greenhouse gas emission from the stationary energy sector.

Around 93% of Australia's electricity supply comes from traditional fossil fuel generators. Further, of the 7% sourced from renewables [4], more than 85% comes from hydro electricity. As with wind generators, hydro generators bid their energy at zero dollars and take whatever spot price is determined by the market [5]. Hence, hydro generators will be dispatched first in the NEM in the same manner as Wind farms. As a result, the energy that is displaced by renewable wind and hydro will be derived from traditional fossil fuel generators – the majority of which are coal based major emitters.

Life-cycle basis greenhouse gas emissions from wind farms are around 10-15kg/MWh. Only about one third of which occurs during the operation of the wind farm while the remainder is account for in turbine manufacturing and wind farm construction [2]. Comparative studies from all over the world have found that even after wind turbine manufacturing processes and wind farm construction the greenhouse emissions from wind farms is quite small – in the order of 1% of those from coal, and approximately 2% of those from natural gas, per unit of electricity generated. In other words, using wind energy instead of coal will reduce emissions by 99% for every MWh displaced by wind. Alternatively, using wind instead of gas will reduce emission by 98% [6] for every MWh displaced by wind.

There is often an argument that due to the intermittent nature of wind energy, there is a need for greater reserve generation to cover periods of little or no wind and fluctuations in wind generation. The argument follows that the need for greater reserves will significantly reduce the benefits of greenhouse gas emission savings resulting from higher wind energy penetration. Hence, if there is a substantial increase in the amount of wind energy in the NEM, there is likely to be an increase in the requirement of reserve capacity in order to maintain security and reliability of the system. However, the existing measures that address fluctuations in supply and demand are able to cope with the variability associated with current levels (and those projected in the immediate future) of wind energy. Thus, the increase in emissions associated with the rise in demand for reserves is likely to be small. Consequently, increased penetration of wind energy will still provide a substantial saving of greenhouse gas emission as the impact of additional reserve only slightly decreases this saving as the proportion wind energy increases [5].

According to a report by Energy Strategies and Greenpeace International, Australia has the ability to dramatically reduce greenhouse emission using a combination of energy efficiency measures and an accelerated roll-out of renewable energy. The study's "Energy Revolution Scenario" found these combined measures could reduce energy related emissions by 37% over 15 years. Increased uptake of renewable energy for electricity could provide 40% of Australia's electricity by 2020, increasing to 70% by 2050. The study's modelling also found that, by 2030, Australia could phase out all existing coal-fired power stations that contribute about one-third of Australia's total emissions [1][7]. According to the projection of renewable energy generation capacity under this scenario, wind energy's contribution will be around 23% of total renewable generation capacity by 2020, second after hydro, and will be around 26% of total renewable generation capacity by 2050 and the greatest contributory among all the renewable energy sources [6]. These figures suggest that wind energy's contribution to reducing greenhouse gas emission will be significant in the future to say the least.

b: Producing off peak and base-load power:

There is often an argument amongst different groups that wind energy cannot supply base-load power as a substitution to traditional fossil fuel generators due to the 'intermittent' nature of wind. However, with appropriate use of wind forecasting techniques, generation planning and coordination, along with energy storage technologies, it can be shown that wind energy can contribute to base-load energy requirements with existing and proven technologies.

While the generation from a single turbine can indeed be considered intermittent, this is not normally true for a system of several geographically distributed wind farms experiencing different wind regimes. When geographically distributed wind resources are considered the aggregated resource presents significantly reduced short term fluctuations. The impact of which is a significant reduction in the variability of aggregated wind generation where geographically distributed generators are considered (this impact is evident from geographic distribution across a wind farm itself or across several wind farms located in different regions). Australia is ideally situated to take advantage of this characteristic with the NEM being one of the world's largest interconnected electrical networks. Hence, given proper geographic distribution of wind farms, we can always rely on some level of wind generation to penetrate the market thus providing some level of firm or 'base-load' generation.

Many different studies have shown through computer simulation and modelling that wind energy can replace base-load generation up to the level of the average annual wind generation. The system can then be made more reliable and secure by using a small amount of additional back-up peaking generation (typically gas) which operates only when it is required (i.e. during periods of no or very little wind). However, back-up generation to an equivalent capacity of the installed wind generation is not required and, for widely distributed wind farms, the back-up capacity only has to be one-fifth to one-third of the installed wind capacity. In special cases where wind generation has not, or cannot, be geographically distributed the back-up requirement will still only be approximately half of the installed wind capacity [8]. Furthermore, back-up generation is not required to operate constantly which ensures lower greenhouse gas emission compared to continuously operated fossil fuel generators without significant wind penetration. One study in mid-western USA suggests that an average of 33% and maximum of 47% of annual average wind generation from widely distributed and interconnected wind farms can be considered as reliable base-load power [9].

Typically, correlations between available wind resources and fluctuation in system load are low. Hence, wind farms provide energy to supply peak or off-peak demand indiscriminately. One of the major concerns of the existing electricity market is that of the impact of wind generation during off-peak periods when the system has less flexible generation on line and is less tolerant to variations in wind generation (off-peak loads are typically supplied by coal base-load generation which is much less capable of managing fluctuations in loads than gas fired peaking plant which is operated during the day in addition to base-load generators). While this is true for the technology which presently provides our base-load energy, the problem arises from the inability of these technologies to vary their output within the time frames which wind generation can vary. Current technologies already have a solution to this issue in the form of wind forecasting and modelling methods. State of the art wind forecasting techniques – such as those presently being implemented by AEMO for the NEM – can estimate 24 hour-ahead wind generation to an accuracy of 7-10% while 4 hour-ahead forecasts are reported to an accuracy of 5% [10]. Given that the operating times required for traditional fossil fuel generators are on time frames of hours, the ability to forecast the level of generation from wind to these accuracies enables the timely control of such plant. Furthermore, given that the majority of loads operating during off-peak periods are schedulable (i.e. electric hot water) remote operation strategies could also be implemented in the future to enable these loads to be switched on to compensate for off-peak periods when wind generation is high. Alternatively, storage devices such as pumped storage may be able to be implemented in short term time frames in order to compensate during the reaction times of base-load fossil fuel plant [11][12].

2: The potential role of energy generated by rural wind farms in relation to the Australian Government's (proposed) Renewable Energy Target

In terms of renewable generation, the present technological regime is focussed on wind and hydro generation as mature technologies. It is reasonable to expect that, although other emerging renewable technologies, such as solar thermal and geothermal, will be coming to maturity within the 2020 MRET time frame, the vast majority of the 20% MRET target will be met by hydro and wind. Given that much of Australia's easily accessible hydro resource has already been tapped, coupled with the projected impact of climate change on water resources, it is also reasonable to expect that the present hydro generation stock will not expand significantly by 2020. Thus, the role that wind generation will play in meeting the target will be immense and, given that wind farms are almost solely located in rural areas, developments in rural wind are going to be instrumental in achieving the 20/20 MRET.

Considering the contribution that rural wind generation will have to the MRET it is important to understand the geographical impact of such a change. Based on the 2007 renewable contribution and the MRET the total 2020 renewable target is in the order of 64TWh. Approximately 20TWh of this will be met by hydro generation, and a further 5TWh by others (including solar thermal and geothermal), leaving 39TWh to be supplied by wind farms in the year 2020. Typical wind farm capacity factors (average generation over a year) are in the order of 30-40% of their installed capacity and assuming a 35% capacity factor implies that approximately 13GW of rural wind generation will need to be installed by 2020 to reach the MRET – or 6,500 rurally installed 2MW wind turbines.

One of the major advantages of wind generation is that the geographical footprint of a wind farm is very small. To put this into context it is reasonable to expect that, once installed, the access roads and turbines required on rural land for the projected 6,500 wind turbines is in the range of 25-100km^2. This will be geographically distributed across Australia's 4.7 million square kilometres of rural land.

References

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