Wind Power in the National Electricity Market

Report prepared for

The Energy Users Association of Australia

by

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1. Preamble

Wind power is now one of the fastest growing forms of power generation around the world, albeit from a very small base. Spurred on by Government policies supporting renewable technologies, wind power is quickly becoming an important component of the generation mix in many of the world's industrialised economies.

This growth, combined with the relative uncontrollability and unpredictability of wind as an energy source, has caused concerns amongst both policymakers and power system operators about its potential impact on power system security and reliability. These factors are also making wind power and its impact of increasing importance to energy users.

As a result, there has been a considerable body of work done, both here in Australia and overseas, to study the issue. The key questions being asked include:

- How much wind power can be connected to the power system without jeopardising power system security and reliability?
- What regulatory and/or other measures are needed to accommodate significant quantities of wind power connected to the power system?
- What are the cost implications for final consumers in terms of the delivered cost of electricity?

This report, prepared for the Energy Users Association of Australia (EUAA) by Gallaugher & Associates Pty Ltd, discusses a range of wind energy related issues pertaining to the Australian National Electricity Market that have arisen as a result of work by the Wind Energy Policy Advisory Group (WEPAG) of the Ministerial Council on Energy (MCE), the Wind Energy Industry Reference Group chaired by NEMMCO, and the Essential Services Commission of South Australia (ESCOSA).[1][2][3]

At the request of the EUAA, the report focuses in particular on:

- Informing EUAA members (and other end users) of the likely impact on energy costs, reliability and contract negotiations from greater uptake of wind energy in the NEM.
- Recommendations on possible National Electricity Rule changes and/or policy options to improve the pricing and/or reliability outcomes of the NEM as a consequence of greater wind energy connection.
- Recommendations relating to contract negotiation pass through terms and conditions that end users should consider adopting as a consequence of greater wind energy connection to the NEM.

2. Key Findings & Recommendations

The findings and recommendations listed below have been developed based on information extracted from publicly available reports and related material published by Governments, regulators, the wind industry and NEMMCO.

Findings

1 As at February 2006, within the area of Australia served by the National Electricity Market, there was 617 MW of operational wind energy capacity and a further 95 MW under construction[4]

2 While retailer marketing of green energy may support some further minor wind capacity additions, no new major wind farm projects are likely to proceed in the near term in the absence of new State or Commonwealth Government policy initiatives

3 Based on the current market price for Renewable Energy Certificates under the Commonwealth Government MRET Scheme, for each megawatt of installed wind generation, electricity consumers are paying of the order of $100,000 to $120,000 per annum in out-of-market costs. That is, they are paying this amount over-and-above what they would pay for conventional thermal generation.

4 Energy from new wind generators costs of the order of $80 per MWh compared with the latest average wholesale prices in the National Electricity Market of up to $40 per MWh

5 While this cost gap is expected to close over time, the extent to which this occurs will be driven primarily by wind energy industry developments and accumulated experience at a global level that will be only marginally impacted by any future wind energy development activity in Australia or any Government assistance that goes with it

6 While the growth in wind farms in the NEM has raised some power system security concerns for NEMMCO, the operational measures proposed by NEMMCO for overcoming these concerns will be more than adequate and they will have no discernable price or supply quality impacts on consumers. This assessment would still hold true even if the amount of installed wind generation were to double or even triple in the medium term

7 The supply curve in the NEM is sub-optimal in that it includes an excessive amount of low marginal cost base load generation and a shortage of lower capital cost but higher marginal cost plant for peaking and regulating duty[1]. Government policy initiatives which encourage more renewable energy

[1] It should be noted that the sub-optimal nature of the supply curve has reduced in recent years as more peaking plant has been constructed in most parts of the NEM.

generation are further distorting the supply curve, and this will inevitably lead to increased price spikes in the market as generators exercise their market power in an attempt to extract an adequate revenue stream from the market or in response to the intermittent nature of a greater amount of wind power. A higher proportion of wind and other renewable generation in response to Government subsidies will further distort the supply curve

8 If the amount of installed wind generation in the NEM were to increase to the point where its generation market share was significant (i.e. say, more than 10% of energy generated), NEMMCO may need to either increase its operational reserves or supplement the existing categories of reserve with a new category covering a longer time frame, in which case there could be an added cost impact on consumers. However, the likelihood of this occurring in the foreseeable future is extremely low, and in any event, it would be relatively small by comparison with the current out-of-market costs being borne by consumers for each existing megawatt of installed wind generation

9 The projected levels of wind generation capacity expected in the NEM for the foreseeable future will not have any discernible impact on power system reliability or consumers' quality of supply.

Recommendations

1 As further increases, if any, in the amount of installed wind power will continue to be driven by Government policy initiatives, EUAA should focus its limited resources on inputting its views and concerns into State and Commonwealth deliberations concerning potential new policy initiatives to support renewables such as those currently under consideration by the Victorian Government

2 There is no cause for EUAA concern with the technical issues associated with wind power in the NEM that are currently being addressed by NEMMCO. Practical solutions to deal with these issues have been identified and the cost of their implementation will be quite small. In summary, these are second-order issues that should be a matter of low priority for the EUAA

3 However, it is recommended that EUAA take an active interest in ensuring that, as participants in the market, wind farms receive efficient price signals concerning their cost impacts on market operation. Their current status as Non-Scheduled Generators entitles them to be treated as negative load in the market. While NEMMCO proposes that they be reclassified as a special form of Scheduled Generators and subject to the same charges as other Scheduled Generators, it is recommended that a new category of participant be established, and NEMMCO's already established principles for cost allocation be applied to develop a package of NEMMCO charges and reserve market cost allocations that is appropriate for their role in the market

4 Provided wind generators pay an appropriate share of NEMMCO-related fees and charges and reserve market costs, the cost impacts of wind generation in the NEM will be almost exclusively confined to the pass-though of retailers' purchase costs of RECs (or their equivalent in any new Government policy

initiatives). In these circumstances, it is recommended that there is no need for consumers in their retail contract negotiations to contemplate any new pass through terms and conditions as a consequence of greater wind energy connection to the NEM, at least for the foreseeable future

5 As a general principle, changes to the National Electricity Rules and NEMMCO Operating Procedures to cope with increased wind generation should impose the minimum level of obligations necessary for efficient management of power system security. NEMMCO's proposals however are driven primarily by their desire for standardization and minimization of changes to their IT systems. As a result:

- Wind farms below 30 MW in capacity are likely to remain as Non-Scheduled Generators and avoid fees and charges that will apply to larger wind farms; and
- All wind farms above 30 MW in an area behind a network constraint will be forced to participate in central dispatch even though NEMMCO's security concerns could potentially be addressed via centralized dispatch of a reduced amount. This may impose unnecessary costs on the wind industry, although those costs are likely to be relatively small.

To prevent NEMMCO pursuing sub-optimal outcomes, it is recommended that in future:

1 NEMMCO be required to adopt the Market Objective in the development of its detailed operating procedures; and

2 NEMMCO be required to submit its detailed operating procedures to the AEMC for ratification, subject to NEMMCO satisfying the AEMC that its procedures:

- are consistent with the Market Objective;
- comply with all remaining provisions of the NER; and
- will satisfactorily meet all of NEMMCO's market and system operations powers and responsibilities under the NER and the NEL

3. Wind Power Technologies

Wind power technologies essentially fall into 3 quite separate and distinct categories:

- Small wind turbines;
- Large on-shore wind turbines; and
- Large off-shore wind turbines.

Recent global development of wind power has been focused on large on-shore wind turbines. "Large" turbines are generally defined as those which exceed 100kW maximum capacity.

In the 10 year period to 2004, the installed capacity of grid connected wind power around the world has grown from 4,000 MW to 40,000 MW, and, subject to national and

international policy initiatives over the next few years, a further 10 fold increase by 2020 is possible.

As the best on-shore wind farms sites are developed, the focus for further development is likely to turn increasingly to large off-shore wind farms in shallow coastal waters close to large load centres. This is likely to occur overseas, particularly in Europe and China, before we witness it here in Australia.

It is also possible that we will see a resurgence in the development of small wind turbines for both inter-connected use and off-grid applications. However, their potential application in large urban load centres is likely to be limited due to their relatively high cost compared with conventional supply arrangements.

4. Wind Power Potential in the NEM

The current focus for wind power development in the NEM is on large wind turbines in wind farms located primarily in southern coastal areas. Wind farms already operational in the NEM as at February 2006[2] include the following:

Wind Farm	Operator	Commissioning Date	Location	No. of Turbines	Capacity (MW)
Crookwell	Country Energy	1998	New South Wales	8	4.8
Blayney	Country Energy	1999	New South Wales	15	9.9
Windy Hill	Stanwell Corporation	2000	Queensland	20	12.0
Codrington	Energy Pacific (Vic) Pty Ltd	2001	Victoria	14	18.2
Hampton	Hickory Hill Wind Energy	2001	New South Wales	2	1.3
Toora	Stanwell Corporation	2002	Victoria	12	21.0
Woolnorth	Hydro Tasmania	2002 Stage 1 2004 Stage 2	Tasmania	37	64.7
Challicum Hills	Pacific Hydro Challicum Hills Pty Ltd	2003	Victoria	35	52.5

[2] Note that this table excludes a number of small wind generators, each with an installed capacity of less than 1 MW

Wind Farm	Operator	Commissioning Date	Location	No. of Turbines	Capacity (MW)
Starfish Hill	Tarong Energy	2003	South Australia	23	34.5
Canunda	Canunda Power Pty Ltd	2004	South Australia	23	46.0
Lake Bonney	Country Energy	2004	South Australia	46	80.5
Wonthaggi	Country Energy	2004	Victoria	6	12.0
Yambuck	Energy Pacific (Vic) Pty Ltd / Pacific Hydro	2005	Victoria	20	30.0
Cathedral Rocks	Cathedral Rocks Wind Farm Pty Ltd	2005	South Australia	33	66.0
Wattle Point	Wattle Point Wind Farm Pty Ltd	2005	South Australia	55	90.7
Mount Millar	Tarong Energy	2006	South Australia	35	70.0

The currently operational wind farms have a combined installed capacity of some 617 MW, which represents less than 1.5% of the total registered generation capacity in the States served by the NEM.

Operational wind farm capacity (as at February 2006)	617 MW
New projects under construction	95 MW

While this may appear to be quite modest, and might even be considered immaterial in terms of the overall cost structure and operation of the NEM, it is worth bearing in mind the following:

The technical potential[3] for further wind power development in the NEM States is vast, limited only by the need to have sufficient controllable generation connected to the grid to maintain the balance between supply and demand at all times.

[3] "Technical Potential" in this context means the amount of wind energy that it would be practical to harness under current planning restrictions using available technologies even though it may not necessarily be economic to do so.

The following examples are a clear indication of the how wind power can make a significant contribution to a nation's energy needs:

- Germany already has in excess of 16,000 MW of wind turbines connected to its grid – this accounts for some 13% of the total installed power generation capacity connected to the German power grid;
- The island of Ireland is anticipating some 4,900 MW of installed wind generation by 2010 compared with its total of all forms of installed generation at present of some 7,000 MW;
- Denmark has targeted a contribution of 40% of its electricity needs from wind power by 2020; and
- China is targeting some 20,000 MW of wind turbine capacity by 2020, although this is still less than 4% of the total installed power generation capacity in China at the end of 2005.

The extent to which the technical potential may be realized in the NEM is critically dependent on both future Government policies that would provide support to the wind industry and future costs trends for wind power vis a vis other forms of generation.

For example, new wind farms are now being installed in Europe at the rate of 6,000 MW per annum and this continues to rise, spurred on by the European Union's introduction of emissions trading in 2005. The emissions trading scheme has had the effect of:

- Increasing the cost of power generation from coal fired power stations by up to 18 Euros per MWh or Au$30/MWh; and
- Generating a structural shift in the demand for and therefore the market price of natural gas across Europe.

While the EU policies are driving a significant growth in wind power, they are also driving up European electricity and gas prices at the same time. If, for example, the cost of coal fired power generation were to rise by Au$30/MWh in Australia, one way or another, this would finally flow through to consumers who would experience on average an increase in retail power prices of up to 30%.

5. Current Pro Wind Power Policies in Australia

In recent years, Governments at both the State and Federal level have introduced policies that provide financial support for wind power.

We already have the Mandatory Renewable Energy Target (MRET) scheme, introduced by the Federal Government in 2001. It requires a progressively increasing amount of additional power generation from renewable energy sources each year, peaking at 9.5 TWh in 2010, with this level being maintained each year through to 2020. In spite of strong pressures from various States, environmental groups and other interests to increase the MRET obligations beyond 2010, the Federal Government has rejected this on the grounds of unduly high cost.

New wind generation projects since 2001 accounted for a little more than 15% of the Renewable Energy Certificates created in the 2004 calendar year, and the current and expected future REC prices are unlikely to be attractive enough to support any new wind farm projects beyond the 712 MW of capacity that is either already operational or under construction.

State Government energy policies are having both a positive and a negative impact. Recently announced requirements for new wind farm developments in South Australia are likely to act as a brake on further expansion of wind power in that State. On the other hand, other States are actively encouraging new wind farm developments.

The Victorian Government's Environmental Sustainability Framework published in April 2005 committed the Government to "*facilitate the development of up to 1,000 MW of wind energy in environmentally acceptable locations throughout Victoria by 2006*". In December 2005, the Government published an Issues Paper, "Driving Investment in Renewable Energy in Victoria" in which it canvasses market-based measures much like the MRET scheme as a means of achieving the Government's target of 10% of Victorian electricity consumption being supplied from renewable sources by 2010. If implemented, this would boost renewable energy production in Victoria by a further 2.5 TWh per annum over the next 4 years. This compares with current energy production in Victoria of approximately 1.8 TWh per annum. If it was met entirely via new wind farms, it would require approximately 800 MW of new wind turbine capacity. However, a considerable proportion of the target will probably be met via new hydro projects and other forms of renewable energy[4].

The NSW Government's Greenhouse Gas Abatement Scheme (GGAS), introduced in 2003, establishes a local market for greenhouse gas reductions by imposing mandatory greenhouse gas targets for all electricity retailers operating in the State.

There has been a good deal of discussion about the introduction of a national emissions trading scheme, including in-principle agreement amongst the Labor controlled State Governments in March 2005 to "go it alone" with such a scheme if the Federal Government fails to do so. At this stage however, no details of the proposed State sponsored scheme have been announced.

Programs like MRET, the Victorian market-based proposal and GGAS effectively create a supplementary income stream for wind farm operators to make up the difference between the market value of their electricity output and their long run costs of production. Conversely, the introduction of tradable emission rights would close the cost gap by increasing the effective cost of new fossil fuel fired generation technologies.

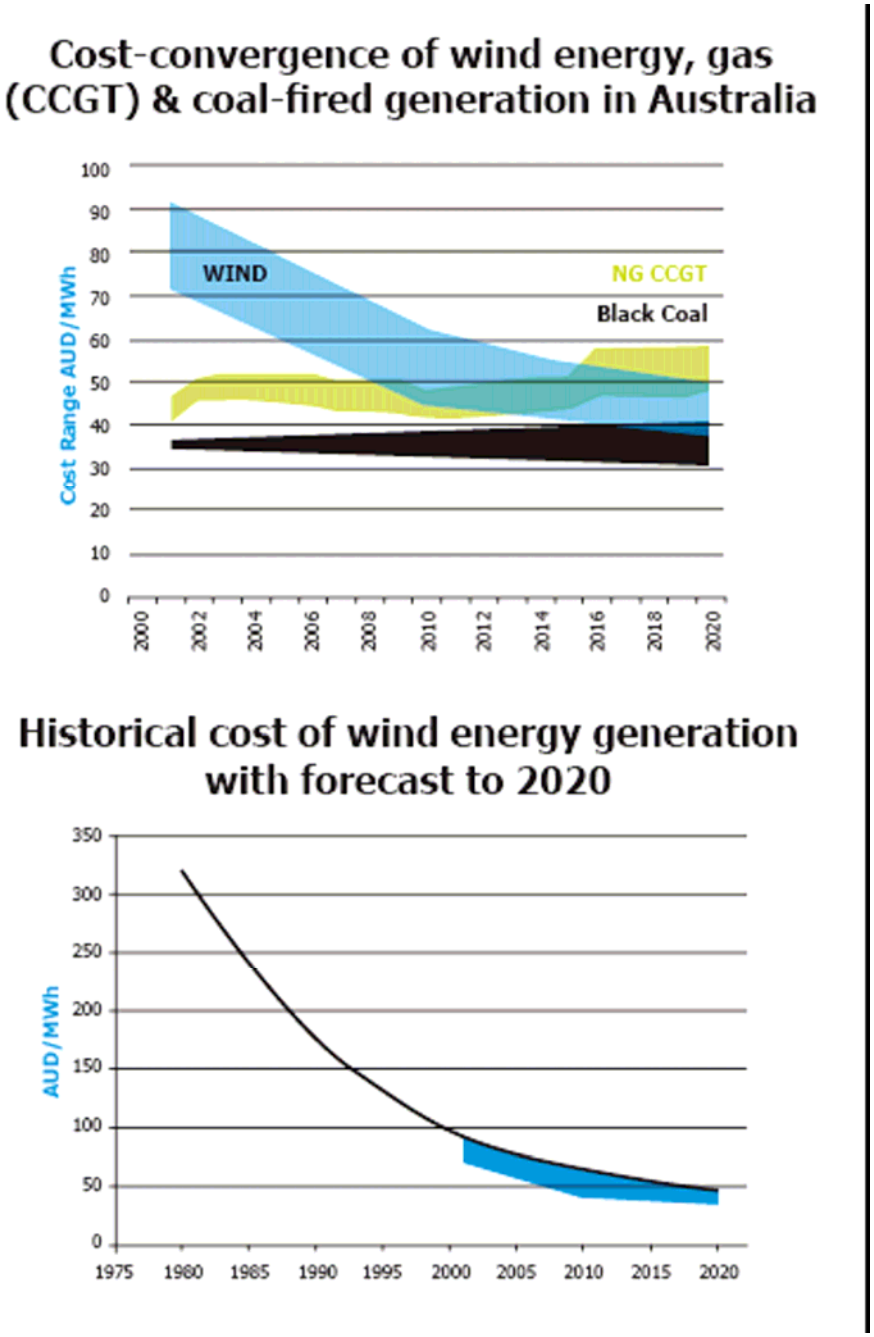
In summary, in the absence of any new Government policy initiatives, the total installed capacity of wind turbines in the territory served by the NEM is likely to stall at around 700 MW, i.e. the capacity of all of the existing and fully committed projects.

Finally, the COAG's Plan for Collaborative Action on Climate Change published on 10 February 2006 is a step in the right direction, and it appears to be a genuine attempt by Governments to clarify climate change policy settings and ameliorate the level of policy uncertainty that is a major concern to private investors in infrastructure such as new power stations. It is also a step in the right direction for all energy users who would benefit from policy certainty and stability. However, it is too early to tell if it will be truly effective in delivering stable long-term policy initiatives which will adequately address the climate change issue.

[4] On 17 July 2006, the Victorian government formally announced its plans to increase the mandatory target for power from renewables from 4% now to 10% by 2016. This will support an additional 3.7 TWh or some 800 to 900 MW of renewable generation capacity

6. Cost Trends

The wholesale market value for electricity in the NEM, as measured by the time-weighted prices in the spot and contract markets, is of the order of $35 per MWh. By comparison, the long run marginal cost of new wind farm developments is generally in the range of $60 - $80 per MWh.



Source: Australian Wind Energy Association publication "Tradewinds 2004/05"

The Australian Wind Energy Association claims that the long run costs of new wind power developments have decreased by approximately $10 per MWh over the past 4 –

5 years and, provided the global wind industry can continue its current rate of growth over the next decade, within 10 years it will be cost competitive with conventional forms of large scale power generation such as black coal and natural gas fired base load power stations.

These cost projections for wind power are consistent with achieving:

- A 12-fold increase in the amount of globally installed wind generation - up from 50 GW in 2005 to 600 GW in 2020; and
- A "progress ratio"[5] of 80 – 85% for the total installed cost of wind generation over the period.

While these projections are plausible, they must be treated with some scepticism. The 12-fold increase in installed generation for example would only be achievable with an extraordinary and sustained amount of government support around the world until the wind industry became cost competitive.

More importantly however, this highlights the fact that cost trends for wind power over the next 10 – 15 years will be driven by cumulative global wind industry activity and experience, particularly as turbine costs account for over 80% of the installed cost of a wind farm. In these circumstances, Federal or State Government policy initiatives affecting the rate of installation of wind farms in Australia will have only a marginal impact on the cost of wind farm installations in Australia.

At present, the long run marginal cost differential between new wind farm developments and conventional forms of generation is of the order of $35 per MWh or more. And as the market expectations for the price for RECs issued under the MRET scheme beyond 2006 are less than this, further investment in new wind farm developments not already committed is almost at a standstill.

The extent to which the cost gap between new wind power developments and other forms of generation will close over time depends upon:

- Future fuel price movements;
- Cost trends for all the various forms of generation technologies; and
- The costs (or benefits) for each technology arising out of Government environmental and/or climate change initiatives.

From a global perspective, some closing of the gap over the next decade appears to be very likely because:

- Wind energy technology is still in the early stages of its life cycle compared with more conventional fossil-fuelled technologies and therefore the potential for future cost reductions is higher;
- There is growing evidence of an emerging structural under-supply in the global oil market, which is likely to lead to higher sustained oil, gas and coal prices compared with the recent past; and

5 In experience curve theory, the progress ratio (PR) is a parameter that expresses the rate at which costs decline each time the cumulative production doubles. In this case, it refers to the fully installed cost for each additional unit of wind turbine capacity installed.

- Increasing pressure from the international community for effective, coordinated global policy responses to the climate change issue are inevitable.

Just how much the gap might close over the next decade is impossible to predict; however it's worth noting that the closure will probably be driven more by increases in the full cost of new alternative generation rather than a decrease in the overall cost of wind power.

7. Current Wind Farm Project Activity

Based on publicly available information, the following table summarises the current state of play for all wind power projects located within the States served by the NEM.

Status of Projects	(Capacity in MW of all known Projects)					
	QLD	NSW	SA	VIC	TAS	Total
Operational	12	16	388	134	67	617
Under Construction	-	-	95	-	-	95
Under Tender	-	-	160	165	-	325
Planning Approvals Granted	-	339	718	192	214	1,463
Planning Approvals Sought	123	418	-	329	-	870
Feasibility Studies	52	435	875	1,074	350	2,786
Total	**187**	**1,078**	**2,461**	**1,814**	**631**	**6,156**

Source: Australian Wind Energy Association website

In spite of the poor economics of new wind farm developments in the absence of new government policies initiatives targeted specifically at wind power or more generally at renewable energy technologies, the proponents of new wind power projects are still very active. There are more than 5,000 MW of new projects under active consideration and the industry is lobbying Governments, State and Federal, very intensely to provide further policy (and financial) support for the industry. Notwithstanding all of this activity, few if any new projects are likely to proceed in the absence of new policy initiatives.

8. Technical Issues

Currently wind farms are treated as non-scheduled generation in the NEM regardless of their size, principally because the variability of the wind doesn't allow them to be finely controlled as is possible with other conventional large scale generation plants.

However, if connected in large numbers, there is a possibility that wind farms may both distort the market and degrade power system security and reliability. These concerns have been the subject of considerable investigative work over the past 18 months by both policy-makers and NEMMCO's technical experts.

Specific issues and concerns with wind power installations have been identified and high level proposals for dealing with them have been developed. In broad terms, NEMMCO is confident that there are relatively low cost technical solutions that can be implemented within the current NEM design framework to enable the NEM to absorb a significant amount of additional wind power.

The following table summarises what are considered to be the potential problems created by large scale wind power and how NEMMCO is proposing each be addressed within the National Market Rules and system operations arrangements.

Issue	Perceived Problem	Proposed Solution
Generator Technical Requirements for Connection to the Grid	The current technical standards have been developed with conventional large scale generation in mind and not all of the requirements are relevant or appropriate for wind turbines	The standards are being reviewed to deal with these concerns – no material impact on system security or reliability is expected as a result of the modifications
Network Congestion	Significant amounts of non-scheduled generation such as wind farms in an area subject to network congestion can inhibit NEMMCO's ability to manage the congestion and maintain the power system in a secure operating state	A semi-dispatch process which allows NEMMCO to cap the output of larger wind farms when network congestion occurs is proposed; this process would not only improve NEMMCO's capacity to maintain a secure system, but it would also result in more efficient market outcomes
Very short-term variability in wind farm output	Variability in wind farm output within the 5-minute dispatch interval will add to the uncertainty NEMMCO already has to contend with in balancing supply and demand and maintaining power	NEMMCO regularly reviews and revises the amount of regulation FCAS it requires, and it can readily modify the amount it purchases through the daily FCAS markets if required –

Issue	Perceived Problem	Proposed Solution
	system frequency in accord with published standards	however, additional AS costs would be incurred[6]
Uncertainty re wind farm output over a period up to 6 hours ahead	As a general rule, the NEM relies on decentralised decision-making by market participants to ensure supply and demand are kept in balance in timeframes beyond half an hour or more. Participants rely on market signals and forward information published by NEMMCO for the process to work reasonably efficiently. The added uncertainty created by significant amounts of wind power may jeopardise the effectiveness of the current approach and increase the risk of load curtailments	Both market participants and NEMMCO are confident the current combination of spot and contract market arrangements will be able to cope with any increased uncertainty created by additional wind power in the NEM. In any event, if necessary, NEMMCO could introduce a new category of contingency reserve with a longer time frame – however, additional AS costs would be incurred
Provision of Information	To manage power system security and operate the spot market efficiently, NEMMCO requires high quality information on all material dynamic factors about the state of the power system and both supply and demand. Wind farms, as non-scheduled generators have not been obligated to date to supply such information	Changes to the Market Rules have already been made and/or are proposed to address each of the deficiencies in this respect. In addition, the wind industry and NEMMCO are collaborating with the AGO to develop improved wind forecasting methods and systems for practical application in the NEM. This work is being subsidised by the AGO

In summary, while it may take some time to work through all of these matters in detail and develop elegant, highly efficient solutions to each, from a technical perspective, each of them is soluble and is being progressed on a cooperative basis within the current market and regulatory framework. There are, nevertheless, cost implications for NEM consumers and these are addressed in Section 9 below.

From a broader perspective however, the advent of multiple new wind farms being located away from the traditional generation centres around the States served by the NEM should be viewed as the start of a long term trend away from relatively large remote generation sources towards a multiplicity of different types of smaller decentralised generation sources, usually embedded in the sub-transmission and distribution networks. As and when this trend gathers pace, it will have important system

[6] At this stage, the variability in wind farm output is considerably less than the short-term variability in demand because the total capacity of all wind farms connected to the power system is still quite small, and no additional ancillary services are needed. Currently, frequency control ancillary services costs account for approximately 0.5% of the value of energy traded in the spot market.

operational and market implications for the NEM that ideally should be addressed and resolved in the near future before problems arise.

In these circumstances, it would be prudent to treat wind generation in the NEM as the beginning of a new category of resource for which neither the current categorisations of "scheduled" or "non-scheduled" resources nor their treatment under the National Electricity rules is appropriate. Energy end users are likely to be significant contributors to this new resource category through various forms of demand side participation, grid connected cogeneration and standby generation plants and the like. The growth in more conventional distributed generation and demand side participation will be spurred on by the improved fuel efficiency and/or considerable cost advantages of each of these technologies compared with large centralised plants and even higher cost renewables such as wind power.

NEMMCO's proposed technical solutions to the problems being created by wind power however have a very short term focus motivated principally by a desire to keep required modifications to its market and power system operations IT systems and procedures to a minimum; i.e. it focuses on minimisation of NEMMCO's costs, which is not necessarily the same as minimising overall market costs. Also, while this approach will facilitate implementation and minimise the costs associated with addressing the immediate problems created by wind farms, it does little in terms of providing a robust regulatory and operational environment for all forms of distributed generation into the future.

9. Cost Implications for Consumers

9.1 Wholesale Energy Costs

Wind power and other forms of renewable energy are currently being supported by Governments principally as a Greenhouse Gas Abatement measure and as a means of facilitating renewable energy and associated manufacturing. Unduly narrow or targeted supply side measures such as those currently in place or under consideration as discussed in Section 5 are generally economically inefficient by comparison with much broader, market based measures or those supporting lower cost, low emission technologies.

In addition, the Federal and State Governments' failure to date to develop a comprehensive, long-term bipartisan strategy to deal effectively with the climate change issue has been causing anxiety amongst virtually all prospective investors in any form of power generation because future policy shifts could have a profound effect on the relative competitiveness of different types of generation.

The present policy framework has 3 cost impacts on consumers:

- The costs associated with the existing stop gap policy initiatives (such as the MRET scheme that has underpinned the installation of high cost renewable technologies including wind farms), which are of the order of some hundreds of millions of dollars per annum, are being passed on to consumers through higher retail energy charges in the competitive market;
- The long term policy indecision is likely to have serious implications for the future dynamic efficiency in the NEM as it will materially distort future investment decisions in the generation sector, and at the same time raise the cost of capital in the industry; and

- Injecting further high capital cost, low operating cost generation (such as wind power, solar, hydro etc.) into the NEM further distorts the overall generation plant mix compared with an economic optimum – this is likely to lead to an even more volatile spot market as generators generally exercise their market power at peak times and other times of relative scarcity so as to recover their long run marginal costs.

The first of these has been identified previously by the EUAA and discussed in its various public submissions concerning those policy initiatives.

The second issue concerns the added risk for generation investors in the NEM when faced with policy indecision and/or policies that are broadly accepted as being unsustainable. Generation investors in a competitive market already face the normal market risks associated with future fuel price movements, operating risk, trading risk, technology risk and so on. When one adds to this significant sovereign and regulatory risk associated with potential future climate change responses by Governments, it must inevitably lead to an increase in the cost of capital for the industry. Lenders will look for a higher proportion of equity funding of new projects, and equity investors will expect higher risk adjusted returns and/or a shorter payback period before they will commit to the new investment.

In the NEM States, capital charges and capital recovery combined represent on average close to 50% of the retail cost of electricity, and, as a consequence, retail electricity prices are very sensitive to changes in one or other of the industry's cost of capital and the expected economic life on new infrastructure investments. In broad terms, a 1% per annum increase in the cost of capital across the entire industry would increase competitive retail prices on average by up to 4%.

The third cost impact listed above is less obvious but no less important. The spot price duration curve for the NEM is already sub-optimal with an excess of very low short run marginal cost plant (e.g. - run-of-river hydro, black coal and brown coal fired plant) and a corresponding shortage of lower capital cost, higher operating cost plant more suitable for regulation and/or peaking duty on the power system. In the short term, this is likely to be exacerbated in any event by highly economic brownfields developments at most of the more modern coal fired stations to lift their capacity ratings by 10% or more.

Significant amounts of wind power and other renewable technologies with very low short run marginal costs would distort the plant mix even further. In particular, this would cause a decrease in the spot market prices, particularly when reserve margins are high and competition amongst all available generators for dispatch is strong.

However, economic theory suggests that the *expected* time-weighted prices in the energy market over longer periods must be not less than the long run marginal cost of the most economically efficient new base load plant options available if the market is to attract new base load plant as and when required. This suggests that lower market prices at times of lower load will inevitably be offset by higher prices at times of high demand and other times of relative scarcity. Under these circumstances, the average volume-weighted price for electricity in the wholesale market will increase accordingly.

Quantifying these cost impacts on consumers with any level of precision would be extremely difficult, and any estimation of them would be quite sensitive to the input assumptions made about detailed policy settings, and fuel price and generation technology cost trends into the future.

9.2 Ancillary Service Costs & NEMMCO Charges

At least for the foreseeable future, the relatively small amount of wind generation capacity that will be connected in the NEM will not have a material effect on the overall level of NEMMCO costs or ancillary service market prices or costs.

NEMMCO's proposals for addressing the various technical issues associated with the operation of wind farms will require only relatively minor changes to NEMMCO's IT systems, operating systems and procedures and market registration arrangements.

Also, having analysed the currently available data regarding variability and unpredictability of wind generator output in the short term (i.e. minutes ahead out to a period of up to 6 hours ahead), NEMMCO is also very confident that the current levels of ancillary services being acquired in the daily reserve and regulation markets combined with the normal market mechanisms in the energy market are adequate for managing power system security, and no extra services will be required, at least for the foreseeable future.

NEMMCO's proposal to require all wind farms of 30 MW or more capacity to register as Scheduled Generators will result in those generators being included directly in NEMMCO's cost allocation arrangements, and will be required to contribute towards the overall costs of these services, whereas, under the current market arrangements, they are exempted.

In summary, this suggests that even if the projected 700 MW of wind generation were to increase quite significantly in the short to medium term, it would not result in any discernible increase in either NEMMCO's charges or ancillary service costs that are passed through to consumers by retailers.

9.3 Network Charges

Like all other generators, wind farms are required to meet 100% of the costs of extending the current network to enable the wind farm to be connected to the existing grid, even in quite remote locations. Secondly, if the connection of a wind farm is likely to cause operational issues or concerns with the security and integrity of the local network, the Network Service Provider is entitled to impose operational constraints and any other technical requirements on the wind farm that may be necessary to prevent any degradation of quality and/or reliability of network services being provided to other network users including consumers.

Where the wind farms are located away from the traditional generation centres, any level of wind generation will have the effect of off-loading elements of the existing transmission network and possibly defer the need to augment the network for its capacity to keep pace with demand growth. Because of this, wind generators as well as any other form of embedded generation, is entitled to receive a credit for the avoided transmission charges resulting from the reduced level of loading on the transmission network. To the extent that these credits are not immediately off-set by realisable reductions in network costs, their net effect is to raise the prices for the network services chargeable to consumers. However, their impact on network prices is likely to be immaterial.

10. Key Issues for NEM Consumers

The Communiqué released by COAG on 10 February 2006 reaffirms the collective commitment of all of the Governments involved in the NEM to transparent, market-based pricing and enhanced competition as the key drivers for ongoing reform of the energy sector.

At the broadest level, consumers need to be convinced that Government policy initiatives arising out of this re-commitment to push ahead with further energy market reform are done in a way which, for new infrastructure investment:

- Reduces policy risk and uncertainty;
- Provides efficient long-term economic price signals throughout the NEM; and
- Promotes competition and facilitates new entry into the market.

In addition to these broader policy considerations impacting on all new generation investment opportunities across the NEM including wind power, there are some more specific policy and technical issues affecting the relative economics of wind power in the NEM. These policy and technical issues have been discussed throughout this paper.

In summary, the dominant issue in this respect is the higher purchase cost for energy arising from mandated measures aimed at increasing the renewables component of the energy supply mix. All of the other issues identified in this paper are, by comparison, second order issues. For the convenience of the reader, all of the issues have been summarised in the Table below, together with their potential impact on consumers and the suggested consumer position in respect of each of them.

Topic	Issue	Potential Impact on Consumers	Suggested Consumer Position
Technical Standards for Wind Farms	Current technical standards for generators are not well suited to the capabilities of wind farms, and the cost of compliance would be unduly high	Poorly designed standards generally add unnecessarily to the generator's costs, leading to higher wholesale energy prices. Re the standards specifically applying to wind farms, the higher costs would generally reduce the competitiveness of wind farms vis a vis other forms of renewable generation.	As a general principle, technical requirements imposed on all generators and consumers[7] should be the minimum necessary to protect the quality and reliability of supply to others connected to the network and consistent with overall minimisation of the delivered cost of energy to consumers. In broad terms, this principle is being pursued by NEMMCO and the AEMC. However, consumer organisations should maintain a watching brief on the review of technical standards to satisfy themselves that it is being faithfully applied, and not compromised for the convenience of either NEMMCO or the NSPs.

[7] Technical requirements governing their electrical installation are imposed on consumers via their retail contract.

Topic	Issue	Potential Impact on Consumers	Suggested Consumer Position
Local Network Congestion Management	A wind farm connected in a weak area of the local network may cause localised network congestion under some conditions	Provided the local NSP manages the congestion adequately without additional investment in the network, there would be no cost or other impacts on consumers	This is a bilateral issue between the wind farm proponent and the NSP and must be addressed as a connection agreement issue. As general principle, NSPs should not spend capital to relieve the congestion unless the wind farm agrees to fund it.
Main Transmission Network Congestion Management	A collection of wind farms and/or other types of non-scheduled generation in a geographical region may cause network congestion on the main transmission network	If not properly managed by NEMMCO, it would jeopardise power system security, increasing the risk of supply interruptions. NEMMCO has developed a relatively low cost solution, the costs of which will be covered by new NEMMCO charges applying to the larger wind farms.	NEMMCO's proposed semi-dispatch process, while providing a low cost solution to the problem, is both unduly restrictive and potentially economically sub-optimal in that it requires more dispatch control over wind generators than is absolutely necessary, and it is designed to minimise NEMMCO's costs rather than total market costs. It also ignores the longer-term market requirement to clearly establish robust market participation arrangements for the expected proliferation of smaller embedded generation plants and more active demand side participation into the future.
Wind Farm Output Variability within the 5-minute Dispatch Interval	The uncontrollability of wind farm output will increase the amount of variability and uncertainty faced by NEMMCO in their task of continuously balancing supply and demand	The mechanisms already available in the NEM for managing dispatch uncertainties are more than adequate to "do the job" even if there is a sizable increase in the amount of wind power connected to the grid.	NEMMCO's approach to determining the amount of regulation services that are needed to maintain power system frequency could potentially be reduced (and the costs of such services minimised) by developing a more dynamic approach to determining how much regulation service is needed at any time. Even though the costs of FCAS are less than 1% of wholesale energy costs, achievable savings could amount to some millions of dollars per annum. In addition, all wind farms which export power into the shared network should be accounted for quite separately in the "causer pays" arrangements for the allocation of the costs of regulation services – they are neither fully scheduled generators nor "negative load" – the latter being the way they are treated at present.

Topic	Issue	Potential Impact on Consumers	Suggested Consumer Position
Wind Farm Output Variability beyond the 5-minute Dispatch Interval	The uncertainties relating to wind farm output are less predictable than relatively short-term changes in customer demand. However, both NEMMCO and wholesale market participants are very confident that the existing market functionality, supplemented by improved short-term forecasting methods, will provide efficient solutions for addressing this.	Large, unexpected shifts in the amount of wind generation may result in tighter than expected reserves being available to the market for a period of time in which case prices in the spot market would probably rise for short periods until the position can be alleviated by bringing more conventional generation on line.	The AGO is progressing the development of improved wind forecasting methodologies for application in the NEM, and this, supplemented with more dynamic real-time information from wind farm operators re turbine availabilities will reduce the level of uncertainty as much as it is practical to do so. Consumers should be concerned to ensure that the principle of market transparency is applied in the detailed implementation of these arrangements. This will ensure that any additional ancillary services costs resulting from wind power variability are monitored and allocated appropriately to those who cause them.
		NEMMCO analysis using the actual variability of SA wind farms however suggests that the risk of the market being caught short due to major fluctuations in wind farm output is very low for current and projected future levels of wind farm capacity in the NEM for the foreseeable future.	NEMMCO and market participant faith in the current market mechanisms being adequate to cope with increased uncertainty and still deliver efficient market outcomes is possibly driven primarily by the strong resistance of market incumbents to either any form of external monitoring or closer regulatory supervision of the contract market. While this is understandable, it may result in increased market costs if indeed the current market mechanisms prove to be inadequate. At the same time, it's not clear that the market revenues received by the wind farms would be net of these additional costs or whether those costs will merely be passed on to consumers in the form of higher energy prices. Consumer groups therefore should be concerned to ensure that this issue is investigated further (by an independent market expert) to satisfy themselves that either the matter is immaterial or alternatively, the combination of contract and spot market arrangements does provide adequate economic price signals under all market conditions.

Topic	Issue	Potential Impact on Consumers	Suggested Consumer Position
Wind Farm & other renewables out-of-market costs	Retailers, via the mandatory purchase of RECs and the like are subsidizing wind farms and other renewables that are more expensive than conventional generation technologies	These subsidies, which are already in excess of $200 million per annum across Australia are being passed through to retail consumers in the form of either higher bundled retail energy rates or as a separate pass-through item	As a general principle, consumers should expect their retailer to manage the price risk associated with the purchase of RECs and other similar regulatory obligations, and recover the cost via their bundled retail energy charges. They should risk these costs being treated as a pass-through item by retailers. Retailers however will generally expect consumers to bear the risk of any material Government policy shift during the period of the retail contract. Retailers are in the best position to bundle to hedge these costs via medium- to long-term bilateral contracts with the owner/operators of the renewables projects. If consumers believe that retailers are changing an undue premium for managing these costs, then consumer groups should lobby for the right to manage these commitments directly or by use of an accredited agent.

In broad terms, the key issue for consumers is the potential introduction of new Government policy initiatives that are specifically aimed at increasing the amount of renewables in the generation plant mix that will:

- Need to be subsidised via REC-type payments, the cost of which would eventually be passed through to consumers; and
- Further distort the NEM supply curve thus exacerbating the level of volatility in the market and increasing the volume-weighted market price of wholesale energy, at least to a minor extent.

Given the current and likely future penetration of wind power in the NEM for the foreseeable future, other potential costs such as the need for increased ancillary services to manage wind power variability are second order issues at this time.

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[1] "Integrating Wind Farms into the National Electricity Market: Discussion Paper", published by the Wind Energy Policy Advisory Group of the Ministerial Council of Energy Standing Committee of Officials, March 2005

[2] "Significant Non-scheduled Generation in the NEM" unpublished draft version 1.0, November 2005 - prepared by NEMMCO in consultation with the Wind Energy Industry Reference Group at the request of the Ministerial Council on Energy's Wind Energy Policy Working Group

[3] "Wind Farm Licensing: Draft Statement of Principles" published by the Essential Services Commission of South Australia, June 2005

[4] "National Code for Wind Farms: A Discussion Paper" published by the Australian Greenhouse Office, May 2006