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SUBMISSION

AEMC Reliability Panel
Comprehensive Reliability Review

Issues Paper

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1. Introduction

1.1 Introduction

Most of Australia's electricity is generated from fossil fuels which have high greenhouse gas emissions. Renewable energy technologies such as wind and wave turbines and photovoltaic cells offer the opportunity to reduce both the consumption of natural resources and greenhouse gas emissions. For instance, electricity based on coal emits 700-1100 of carbon dioxide; whereas solar energy emits 100-280 g/kWh and wind energy only 6-29 g/kWh.[1] As a response to these reduced impacts, alternative technologies are gaining traction with the community and the National Electricity Market (NEM) must evolve to adequately incorporate them. It is acknowledged within the Issues Paper that alternative technologies are continuing to increase their contribution to power generation, in particular wind technologies – for instance, "peaking generation and wind power appear likely to increase their materiality in the total market generation mix" (p 35) – but the paper does not present solutions to obstructions within the NEM regarding connection and pricing; it merely poses more questions.

Governments around Australia are promoting renewable energy targets in recognition of the benefits offered by the emerging technologies. At the Federal level, there is the Mandatory Renewable Energy Target scheme and Victoria has established a renewable energy target of 10% by 2010. On 28 June, the South Australian government tabled draft legislation – the *Climate Change and Greenhouse Emissions Reduction Bill* – which sets a target for 2050 of reducing greenhouse pollution by 60% of 1990 levels, with a renewable energy target of 20% of total electricity consumption by 2014.

A decentralised generation structure is developing within the NEM, even down to the level of householders producing their own electricity, which has the potential to enhance reliability across the whole system. Mechanisms to deal with adequacy of connection and pricing must similarly be developed to ensure the full benefits of smaller, distributed generators are not disadvantaged in comparison to the megalithic coal-powered generators that much of Australia's electricity production relies on. As the Alternative Technology Association highlighted: "It is crucial for governments to provide long-term certainty for investments in new and emerging technology, through innovative policy measures, progressively-increasing binding targets and other financial incentives."[2]

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[1] Commonwealth of Australia, *Securing Australia's Energy Future*, Australian Government, 2004, p 135
[2] Alternative Technology Association, *Submission – COAG's Renewable Energy and Low Emission Technology Framework*, June 2006, p 2

Demand side alternatives – or demand management (DM [3]) – also offer benefits for reduction of greenhouse gas emissions as well as improved reliability within the NEM. DM can provide reductions to the overall base load as well as to critical peak loads, thus enhancing reliability during periods where the networks are congested.

Total Environment Centre (TEC) has consistently argued for DM to be given equal status with generation and network augmentation within the NEM. The Issues Paper refers on occasion to DM, but there is really only general reference made to the benefits without a full consideration of potential mechanisms for estimation of its contribution to reliability: DM is relevant not only to the power required, but also can provide relief from congestion of the networks. Neither has there been adequate investigation of pricing mechanisms which could be developed to properly apportion price to the benefits of DM – to reliability, reduction of greenhouse gas emissions, relief from the need for network augmentation and the reduced requirement for generation.

Governments around Australia are giving greater credence to DM approaches of various kinds. For instance, energy efficiency in buildings is being promoted through regulations such as the NSW BASIX scheme and the revisions to the Building Code of Australia. There are now a range of other energy efficiency programs at federal and state level, and “smart” meters with associated time-of-use tariffs are also being instituted.

Considering the wide range of benefits brought by DM, however – including to reliability of the system – there has been insufficient attention paid to developing a proper DM program within the NEM, nor have sufficient funds been diverted for DM initiatives.

In addition, the Issues Paper refers to reliability concerns in terms of transmission and generation only. Distribution will be a national responsibility from 2007 and we are interested to know whether the existing mechanisms – and any developed as a result of this Issues Paper – will apply to the distribution networks as well.

1.2 Recommendations

1. Wind energy and other alternative technologies may be defined as intermittent within the Rules, but it should be recognised that the aggregation of output from wind generators will increase their perceived level of reliability. Accurate wind forecasting is essential for the adequate provision of reliability benefits from wind power.

2. A pricing methodology needs to be developed by the Australian Energy Market Commission (AEMC) to properly account for: avoided costs of network augmentation, avoided costs of greenhouse gas emissions, accurate costing of connection to the network, reduced requirement for generation, and contributions to reliability generally, with pricing principles to allow for these costs. This methodology should incorporate the benefits of both alternative technologies and DM, and should be supported by a comprehensive set of case studies.

[3] DM in this submission can be read to include ‘demand response’, ‘demand side management’, ‘demand side response’, ‘energy efficiency’ and ‘non-network solutions’. In general, DM can include both the management of peak loads and energy efficiency as a way of meeting capacity requirements most cost effectively. It includes a diverse array of activities that meet energy needs, including cogeneration, standby generation, fuel switching, interruptible customer contracts, and other load shifting mechanisms.

3. The AEMC could develop a methodology for assessment of the reliability impacts of DM (and other network and non-network solutions) at an appropriate level of accuracy. These reliability impacts should also be explicitly incorporated into the assessment of capital and operating expenditure.

4. Provision of adequate access to the NEM for DM providers and for DM aggregators.

1.3 Scope of this submission

We have concentrated on specific issues within this submission, and wind power has been used as a case study for the approach to alternative technologies since it is the most rapidly expanding type of alternative technology within the NEM. The discussion below focuses on:

- Alternative technologies.
- Demand management.

2. Alternative technologies

2. 1 Introduction – benefits and provisos

Renewable energy provides substantial benefits through minimised greenhouse gas emissions and the reduction of carbon liabilities for electricity consumers, now and in the long term. These factors should be considered in decisions affecting the integration of renewable energy into the NEM. The contribution of wind energy in particular to national electricity supply is now well established and will only continue to increase. South Australia is already a major contributor and supplies 51% of Australia's wind power plus 45% of grid-connected solar power[4]. The use of photovoltaic cells by householders is set to keep increasing as well.

Barker and Outhred noted that in Australia: "At the end of 2005, there was ... [wind generation] which equates to 1% of the total electricity produced. There is a large amount of approved projects which will increase the amount of connected wind energy to ... 3.7% of electricity produced. ... the state of South Australia has 8.5% of their electricity coming from wind energy which is expected to increase to 20% ..."[5], with the implementation of the new mandatory renewable energy target.

In a joint submission, TEC and others have presented the arguments that[6]:

> *As energy generation systems progress beyond inappropriate and unsustainable, fossil-fuel based systems towards cleaner, renewable technologies, it is critical that the supporting infrastructure moves with those technologies. Rather than approaching wind* [and other renewables] *as 'a problem' energy source, the focus*

[4] Premier & Cabinet of South Australia, *Groundbreaking Climate Change legislation*, http://www.premier.sa.gov.au/news.php?id=315, accessed on 28.6.06
[5] Barker, FK, & Outhred, HR, *Wind Integration in Australia*, Conference paper for WINDPOWER, Pittsburgh, USA, June 2006, p 2
[6] Total Environment Centre et al., *Submission – Discussion Paper: Integrating Wind Farms into the NEM*, Submission to the Wind Energy Policy Working Group, May 2005, p 2

> *should be on ensuring that the supporting infrastructure is capable of adapting to a changing, and more sustainable, energy generation landscape.*
>
> *More sustainable electricity industries will almost certainly require more resources to support distributed generation, more active demand side participation and significant penetrations of variable generation like wind. Wind is the first such intermittent generation to begin achieving significant penetration. As such, it presents an opportunity for exploring the adequacy of electricity industry restructuring in Australia and its ability to support the transformation to greater sustainability.*

The AEMC has made moves to increase the reliability of wind power by requiring the National Electricity Market Management Company Limited (NEMMCO) to collect and publish forecasting and historical information to deal with these innovations in the electricity supply system[7]:

> *This Rule change reflects the Commission's view that recent increases in wind power based, non-scheduled, generation has introduced a greater level of uncertainty for market participants in their capacity to anticipate demand for scheduled generation. This Rule change requires the National Electricity Market Management Company Limited (NEMMCO) to publish forecast and historical information in relation to non-scheduled generation. This will improve the efficiency of decision-making by market participants and contribute to the more effective performance of energy markets. Some aspects of this amending Rule will take effect from 12 January 2006. The remaining aspects will take effect from 1 July 2006.*

In the long-term interest of consumers, the future of developing technologies and approaches that are now considered to be "alternatives" must be given primary consideration. They will continue to assume increasing importance and mechanisms must be set in place now to allow for evolution. The degree of reliability is not a genuine barrier to their inclusion, as stated by AusWEA[8]:

> *There is no convincing evidence to suggest that reliability is an issue. The addition of multiple small generating units into the power system will vastly improve system reliability and maintain low reserve levels. In comparison, installing single large units, detract from system reliability and require an increase to the regional reserve requirement.*

Outhred also made suggestions concerning reserve capacity: "... distributing a given wind penetration over a greater number of wind farms and shortening the time horizon for reserve scheduling (for example by using more flexible reserve plant or better forecasting techniques) both reduce the amount of reserves required.[9]"

[7] Australian Energy Market Commission, *Publication of information for non-scheduled generation,* http://www.aemc.gov.au, accessed on 30.6.06
[8] Australian Wind Energy Association (AusWEA), *Integrating Wind Farms into the National Electricity Market*, Submission to the Wind Energy Policy Working Group, May 2005, p 3
[9] Outhred, H, *National Wind Power Study*, Report for the Australian Greenhouse Office, 2003, p 7

We discuss some significant issues of primary importance requiring improvement in order to allow the unencumbered entry of embedded generators and wind energy in particular, that is, aggregation of wind turbines, wind forecasting and pricing.

2.1 Aggregation of wind farms

Assumptions about the potential unreliability of wind energy have been raised in the Issues Paper, however a more realistic assessment of reliability is to consider an aggregation of wind farms at a variety of levels. As pointed out by Barker and Outhred:

> *... the locational diversity of wind farms is a large factor in the amount of wind energy the electricity system can take. The aggregation of wind farms is important to minimise the disturbance to the network from a change in the wind. Currently the electricity system views generators as single entities, the increase in wind farms will require research into an optimal way of aggregating wind farms when assessing system security and forecasting energy output. Aggregating wind farms will help reduce the cost and need for ancillary services.*[10]

Across the NEM – and even within regions – wind power will vary significantly at any one time; therefore aggregating the outputs can smooth out the differences between individual turbines. To assess wind power in the NEM it is more appropriate to aggregate groups of wind turbines: "Thus when considering the effects of wind farms on power system behaviour, we need to consider geographically appropriate groups of wind farms, depending on whether we are considering local, regional or system-wide effects."[11] The sheer size of each region and that of the whole NEM works in favour of wind technology since wind regimes are so disparate across the system: "Therefore, until a relatively high level of wind farm penetration was reached, concerns would focus more on potential local or regional network flow constraints and voltage problems than on system-wide supply-demand balance. The former should be manageable with good network design and operation ..."[12]

2.2 Wind forecasting

Accurate wind forecasting can increase the reliability of wind energy. Denmark has a high penetration of wind energy in the electricity supply and part of this can be laid at the door of improved forecasting. As stated in a report on wind energy in South Australia, "While short-term variability of wind generation will always be an issue to be managed, many of the impacts of longer term variability can be mitigated if some of the variability can be forecast in advance."[13]

There are developments on this front, as an interim forecasting system is being established and a future system is being developed.[14] This is not due for release until 2008, but the mechanisms need to be established now for full entry of wind energy in anticipation of adequate forecasting. There is the potential for a substantial increase of

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[10] Barker, FK, & Outhred, HR, *Wind Integration in Australia*, Conference paper for WINDPOWER, Pittsburgh, USA, June 2006, p 5

[11] Outhred, H, *National Wind Power Study*, Report for the Australian Greenhouse Office, 2003, p 4

[12] Ibid., p 5

[13] Electricity Supply Industry Planning Council, *Wind Energy in South Australia*, Planning Council Wind Report to ESCOSA, 2005, p 2

[14] Barker, FK, & Outhred, HR, *Wind Integration in Australia*, Conference paper for WINDPOWER, Pittsburgh, USA, June 2006, p 5

wind energy providing a number of conditions are met, in particular the development of, "advanced wind forecasting techniques ... to predict the future behaviour of wind farms and groups of wind farms, and in particular to accurately predict significant changes in the output of regional groups of wind farms up to two days in advance."[15]

Barker and Outhred also suggest that:

> *Reliable wind power forecasting has the potential to considerably improve the cost-effectiveness of wind farms in main grid applications by reducing dispatch and commitment errors and by reducing the need for spinning reserve. Accurate forecasts a few hours ahead would reduce costs associated with inappropriate unit commitment. Accurate longer-term forecasts would assist in network planning and in generation investment. Because of the effects of diversity, it is important to be able to predict changes that affect wind farms in a correlated manner.*[16]

The Australian Wind Energy Association noted that adequate forecasting is fundamental to taking full advantage of the potential for wind energy to contribute to the efficiency of the NEM:

> *The NEM is one of the most flexible energy markets in the world and enables fast self dispatch and reoffering of generation to changed circumstances. As it is in a unique position to adapt to the integration of wind energy, the NEM will need an excellent forecasting system for the provision of forward energy forecasts.*[17]

2.3 Pricing

In general, the benefits of renewable energy and distributed generation are not priced accurately within the NEM. Avoided costs of greenhouse gas emissions and network augmentation require the development of appropriate pricing mechanisms. A major impediment is the connection costs paid by embedded generators – the accepted standard is for major generators to pay shallow connection costs, but distributed generators may be expected to pay deep connection costs (that is, for upgrades to the system overall) even where they may be making a minor contribution to the total load. Avoided transmission and distribution use of system charges must also be awarded to embedded generators where appropriate. In addition, distribution tariffs usually rely on the averaging of costs across groups of customers and locations, which can obscure the cost benefits distributed generation may bring.

A pricing methodology needs to be developed by the AEMC to account for:

- Avoided costs of network augmentation
- Avoided costs of greenhouse gas emissions
- Accurate costing of connection
- Smearing of costs.

[15] Outhred, H, *National Wind Power Study*, Report for the Australian Greenhouse Office, 2003, p 3
[16] Ibid., p 7
[17] Australian Wind Energy Association, *Integrating Wind Farms into the National Electricity Market*, Submission to the Wind Energy Policy Working Group, May 2005, p 2

This methodology should include pricing principles to allow for these costs.

Moreover, there is a further barrier to distributed generators – and therefore another deterrent to investment – since it seems that embedded generators in certain contracts with NEMMCO have been excluded from earning revenue apart from when they are called upon to provide network support. For certainty of investment this anomaly needs to be clarified.

If the arguments above are dealt with, then the pricing of alternative energy should not necessarily be any different to the pricing of any other form of electricity. The primary barrier to levelling costs – and therefore prices – of alternative technologies is that they are new and developing and therefore have not yet reached settled prices; that is, research and development as well as high capital costs are skewing accurate pricing.

3. Demand management

3.1 Introduction – benefits and provisos

Demand management in all its forms must be promoted as a viable alternative throughout the NEM because of the broad range of benefits that it delivers to consumers. The NEL Objective is set up to cater for "the long term interests of consumers"; without effective DM this will not be achieved. Economic efficiency is central to the NEM and to achieve this there must be equal emphasis on demand and supply.

A report for Energy SA[18] gives some examples of demand side management opportunities relevant here, including load shifting, load curtailment and fuel switching. The report goes on to suggest that, "Demand Side Management activities have the potential to provide a low cost alternative to generation and transmission investments, and are often the only effective short term tool for overcoming supply side and distribution system inadequacies"[19], and hence assist system reliability.

The Energy Networks Association described demand management approaches[20] as including load management measures; distributed generation (for instance for renewable energy); power factor correction; and fuel substitution. They noted that these, “approaches may provide alternatives to increased energy supply or augmentation, through shifting or reducing customer demand, actions that alter the level or pattern of energy consumption, the energy source, or the use of the distribution network.” The ENA also pointed out that there is an emerging market for demand management.

Demand management, supplemented by alternative technologies, can produce more efficient and more reliable outcomes, as described by Gavan McDonnell:

> *In the present state of the NEM, scarcity of capacity generally arises from the decision to cater for peak demands by using the most expensively priced plant. The peak demand could, of course, be managed by reducing it. ... DM and EE measures may require relatively small amounts of capital investment, and some*

[18] Energy SA, *Demand Side Management – Benefits to Industry & the Community*, 2001, p 5
[19] Ibid., p 5
[20] Energy Networks Association, *Submission to the Productivity Commission: Energy Efficiency – Response to Draft Report*, 27 May 2005, p 4

> *require none at all, but are sometimes more, and often very much more, efficient than supply side investments.*[21]

There are a few major areas regarding reliability that we have addressed here, that is, pricing of DM, demand side response and NEMMCO intervention.

3.1 Price mechanisms

One price mechanism that would facilitate uptake of DM in the NEM would be the development of firm short and long-term prices for demand side response arrangements, which would not only make investment more attractive but would also enhance the reliability benefits of DM. It appears that the Ministerial Council on Energy (MCE) is investigating the means for establishing a short-term price process, which would be helpful. With short-term pricing forward trading would probably be enabled.

The proper implementation of tailored price mechanisms in response to interval metering (providing the meters are advanced, interactive meters) would also assist here. The MCE has given the go-ahead for the use of "smart" meters across the NEM, but the specific type and timing has been left to the jurisdictions. This means that there is no real certainty for investors in all areas of the NEM – from generators through to retailers – and this situation really needs to be clarified. Interactive meters and varied tariff plans will increase the importance of DM within the NEM as customers implement their greater range of choice, with the potential for reduction not only of the peak loads but also base loads. This can only improve the reliability contribution of DM.

3.2 Demand side response

There are a range of demand side responses – in the broad sense of the term – which can enhance reliability. Promotion of energy efficiency (in buildings and appliances, for example), active demand side responses such as load shifting or curtailment, and the use of on-site generation can all contribute. There needs to be considerably more work done in detail on the actual benefits and reliability contributions brought by DM, with a serious body of case studies developed to give future guidance regarding magnitude, timing and costs. A DM industry needs to be fostered and proper assessment made of wholesale and retail cost savings.

The potential for DM aggregation, and the ability for aggregators to participate fully within the NEM, has not been properly assessed or instituted. Reliability gains when linked with proper forecasting – particularly if based on arrangements set up by NEMMCO – would also reduce unserved energy and thus contribute to overall cost savings.

The barriers to DM tend to be less related to customer views on reliability and rather on institutionalised barriers to reduced consumption. It is obviously more in the interests of fossil fuel generators and network businesses to promote the consumption of more electricity and thus increase their revenue than to foster reduced demand in any form. This is exacerbated by the variable treatment of DM activities in terms of revenue setting by regulators. As discussed in section 3.1 and as noted in the Issues Paper (p 38), instruments such as interval meters are still in development and the true cost benefits of DM are nowhere near being realised within the NEM.

[21] McDonell, G, *COAG's Quandary: What to do with the Energy Markets Reform Program?* February 2005, p 18

3.3 NEMMCO intervention

To date, the contribution DM can make to reliability has not been explicitly acknowledged within the NEM. For instance, direct load shedding arrangements with large end users have the potential for significantly easing constraints during critical peak periods. NEMMCO has the power to intervene in this situation and can make arrangements in advance of a perceived constraint. As an independent body, it is appropriate for NEMMCO to be able to institute these kinds of provisions. The efficiency benefits – and reliability of supply – outweigh any reasonable payments made to such consumers.

NEMMCO's powers could be enhanced by the development of a methodology by the AEMC for assessment of the reliability impacts of DM (and other network and non-network solutions) at an appropriate level of accuracy. These reliability impacts should also be explicitly incorporated into the assessment of capital and operational expenditure.