APPENDIX K

Carbon Reduction Scenarios in AER Draft Decision on Powerlink Transmission Determination

December 2011

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28th December 2011

Powerlink Queensland
PO Box 1193
Virginia, QLD 4014

Dear Dr Stewart Bell,

Re: Carbon reduction scenarios in AER Draft Decision on Powerlink Transmission determination

Recently, Powerlink submitted their proposal for transmission determination[1] for the period 2012-13 to 2016-17. ROAM Consulting provided input to this process in the form of a report[2] outlining various possible generation development scenarios for the electricity sector, with probabilities for each. This was used as an input for modelling conducted by Powerlink.

The Australian Energy Regulator (AER) has since released their draft decision[3] on Powerlink's transmission determination. In this draft decision, the AER considered it appropriate to use only the low carbon reduction scenario, corresponding to a -5% by 2020 emissions target (below 2000 levels). This letter responds to the specifics of the AER's reasoning on this decision.

AER statement: The Australian Government has committed unconditionally to only the 5% reduction target.

As acknowledged by the AER, the Australian Government has made a commitment to a minimum emissions reduction target of -5% by 2020[4]. This is clearly announced as a *minimum* level of ambition, with possible alternative targets ranging as high as -25% by 2020 (given comparable action by other nations). The AER has rejected any possibility that these higher targets may occur, despite this clear statement by the Australian Government that they are a possibility.

[1] http://www.aer.gov.au/content/index.phtml/itemId/750646
[2] Appendix E - Generation Scenarios for 2012 Revenue Reset Application, 7 May 2010. http://www.aer.gov.au/content/item.phtml?itemId=747343&nodeId=23752b88fbc2bcb22766458cad4ec3a3&fn=%20Appendix%20E%20-%20%20Generation%20Scenarios%20for%202012%20Revenue%20Reset%20Application%20-%20May%202010%20ROAM%20Consuting.pdf
[3] http://www.aer.gov.au/content/index.phtml/itemId/750738
[4] As referenced in AER Draft Determination - Australian Government, Carbon pollution reduction scheme: Australia's low pollution future, volume 1, December 2008, p. iv. Reiterated in: Australian Government, Australia's submission to Copenhagen Accord, 27 January 2010. Reiterated in: Department of Climate Change and Energy Efficiency, National targets, www.climatechange.gov.au/en/government/reduce/national-targets.aspx, updated 12 August 2011. Also stated in: United Nations Framework Convention on Climate Change, "Compilation of economy-wide emission reduction targets to be implemented by Parties included in Annex I to the Convention", http://unfccc.int/resource/docs/2011/sb/eng/inf01r01.pdf, 7 June 2011.

AER statement: The potential action of other countries is highly uncertain

ROAM acknowledges that there is significant uncertainty at present, and therefore for this analysis deliberately applied a probabilistic methodology, assigning probabilities to various important market drivers (such as demand and carbon price). The power of this method is that it allows consideration of outcomes that may be outside the central expectation, but nonetheless are a possibility. Excluding possible scenarios (such as higher carbon reduction scenarios) outright negates the usefulness of this method.

AER statement: Powerlink did not provide sufficient evidence that the Australian Government will commit to higher targets

Given the probabilistic methodology employed by ROAM, it should not be necessary to provide evidence that the Australian Government *will* commit to higher targets, only evidence that it is a *possibility* that this may occur, with suitably assigned probabilities.

As outlined in ROAM's earlier statement[5], it could be strongly argued that the conditions around Australia moving to a higher carbon reduction target have already been met[6]. As specified by the Australian Government, it is required that "major developing economies commit to substantially restraining their emissions and advanced economies take on commitments comparable to Australia's". There is no precise way to determine whether this has been met, but the commitments already tabled at the UNFCCC (as outlined in ROAM's earlier statement) could be argued to meet these requirements.

Significant progress continued to be made at the recent Durban UNFCCC negotiations, with an agreement to develop a legal outcome that is applicable to all Parties, importantly including the USA and large developing countries[7]. This is a large step towards meeting the Australian Government's stated requirements that should not be underestimated in significance.

The Durban platform also notes explicitly the significant gap between the aggregate mitigation pledges, and the targets necessary to limit global warming to less than 2°C or 1.5°C. There is wide acceptance of the importance of meeting these temperature targets, and all Parties acknowledge that this means that the pledges made by Parties at this time will need to be increased significantly. Ross Garnaut and many others have consistently emphasised that it is in Australia's best interests to act aggressively to mitigate climate change[8]. This dictates a negotiation strategy based upon trust building ratcheting of ambition, alongside other nations. This means there is significant pressure (and incentive) for Australia to commit to a target beyond -5%.

The conditions defined in Australia's pledge for moving to a 10-15% target are not precise, but it could certainly be argued that they have been met already, or are likely to be met soon. Therefore, although a -5% target remains a likely outcome, a -10-15% target should also be considered a reasonable possibility.

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[5] ROAM response to AER question on national emissions targets, 2 September 2011.

[6] http://www.climatechange.gov.au/government/international/global-action-facts-and-fiction/~/media/government/international/global-action-facts-and-fiction/20110531-International-pledges-on-climate-change-action.pdf Also, Australian Government, Productivity Commission, Carbon Emission Policies in Key Economies, Productivity Commission Research Report, May 2011.

[7] Establishment of an Ad Hoc Working Group on the Durban Platform for Enhanced Action, Draft decision -/CP.17, UNFCCC, 10 December 2011. http://unfccc.int/resource/docs/2011/cop17/eng/l10.pdf

[8] The Garnaut Review 2011, http://www.garnautreview.org.au/

AER statement: The Australian Government has not altered its position on carbon reduction targets for several years.

The fact that the Australian Government has not altered its position for several years does not mean that they are any less likely to move towards a higher emissions reduction target, since this stated position explicitly includes these higher emissions reduction targets as a possibility.

The Australian Government has first taken steps to put in place a mechanism for meeting any commitments, and now has successfully passed the Clean Energy Future package[9]. This was a necessary (and time consuming) step to be implemented before they committed unconditionally to a higher level of ambition.

Passing of the Clean Energy Future legislation is a critical step, the significance of which should not be underestimated. Now that there is a clear legislative instrument, the Australian Government is able to commit to higher levels of ambition without fear of not being able to meet the targets. The recent Treasury modelling[10] also indicates that a higher level of ambition will not come at a substantial cost to the Australian economy, particularly when compared with the cost of adapting to climate change.

Although at present higher carbon reduction targets appear extremely controversial, this is likely to be transient. The experience of other nations (such as New Zealand and the EU) when implementing an emissions trading scheme has been that there is significant national controversy when the scheme is decided upon, but once it is implemented there is very little public concern. The "heat" rapidly leaves the debate once it is clear that the scheme will not cause dramatic upheaval. This same trend is expected in Australia, particularly once the fixed price period begins in 2012. This will mean that by the announcement in May 2014 (of the carbon targets to apply for 2015-2019)[11], the Australian Government is likely to have significantly more public support for higher carbon reduction targets (which are assessed by Ross Garnaut and others to be in Australia's best interests)[12]. It is likely that this is a deliberate strategy employed by the Australian Government - focusing on a minimum level of ambition (-5% target) during the initial controversial period, but clearly allowing flexibility to move to a higher level of ambition once it is widely acknowledged that this can be done without significant economic harm.

AER statement: Even if the Australian Government commits to the higher CPT scenarios, there is still the question of when in the next regulatory period the commitment would take place and when those commitments would manifest into policies and other instruments.

A clear process has been outlined for setting and manifestation of emissions reduction targets[13]:

1. A new Climate Change Authority will soon be formed, and will provide recommendations on the emissions reduction targets applying for the first five years of the flexible price period by February 2014.
2. The carbon targets applying in 2015-2019 will be announced in May 2014.
3. The carbon targets will determine the total quantity of emissions permits available in each year of the flexible price period, beginning in July 2015.

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[9] Securing a Clean Energy Future, The Australian Government's Climate Change Plan, Australia Government, 2011, http://www.cleanenergyfuture.gov.au/wp-content/uploads/2011/07/Consolidated-Final.pdf

[10] Strong Growth, Low Pollution, Australian Government, The Treasury, July 2011. http://www.treasury.gov.au/carbonpricemodelling/content/default.asp

[11] Securing a Clean Energy Future, The Australian Government's Climate Change Plan, Australia Government, 2011, http://www.cleanenergyfuture.gov.au/wp-content/uploads/2011/07/Consolidated-Final.pdf

[12] The Garnaut Review 2011, http://www.garnautreview.org.au/

[13] Securing a Clean Energy Future, The Australian Government's Climate Change Plan, Australia Government, 2011, http://www.cleanenergyfuture.gov.au/wp-content/uploads/2011/07/Consolidated-Final.pdf

It is expected that the 2020 target will not be a significant step change from the 2019 target (announced in May 2014). This means that there will be a clear statement of the intended 2020 target by mid 2014, which is well within Powerlink's next regulatory control period.

In terms of international commitments, the Durban mandate agrees to complete work on the new legal outcome by 2015, and it is anticipated that this will include a commitment by the Australian Government as to their 2020 target[14].

The impact of market uncertainty must also be considered. For example, it is widely acknowledged that investment in the Australian electricity sector over recent years has been strongly affected by "carbon uncertainty"[15]. Despite the fact that carbon pricing policy has only recently been legislated, for many years generation developers and financing companies have been aware that mitigation action was imminent. For example, despite the lack of an explicit carbon price until very recently, no new coal-fired plants have been installed in Australian since 2007, with most new installed capacity being wind or gas-fired.

Generation developers and financing companies are well informed of the global situation, and will invest in a way that hedges against risks of likely future policies. It is therefore not unreasonable to expect that generation planting outcomes correlate to higher carbon reduction targets (given clear indications of the necessity of a higher level of ambition), even in the absence of this target being legislated. It is the market perception that matters in driving generation outcomes, and this will typically lead policy (rather than the other way around).

AER Statement: It is unclear what form international commitments will take in terms of legislation, schemes or other instruments.

There are two separate aspects to consider:

1. The legal nature of any international agreement; and
2. The legal nature of domestic schemes implemented in each country to meet any international commitments they make.

Addressing the first of these, the legal nature of any international agreement can be argued to be of relatively minimal importance. Any agreement necessarily must be "opt-in" by nature, and there are very few practical mechanisms for enforcement. For example, the Kyoto Protocol is considered legally binding, but Canada has recently elected to leave the Kyoto Protocol to avoid significant financial penalties from not meeting their target in the first commitment period (and faces no direct legal consequences for doing so).

Therefore, the true value in continued UNFCCC negotiations is in facilitating the continued conversation between nations, and in the global public scrutiny that it allows. Any country that does not meet their commitments suffers an international "loss of face". Whilst subtle, in an increasingly globalised world this is a powerful incentive to meet commitments, and it is present regardless of the legal nature of any agreement.

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[14] Establishment of an Ad Hoc Working Group on the Durban Platform for Enhanced Action, Draft decision -/CP.17, UNFCCC, 10 December 2011. http://unfccc.int/resource/docs/2011/cop17/eng/l10.pdf

[15] Nelson, Kelley, Orton and Simshauser (AGL Energy Ltd), "Delayed carbon policy certainty and electricity prices in Australia". March 2010. https://senate.aph.gov.au/submissions/comittees/viewdocument.aspx?id=efe56f45-9f47-47f4-9ba7-bab4900732d3

Addressing the second point, it is up to each nation individually to implement domestic schemes or mechanisms to meet the commitments they make. Many nations (both developing and advanced economies) have already done so, or are in the process of implementing such schemes. For example, the European Union[16] nations have been covered by an emissions trading scheme for many years, as has New Zealand[17], and the world's 8th largest economy, California[18], approved a cap and trade emissions trading scheme in 2010 for implementation from 2012. China has announced plans for emissions trading to be rolled out in six regions by 2013, possibly to be extended nationwide by 2015, to achieve a 40-45% reduction in carbon emissions intensity by 2020[19]. India also has plans for emissions trading among the country's biggest polluters from 2014, and has already implemented a carbon tax on coal (both domestic and imported)[20].

Although the legislative details of many of these schemes are not yet concrete, the stated plans appear workable and likely to move forward in the near future. As outlined above, each nation has a significant interest in meeting any international commitments they make, so it is anticipated that they will take these commitments very seriously.

AER statement: The assignment of non-zero probabilities to higher CPT scenarios is arbitrary.

ROAM agrees that the exact level of probability assigned to each CPT scenario is somewhat imprecise. However, assigning a zero probability removes the variable from the probabilistic assessment entirely. As outlined in this letter, there is a significant weight of evidence that suggests that the assigned probability should *not* be zero. ROAM concedes that it is reasonable to assign a lower probability to the 25% reduction, since it is a more stringent target than the 10-15% target. However, rather than arbitrarily assigning a zero probability to all higher targets, ROAM suggests that it would be more suitable to assign probabilities as follows: 80% probability of a 5% target, 17.5% probability of a 10-15% target and a 2.5% probability of a 25% target. These probabilities will ease the AER's concerns with the practicalities behind the single 25% target scenario since the now conservative 2.5% probability is consistent with ROAM's original work.

Other factors for consideration

Projections of the future notoriously underestimate how rapidly changes can occur, particularly where public opinion and policy is involved. In 2006 (five years ago), NEMMCO projected that by 2011-12, 1620 MW of wind would be installed in the NEM[21]. The installed capacity of wind now

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[16] United Nations Framework Convention on Climate Change, "Compilation of economy-wide emission reduction targets to be implemented by Parties included in Annex I to the Convention", http://unfccc.int/resource/docs/2011/sb/eng/inf01r01.pdf, 7 June 2011.

[17] Emissions Trading Scheme Review Panel. 2011. *Doing New Zealand's Fair Share. Emissions Trading Scheme Review 2011: Final Report.* Wellington: Ministry for the Environment. http://www.climatechange.govt.nz/emissions-trading-scheme/ets-review-2011/review-report.pdf

[18] Final Regulation Order, Subchapter 10 Climate Change, Article 5, Sections 95800 to 96023, Title 17, California Code of Regulations. California cap on greenhouse gas emissions and market-based compliance mechanisms. http://www.arb.ca.gov/regact/2010/capandtrade10/finalrevfro.pdf

[19] Adam Morton, Sydney Morning Herald, 8 September 2011. http://www.smh.com.au/environment/climate-change/beijing-praises-emissions-plan-20110907-1jxql.html. Also in The Australian, 18 July 2011, http://www.theaustralian.com.au/news/world/polluted-china-plans-carbon-emissions-trading-scheme/story-e6frg6so-1226096969756

[20] The Guardian, Carbon tax and emissions trading: how countries compare. Sunday 10 July 2011. http://www.guardian.co.uk/environment/2011/jul/10/carbon-tax-emissions-trading-international. Also in The Economic Times, 27 January 2011, India to unveil emissions trading scheme on February 1. http://articles.economictimes.indiatimes.com/2011-01-27/news/28430106_1_emissions-trading-pollution-control-emission-levels

[21] NEMMCO, Statement of Opportunities 2006.

exceeds 2450 MW and by 2011-12 is projected to reach 2600 MW, far exceeding expectations. Any revenue determination conducted based upon the initial projection would have significantly underestimated necessary expenditure to integrate a significantly larger quantity of wind generation. Even in 2007, NEMMCO's Statement of Opportunities[22] shows no evidence of consideration of the expanded Renewable Energy Target (RET), with the anticipated installed wind capacity remaining constant beyond 2011-12. The very substantial ramp-up in wind generation in the early years of the RET (currently in progress) would not have been anticipated in the revenue determinations conducted in that year (2007-08), but would have been included well within the determination timeframe (2008-09 to 2012-13).

Given this unavoidable tendency for nearsightedness in forecasting exercises, we must widen the focus to inform possible policy shifts that will drive substantial changes in the electricity sector. In this case, climate science clearly dictates that all countries (Australia included) must move to higher carbon reduction targets to avoid dangerous climate change. This is inevitable, and we can therefore expect that any new and unanticipated policies will continue to shift towards higher levels of ambition.

Given this weight of evidence, ROAM considers that it would be reasonable to assign probabilities as follows: 80% probability of a 5% target, 17.5% probability of a 10-15% target and a 2.5% probability of a 25% target.

Yours sincerely,

Dr Jenny Riesz
Principal - Renewable Energy and Climate Policy

Andrew Turley
Principal - Market Modelling

Ben Vanderwaal
Managing Director

[22] NEMMCO, Statement of Opportunities 2007.

Dr Jenny Riesz

Principal - Renewable Energy and Climate Policy

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Employment

Principal - Renewable Energy and Climate Policy, *ROAM Consulting*
Employed at ROAM from Oct 2007 – Present
Brisbane, Australia

Jenny leads ROAM's expertise in the integration of renewable technologies and the impacts of climate policy on electricity systems. Since joining ROAM Jenny has been the primary consultant delivering a wide range of projects, including those listed below:

Clean Energy Council - RET Market Analysis - Oct 2011
Analysis of the market for Renewable Energy Certificates in Australia, determining the interaction between contract prices (Power Purchase Agreements) and the spot market, and analysing data available through the REC Registry.

Australian Energy Market Commission (AEMC) - FCAS, NCAS and Transmission impacts of the LRET - Jul-Sept 2011
Assessment of the impacts of the Large-scale Renewable Energy Target upon Frequency Control Ancillary Services (FCAS), Network Control Ancillary services (NCAS), including reactive power and voltage control, and the transmission augmentation requirements to facilitate the entry of renewable generation.

Western Power - Overnight Dispatch Operations Manual - Jun 2011
Preparation of an operations manual for the operators of the Wholesale Electricity Market (WEM) in the South-West Interconnected System (SWIS). Focused on challenges related to overnight dispatch during low-load conditions and the decision making process around the de-commitment of large thermal units.

Clean Energy Council - Retail Price Forecast - Feb 2011
Forecast of retail prices applying in each region of Australia, including a detailed assessment of the contribution of the various renewable schemes (large-scale generation certificates, small-scale technology certificates, and feed in tariffs).

IMO WA - Rule change proposal for Ancillary Services - Dec 2010
Assisted the Independent Market Operator of Western Australia with preparation of revised rules and equations for the settlements related to ancillary services (Load Following and Spinning Reserve).

Electranet - Commerciality of wind farms in South Australia - Dec 2010 to Sept 2011
An assessment of the quantity of wind generation that can enter in South Australia on a commercially viable basis, taking into account depression of the pool price with significant entry of wind farms and transmission congestion issues. Included extensive sensitivity analysis, and investigation of ways to increase the commercially viable capacity (including assessment of storage technologies).

Clean Energy Council - Wind farm congestion - Aug-Sept 2010
An assessment of transmission congestion in the National Electricity Market with wind development under the Renewable Energy Target.

	Western Power - **Revenue Reset Application** - **Jun 2010** Design of probabilistic scenarios of generation development in the South West Interconnected System for revenue reset application analysis. **Independent Market Operator Western Australia** - **Gas usage in the South West Interconnected System (SWIS)** - **May-Jul 2010** Forecast of gas usage in the SWIS under various optimised generation development scenarios, with financial analysis. **Clean Energy Council** - **True Costs and Benefits of the Renewable Energy Target** - **May 2010** A holistic analysis of the costs and benefits of the RET, including avoided capital, fuel costs and carbon costs, in addition to transmission requirements, voltage control and frequency control services. **Independent Market Operator Western Australia - Assessment of Frequency Control Services and Technical Rules - Apr 2010** An analysis of the sufficiency of the Market Rules on frequency control services required in the South West Interconnected System with significant wind penetration. This lead to further work drafting rule change proposals regarding the settlement equations for ancillary services in the SWIS. **Clean Energy Council** - **LRET/SRES modifications to the RET** - **Mar 2010** An analysis of banked Renewable Energy Certificates and the implications for the proposed LRET/SRES **Grid Australia** - **Transmission investment under the Renewable Energy Target** - **Feb 2009** Modelling of the impacts of the Renewable Energy Target (met largely by wind) on the transmission infrastructure in the NEM, and analysis of transmission augmentation options.
Policy Analyst and Advisor to Government of Solomon Islands - United Nations Climate Change Negotiations July 2009 to December 2009 (Copenhagen COP meeting) Honiara, Solomon Islands	
	Advised the Government representatives of the Solomon Islands negotiating at the United Nations Framework Convention on Climate Change meetings throughout 2009, culminating in joining their delegation to advise at the Copenhagen COP meeting in December 2009. This role involved a large proportion of capacity building and training for Solomon Islands staff in International Climate Policy.

Professional Memberships

- Chartered Professional Engineer
  Institute of Engineering and Technology (IET), 2011
- Member of Institute of Engineering and Technology (MIET), 2011

Tertiary Education

- PhD in Biophysics, University of Queensland, 2007
  [Dean's Commendation for Outstanding PhD]
- Bachelor of Science (Physics), University of Queensland, 2003
  [First Class Honours, University Medal]

Awards

- Queensland Young Achiever of the Year (2007)
- Smart State PhD Scholarship (2006)
- Smart Women Smart State Award winner (2005)
- Australian Academy of Technological Sciences and Engineering Young Science Ambassador (2004, 2006)
- University Medallist, University of Queensland, BSc (Hons I) (2003).
- Australian Institute of Physics Prize (2003)
- Awarded to the student completing the BSc (Physics) with Honours who obtains the highest aggregate mark.

Recent Papers

- *Frequency Control Ancillary Services for High Penetration Wind in Australia*, Utility Wind Integration Group (UWIG), 2011 Fall Technical Workshop, Maui, Hawaii. Also presented at 10th International Workshop on Large-Scale Integration of Wind Power into Power Systems, 2011, Aarhus, Denmark.
- *Impacts of Electricity Markets on Solar Development - An Australian Case Study,* 1st International Workshop on the Integration of Solar Power into Power Systems, 2011, Aarhus, Denmark.
- *Australian Challenges in Meeting Reliability and Security of Supply in 2020,* CIGRE International Colloquium, 2011, Sydney, Australia.

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Employment

Managing Director, *ROAM Consulting*
February 2010 – Present
January 2000 – January 2010 **(Market Forecasting Manager)**
Brisbane, Australia

Ben was a founding employee of ROAM Consulting when the company was formed in early 2000. He has held the position of Managing Director since February 2010. Prior to this Ben was employed as an undergraduate engineer in the Queensland Government generation planning body, to assess the impacts of the fledgling National Electricity Market on the Queensland energy system. His combined experience equates to more than 13 years in the industry.

Ben's specialisation began with algorithm development, optimisation and data processing techniques for large analytical models. In ROAM's early years Ben was the team leader for design and primary developer of ROAM's integrated software suite. He has since carried out consulting projects covering major electricity systems in Australia, New Zealand and the USA. As an independent consultant to energy market participants Ben has employed computer modelling techniques to advise on commercial transactions of existing power system assets and development of proposed new assets. Extending into planning and development of competitive energy delivery systems Ben has worked with market operators and planners in determining operational parameters in the design of markets to deliver on investment signals and reliability standards. Ben's niche of expertise is in assisting participants, market operators and rule-makers in understanding the bridge between the physical energy delivery system and the financial market framework. With a focus on composite transmission and generation reliability of supply, Ben has developed a deep knowledge of both planning and operation of multi area energy supply systems.

Ben's knowledge covers a wide range of market analysis from AC powerflow modelling to issues surrounding 5 minute dispatch intervals through to the 30 year planning time frame. He has presented at a number of industry forums and provided training courses to government departments in Australia and abroad. The task of developing an understanding of complicated interrelated systems in order to extract and present the key information in a form that is easily digested by the target audience through written reports and presentations is the ultimate challenge of Ben's professional career.

Information on recent assignments completed is as follows.

Review of NEM Energy Market for large customer contract renewal – Jul-Dec 2011

With the proposed and now implemented Australian carbon pricing legislation a number of large customers have faced uncertainty regarding the expected increase in their energy costs. As project manager for three separate independent reviews of the potential impact of carbon pricing on energy market prices ROAM's highly detailed energy market models have been employed to determine such factors as carbon price pass-through by time of day, seasonally, and annually over the longer term. The impact on generation and transmission planning decisions has also been reviewed as part of this work to assist the clients to understand and negotiate long term energy supply contracts.

ElectraNet & SP AusNet – MITC performance target – Oct 2010-Mar 2011

During the previous regulatory period (during 2007-08) for transmission network service providers, the AER developed a new metric under the Service Target Performance Incentive Scheme (STPIS) to incentivise TNSPs to minimise the impact of prescribed transmission network element outages on the energy market. Participation in the Market Impact of Transmission Congestion (MITC) parameter requires TNSPs to develop a performance target (or benchmark) based on an assessment of this new parameter for the previous five years of market operation. This required a significant data collection, collation and analysis of TNSP network outage data and NEMMCO/AEMO market data relating to binding transmission constraint equations. Establishing a causal (rather than coincidental) relationship between binding constraints and network element outages required analysis of network topology, an in-depth understanding of NEM constraint equations and consultation with operations personnel from the respective TNSPs.

Clean Energy Council – Wind farm congestion – Aug-Sept 2010

An assessment of transmission congestion and resulting commercial viability of wind generation development and transmission development in the National Electricity Market under the Renewable Energy Target. This study involved consulting with a number of stakeholders to develop input data for the assessment and report back to the stakeholders including presenting at a public forum, a number of private forums and developing a written paper. The paper, "*Transmission Congestion and Renewable Generation*" was published by the CEC and is now widely referenced in relation to transmission congestion issues in the NEM as a possible result of wind generation development.

AEMO – Minimum Reserve Level Assessment – July 2009 to June 2010

Project manager responsible for undertaking a full assessment of minimum reserve levels to apply in the NEM from July 2010. In 2010 the modelling for determining minimum reserve levels was expanded beyond that developed in the previous 2006 assessment (also completed by ROAM with myself as primary modeller). Advancements include considering the impacts of increasing penetration of wind generation in the NEM and impacts on reliability associated with high temperatures associated with extreme weather conditions.

	AEMC – Reliability Standard and Settings Review – Jan-Mar 2010 Comprehensive market modelling exercise to determine the profitability of extreme peaking generation capacity operating to avoid unserved energy. The review was used to determine the Market Price Cap (MPC) which should apply beyond 1st July 2012. A further report was published which focused on the impact of extreme weather events, considering MPC levels consistent with the value of customer reliability used in Victoria. **Alinta Energy – Review of Tasmania Frequency Standards – Jul-Aug 2008** This work involved a detailed review of the Tasmania region frequency standards and resulting frequency control ancillary services (FCAS) market. The issue developed out of the Alinta Energy Tamar Valley CCGT project which would materially increase the size of the largest single contingency in the isolated Tasmania region. The technical performance requirements of the CCGT also exceeded the existing Tasmania frequency requirements. ROAM's modelling incorporated the complete co-optimisation of the nine markets (one energy and eight FCAS). The frequency standard was modified in Tasmania to accommodate development of the Tamar Valley CCGT. **IBC International Conferences – March 2008** I developed and presented a five day seminar in Dubai for Middle East participants on all aspects of market design and development including interaction of generation and transmission. This seminar leveraged off my experience in modelling the Australian NEM, Western Australia Market, New Zealand Market and California ISO market. **Western Power – East Kimberley Energy Supply/Demand Optimisation Study – March to May 2005** This assignment required consultation with many stakeholders in the development of the region to establish possible candidates for new power development including a field trip to Perth and the East Kimberley area. A complete integrated resource plan of generation, transmission and demand was developed and assessed for a 25-year outlook for various regional demand development options. This project required significant development of the 2-4-C software to include an in depth hydrological model of the Lake Argyle reservoir on which the region is entirely dependent for both power generation and irrigation requirements. This required a research effort and liaising with interested parties and government departments. The findings of this report underpinned the development of the preferred power project which will meet the needs of the dynamic East Kimberley region. **QLD Department of Energy – Queensland Energy Policy – Modelling of Policy Proposals – January to April 2005** Completed detailed assessment of the possible development opportunities for the Queensland region under a number of policy proposals with a focus on CO2 emissions and cost of mitigation. This assessment was completed by employing Integrated Resource Planning to establish the least cost generation development path for the Queensland region under varying conditions, policies and carbon tax regimes.

Education

Qualifications

Company Directors Course Diploma
Australian Institute of Company Directors, 2009

Bachelor of Engineering in Electronics
Bachelor of Information Technology
Queensland University of Technology, 1999

Courses

Finance for Non-Financial People
Chifley Business School, 2008

Professional Memberships

- Graduate Member of the Australian Institute of Company Directors (2009)
- Member of The Association of Professional Engineers, Scientists and Managers, Australia (1999)

Publications (since 2005)

Papers

- Bean, R., Vanderwaal, B., 'Calculation of Minimum Reserve Levels for the Australian National Electricity Market', 17th Power Systems Computation Conference, Stockholm, 22-26 August 2011
- Peard A., Vanderwaal B.J., 'Calculation of Minimum Reserve Levels and their Application to Maintain Reliability of Supply in the NEM', EESA Conference, Melbourne, 16-18 August 2006

Presentations

- Vanderwaal B.J., 'Delivering Reliability of Supply in a Market Environment', Program for Research in Energy and Emissions Markets (PREEM), University of Technology Sydney, Wednesday 9th March 2011
- Vanderwaal B.J., 'Electricity Market Design and Operation & Project Economics', Queensland Department of Energy, Brisbane, 26-27 November 2007
- Vanderwaal B.J., 'Electricity Transmission Planning and Pricing', IBC Gulf Conferences, Dubai, 23-24 March 2008
- Vanderwaal B.J., 'Energy Supply Planning, *How do the models work and why are they required?*', IBC Gulf Conferences, Dubai, 25-27 March 2008

Andrew Turley

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Employment

Principal – Market Modelling, *ROAM Consulting*
March 2005 – Present
Brisbane, Australia

With my commercial background, with specialised knowledge in Information Technology systems, I have been the principal market modeller on a wide range of market forecasting consultancies. I am the chief architect of many of the Excel based analysis tools which support the ROAM enterprise day to day, and have developed a number of standalone market models specific to client requirements.

I have recently been acknowledged for my significant contribution provided to the Treasury for the modelling of the Federal Government's current Carbon Policy.

Recent major projects in the past eighteen months have included the following, many of which have published reports and findings in the public domain:

- **Treasury:** Author and Principal Analyst for ROAM's 116 page report which supported Treasury's modelling of the Carbon Policy as one of two expert consultants. Numerous scenarios and sensitivities were modelled, with a comprehensive suite of results provided to Treasury's staff.
- **Ergon Energy:** Long term price forecasting of Renewable projects in Queensland
- **AEMC**: Reliability Standard and Settings Review
- **AEMC:** Extreme Weather Review
- **AEMC:** Assessment of Generator TUOS
- **Powerlink, ElectraNet SA, Western Power:** Scenario Analysis for generation development over the next decade for support of TNSPs revenue proposal applications
- **RIO Tinto/Alcan:** Detailed analysis of Tasmanian transmission network and impact of load development
- **Roaring 40s:** Development of customised Wind Farm Congestion Analyser software model, designed to identify the capability of wind farms to deliver energy in constrained transmission networks
- **2-4-C Lite** software model – customisable market modelling software package within the Excel framework for detailed dispatch modelling. Includes market dispatch engine, supporting user interfaces, input data, results analysis tools
- **Other Projects:** Dynamic bidding development for 2-4-C forecasting package, DC Load Flow application development for intra- and inter-regional transmission flows, analysis of GEC and RET markets, Independent expert on

	NEMMCO market directions compensation determination
School of Economics and School of Business Tutor, *University of Queensland* March 2005 – June 2005, July 2002 – July 2004 Brisbane, Australia	
	Official University Tutor of subjects including Microeconomics, Macroeconomics, and Computer Based Information Systems.
Subcontractor, IT Consultant, *ClienTel Connection Ltd* October 2004 – December 2004 Surrey, UK	
	Maintenance, support and development of existing infrastructure and technology. General reporting of financial and operational sections of the organisation to upper management.
Web-Application Developer, *Generic Solutions Pty Ltd* March 2003 – July 2004 Brisbane, Australia	
	Principal developer of web-based applications in computer languages including ASP, JavaScript and VBScript, utilising MS SQL 2000 database connectivity.

Education

Undergraduate

- Bachelor of Commerce (GPA 5.7)
  Bachelor of Information Technology (GPA 6.1)
  (University of Queensland) 2004
- Faculty of Business, Economics and Law Dean's Honour Roll 2004.
- *Award for Outstanding Academic Excellence*

Skills and Proficiencies

General Software

- Microsoft Office applications, including a high proficiency in the development and deployment of complex **Microsoft Excel** spreadsheets and VBA applications

Commercial Electrical Engineering Applications

- Powerworld™ Power Flow Software

Programming Languages

- ASP
- JavaScript
- VBScript
- PHP
- C++
- Visual Basic

Databases

- Microsoft SQL Server 2000/7.0
- Microsoft Access