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How to Make the Finkel Electricity Plan Work

A report recommending two enhancements to the Finkel electricity plan

26 September 2017

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1 Executive Summary

1.1 This report has been prepared in the public interest as a community service. It is aimed at providing new options for government to tackle the big issues in the National Electricity Market that have not been adequately addressed over the past decade. If left unaddressed, these issues threaten to derail the Australian electricity industry and consequently the Australian economy in the near future.

1.2 In preparing the Finkel report, the panel has gone into a great amount of detail and in the view of the author missed some critical opportunities to address some very specific high level issues in play in the National Electricity Market (NEM). Two additions to the Finkel plan recommendations are the focus of this report. These recommendations are designed to address the challenge of generation capacity shortfalls that are now evident in the NEM regions of South Australia and Victoria. These generation capacity shortfalls are likely to worsen and spread to other states unless addressed as a priority.

1.3 It is evident from recent pool and wholesale markets price increases that all is not well in the NEM for electricity customers. The Australian Energy Market Operator's (AEMO) two year Reserve Capacity Medium Term Outlook for South Australia and Victoria points to critical future vulnerabilities in the NEM. Understanding how the existing system of electricity markets and rules delivered these undesirable outcomes is the key to providing long term solutions to these problems.

1.4 In this report, historic pool pricing data has been analysed with the aim of understanding how market forces within the NEM led to the closure of the Northern (Port Augusta) Power Station without providing replacement MW capacity support for South Australia. Similar pool pricing data is provided showing the economics in play associated with the retirement of the Hazelwood Power Station on Victoria.

1.5 The Finkel plan as it stands leaves most of NEM fundamentals unchanged. The pool energy only market remains unchanged and the Large Scale Renewable Energy Target (LRET) Scheme is replaced by a mostly similar scheme called the Clean Energy Target.

1.6 Although the Finkel plan calls for a change from the LRET scheme to a Clean Energy Target or an Emissions Intensity Scheme (EIS), in the author's view all three schemes have the same inherent weakness. They encourage and reward intermittent non-despatchable renewable generation output at all times of the day regardless of the customer need for electricity. This creates a disconnect between clean energy market forces and the electricity customer need for a continuous supply/demand balance.

1.7 This report proposes two major additions to the Finkel plan aimed at creating a new scheme that can be successful and sustainable in the medium and long term. The recommendations are:

a) adding a capacity market to the existing pool market.

b) Incorporating a "Clean Energy NEM Integration Scheme" in lieu of the LRET and the Clean Energy Target Schemes.

1.8 Both of these recommendations build on the base prepared by the Finkel plan. The changes will provide pricing signals that will guide investments into building an economic reliable power system with low carbon emissions.

1.9 The Finkel review (box 3.1) considered the capacity market options. The review stated that "such a reform should only be considered in circumstances of irresolvable failure of the energy-only market to bring forward sufficient new capacity to ensure reliability." In view of the market circumstances detailed in this report for the Northern Power Station and the Hazelwood Power Station closures without providing new despatchable capacity, market failure within the energy only NEM is apparent and needs to be corrected quickly before the process is repeated with the proposed Liddell Power Station closure in 2022.

1.10 Implementing the Finkel plan without these changes makes the future NEM economic drivers almost identical to the existing NEM drivers. Without significant reform, the electricity sector is likely to progress along the existing path of high prices, shortages of despatchable capacity with high risks of large scale blackouts. The likelihood is that investments in generation will not meet customer needs in terms of price, reliability and capacity.

2 Introduction

2.1 This report has been prepared in the public interest as a community service. It is aimed at providing new options for government to tackle the big issues in the National Electricity Market that have not been adequately addressed over the past decade. If left unaddressed, these issues threaten to derail the Australian electricity industry and the Australian economy in the near future.

2.2 The Finkel plan[1] put forward 50 detailed recommendations to shore up the National Electricity Market (NEM) to provide reliable supply into the future. Many of the recommendations are administrative in nature, clarifying and redefining the roles of existing key electricity industry bodies including the Australian Energy Regulator (AER), the Australian Energy Market Operator (AEMO) and the Australian Energy Market Commission (AEMC).

2.3 The Finkel plan also recommends the creation of a new Energy Security Board to provide oversight of energy security. Other Finkel recommendations cover a range of technical initiatives designed to stabilise the NEM and improve reliability and security of supply.

2.4 In preparing the Finkel report, the panel has gone into a great amount of detail and in the view of the author missed some critical opportunities to address some very specific high level issues in play in the National Electricity Market (NEM). Superior outcomes can be achieved by analysing and responding to some of the general overriding problems relating to incentivising new and replacement generation. No amount of administrative and operational controls alone can create a world class power system if the underlying investment drivers create a mix of generation that cannot economically and technically provide the MW capacity and MWh energy needs of the customers.

2.5 Two additions to the Finkel plan recommendations are the focus of this report. These recommendations are designed to address the challenge of generation capacity shortfalls that are now evident in the NEM regions of South Australia and Victoria. These generation capacity shortfalls are likely to worsen and spread to other states unless addressed as a priority.

2.6 It is evident from recent pool and wholesale markets price increases that all is not well in the NEM for both electricity customers and some base load generators. The Australian Energy Market Operator's (AEMO) two year Reserve Capacity Medium Term Outlook for South Australia and Victoria points to critical future vulnerabilities in the NEM. Understanding how the existing system of electricity markets and rules delivered these undesirable outcomes is the key to providing long term solutions to these problems.

2.7 In this report, historic pool pricing data has been analysed with the aim of understanding how the NEM led to the closure of the Northern (Port Augusta) Power Station without providing replacement MW capacity support for South Australia. Similar pool pricing data is provided showing the economics in play associated with the retirement of the Hazelwood Power Station on Victoria.

3 Why the Finkel Plan needs Refinement

3.1 The Finkel plan as it stands leaves most of NEM fundamentals unchanged. The pool energy only market remains unchanged and the Large Scale Renewable Energy Target (LRET) Scheme is replaced by a mostly similar scheme called the Clean Energy Target.

3.2 The two key opportunities explored in this report are:

a) splitting of the existing energy only market to a combined capacity and energy market.

b) integrating of the Finkel proposed Clean Energy Target (CET) into the pool energy market.

3.3 Implementing the Finkel plan without these changes makes the future NEM economic drivers almost identical to the existing NEM drivers. Without significant reform, the electricity sector is likely to progress along the existing path of high prices and shortages of despatchable capacity. The likelihood is that investments in generation will not meet customer needs in terms of price, reliability and capacity.

3.4 Although the Finkel plan calls for a change from the LRET scheme to a Clean Energy Target or an Emissions Intensity Scheme (EIS), in the author's view all three schemes have the same inherent weakness. They encourage and reward intermittent non-despatchable renewable generation output at all times of the day regardless of the customer need for electricity. This creates a disconnect between clean energy market forces and the electricity customer need for a continuous supply/demand balance.

4 NEM Insights from the Closure of the Northern Power Station in South Australia

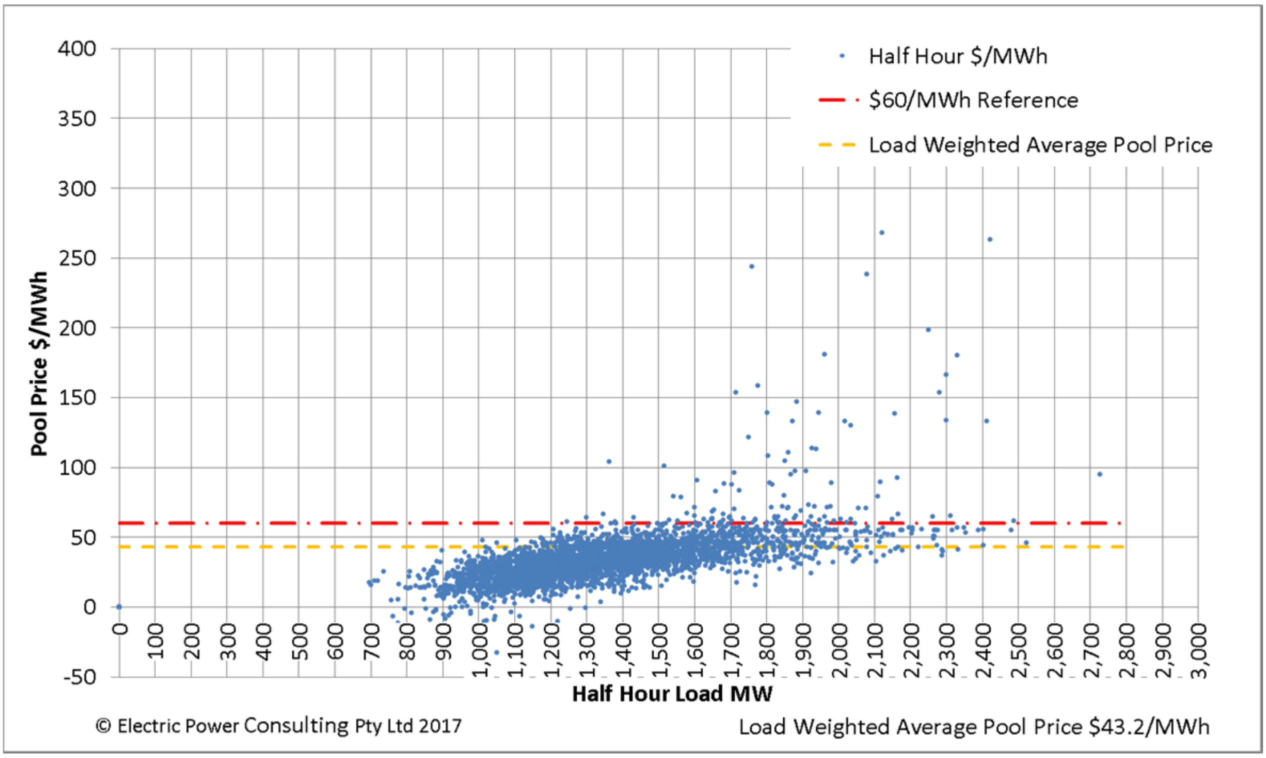
4.1 Analysis of South Australian Pool Prices

4.1.1 The closure of the Alinta Northern Power Station in South Australia provides some very important insights into the operation of the NEM. Insights can be gained on the economic conditions being faced by Alinta at the time the decision was taken to close the power station by analysing South Australian electricity pool prices. An Electric Power

Consulting (EPC) model is used to provide some assessment of the impacts of large scale wind generation in the South Australian market.

4.1.2 Figure 1 shows South Australian pool prices in the form of a scatter graph against the South Australian load. Each dot represents a ½ hour time interval in the 2014/15 financial year. The 2014/15 period was the lead up period when Alinta made the decision to close down the Northern Power Station. The announcement to retire the power station was made on 11 June 2015. The power station ceased operation on 12 May 2016.

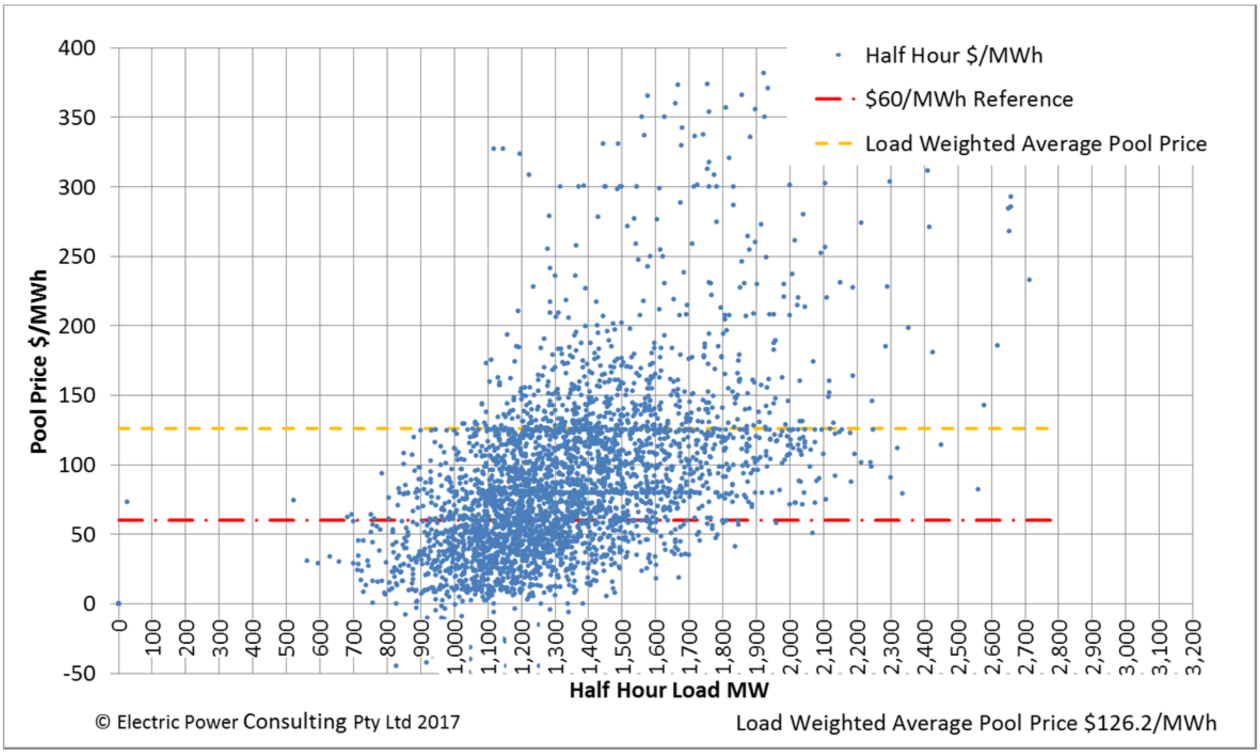
Figure 1 - South Australia 2014/15 Pool Price Scatter Graph



4.1.3 With a brown coal power plant like Northern, the short run marginal cost of operations would be expected to be in excess of $60/MWh, dominated mainly by fuel costs. During 2014/15 the load weighted average price of electricity was $43.2/MWh. The scatter graph shows that most of the time the pricing was well below $60/MWh. At these prices, Alinta would have not been able to recover even their marginal cost of production let alone make any contribution toward their fixed costs. The pressure on the plant to cease operation to cut the losses would have been immense. It is noted that the retirement decision was taken on 11 June 2015 at the end of this period in the knowledge of what is shown in Figure 1. It is evident that high penetration of South Australia wind generation had been a significant part of keeping pool prices low over the preceding 12 months. This is a clear case of technological disruption, something that all business have to contend with in the modern business world.

4.1.4 By contrast, Figure 2 shows the South Australian pool prices in the period 2016/17. This is the first full financial year after the power station was removed from service on 12 May 2016. The impact of wind generation on pool prices is evident with many of the half hour interval prices still below $60/MWh similar to the period below the closure. However, without the Northern Power Station bidding into the pool, prices at other times escalated dramatically. The South Australia load weighted average price increased to $126.2/MWh. That is a 192% price increase on 2014/15 levels. South Australians are now paying much more for electricity due to the change. Unsustainably low pool prices for a coal generator before the power station closure followed by very high prices after the closure is clear evidence of NEM market failure. Pool price pressures on the Northern Power Station contributed greatly to its closure. The power station closure left the South Australia region short of capacity that caused a spike in pool pricing that has and continues to adversely impacted on electricity customers in South Australia today.

Figure 2 - South Australia 2016/17 Pool Price Scatter Graph



4.1.5 The issue is not the retirement of the power station. No generator is immune from economic pressures when revenues do not cover short run marginal costs. The critical market failure is the energy only market comprising the NEM in combination with the LRET, forcing the power station closure without providing replacement MW capacity to replace it in time before the closure. New market structures are needed to prevent this type of market failure event happening again.

4.2 How the Energy Only Market Incentivises the Construction of New Generation Capacity

4.2.1 The operation of the electricity pool before and after the closure of the Northern Power station illustrates how the energy only market results in short term electricity price volatility and delayed pricing signals for investment in new generation capacity.

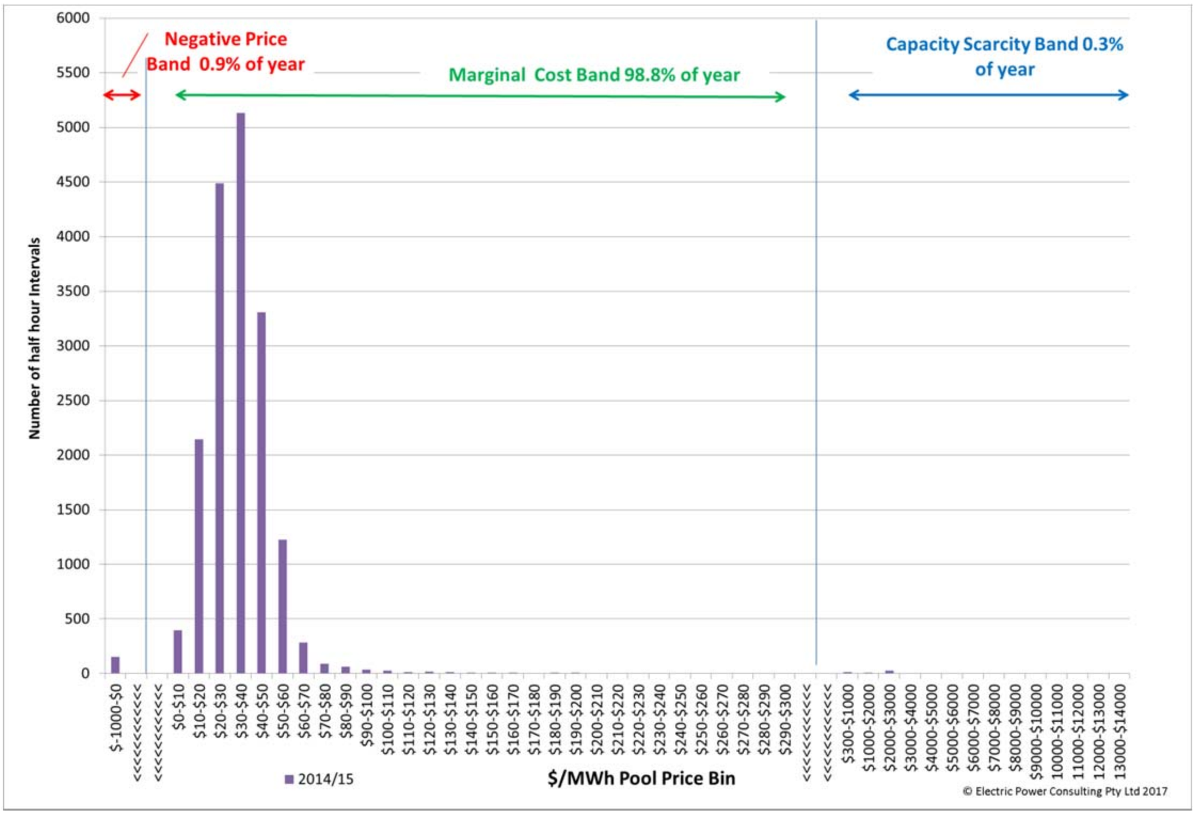
4.2.2 Figure 3 shows the frequency of pool prices in the specified bins. It should be noted that for convenience and display purposes, a number of $ bin sizes have been used. For convenience three bands have been defined as detailed below:

a) **Negative Price Band:** this represents the half hour periods of the year where pool prices are negative. Generators pay to keep their machines on line. These times generally occur when loads are very low and coal fired plants find it more economic to keep running rather than shut down and restart at a later time. During 2014/15 this only occurred for 77 hours or 0.9% of the year.

b) **Marginal Cost Band:** this represents the half hour periods of the year where pool prices reflect the highest marginal cost of the generation plant required to meet customer demand. These times reflect normal pool operation and in the case of 2014/15, this band represents 98.8% of the year. This band has been defined by the price range $0 to $300/MWh.

c) **Capacity Scarcity Band:** this represents the half hour periods of the year where pool prices are well in excess of the marginal cost of the normally operating generation plant. These times reflect generation shortfalls where generators can bid in opportunistic prices that reflect the value customers place on receiving a continuous electricity supply. During 2014/15 this band occurred for only for 24 hours or 0.3% of the year. This band has been defined by the price range $300 to $14,200/MWh.

Figure 3 – South Australia Pool Price Frequency Distribution 2014/15
(mostly prior to the Northern Power Station closure announcement**)**



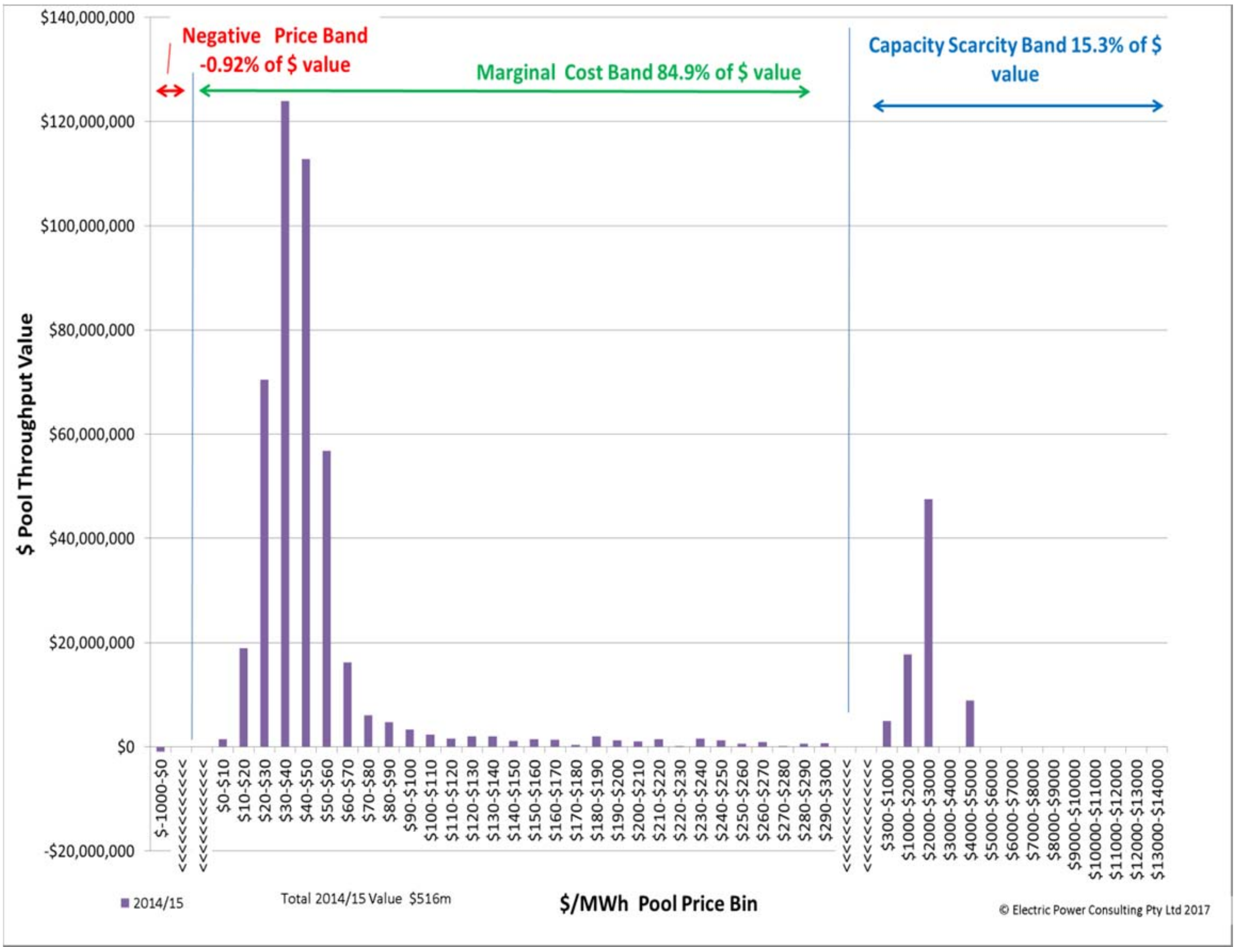
4.2.3 Figure 3 shows that electricity pool pricing stayed in the Marginal Cost Band most of the time and very small times in the Negative and Capacity Scarcity bands.

4.2.4 Figure 4 shows the $ value of electricity traded through the South Australia pool for the same 2014/15 year and bin sizes as Figure 3. Each bar is the summation of price times quantity within each bin.

4.2.5 While most of the NEM value traded through the Marginal Cost Band (84.5%), 15.3% of $ value traded through the Capacity Scarcity Band. Due to the high $/MWh rates, 0.3% of the time in the Capacity Scarcity Band magnifies to 15.3% of $ traded value. The traded value in the Capacity Scarcity Band is a most important signal to investors that additional generation capacity may be both economic, viable and required for the future operation of the NEM.

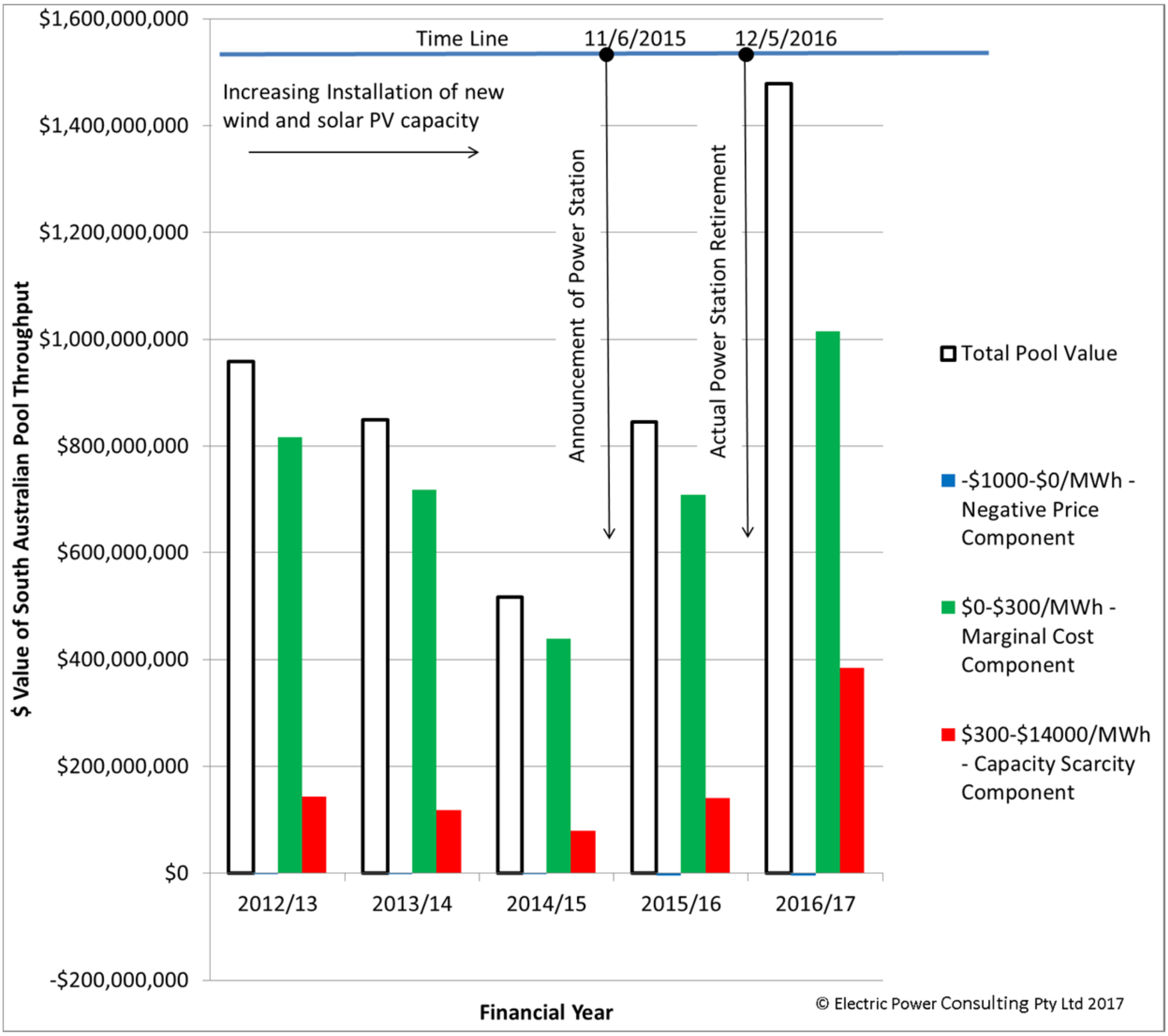
4.2.6 Even small increases in the time spent in the Capacity Scarcity Band can greatly magnify the $ returns received by generators through the pool. This is the main mechanisms for high prices and volatility in the NEM from hot weather induced high customer loads, equipment failures and other system abnormalities.

Figure 4 – South Australia Pool $ value Price Frequency Distribution 2014/15
(Mostly prior to the Northern Power Station closure announcement)



4.2.7 Figure 5 shows annual traded $ value through the South Australian pool for the five financial years 2012/13 to 2016/17 broken up into the three component bands defined above. The negative price components for all years are relatively small but have grown in 2014/15 and 2015/16. This is likely to be related to higher wind farm and solar PV penetrations that have near zero marginal cost combined with additional income streams from the generation of LRET certificates.

Figure 5 – South Australia Pool Component $ Values 2012/13 to 2016/17



4.2.8 Figure 5 also shows rapidly declining revenues to generators in the years 2012/13, 2013/14 and 2014/15. The declines are in both the Marginal Cost Band and the Capacity Scarcity Band. At the time the decision was taken to close the Northern Power Station, the price signals from the energy only South Australian pool were consistent with over generation capacity and ongoing low pool prices. No market signals were evident that new generation capacity was required. Rapid increases in generator pool revenues in 2015/16 and

2016/17 show the effect of both the announcement of the power closure and the actual retirement of the power station.

4.3 Limitations of the Energy Only Market

4.3.1 In the South Australia example, pricing signals to build new despatchable generation capacity began with the announcement by Alinta of the power station closure and became abundantly clear after the power station closure. Price signals from the energy only market came too late to incentivise the construction of the new despatchable generation necessary to supply the market at reasonable prices. This situation has led to the likely capacity shortfalls for at least the next two summers that are evident by the AEMO forecast reserve shortfalls.

4.3.2 The South Australian example illustrates that in situations where old despatchable power stations retire with little notice, the energy only market has no mechanism for signalling the change with enough lead time to incentivise the construction of new despatchable generation in time to meet the shortfall. Historically where there has been adequate or abundant despatchable generation in the NEM, the energy only market has worked well because new investment in despatchable capacity has not been required.

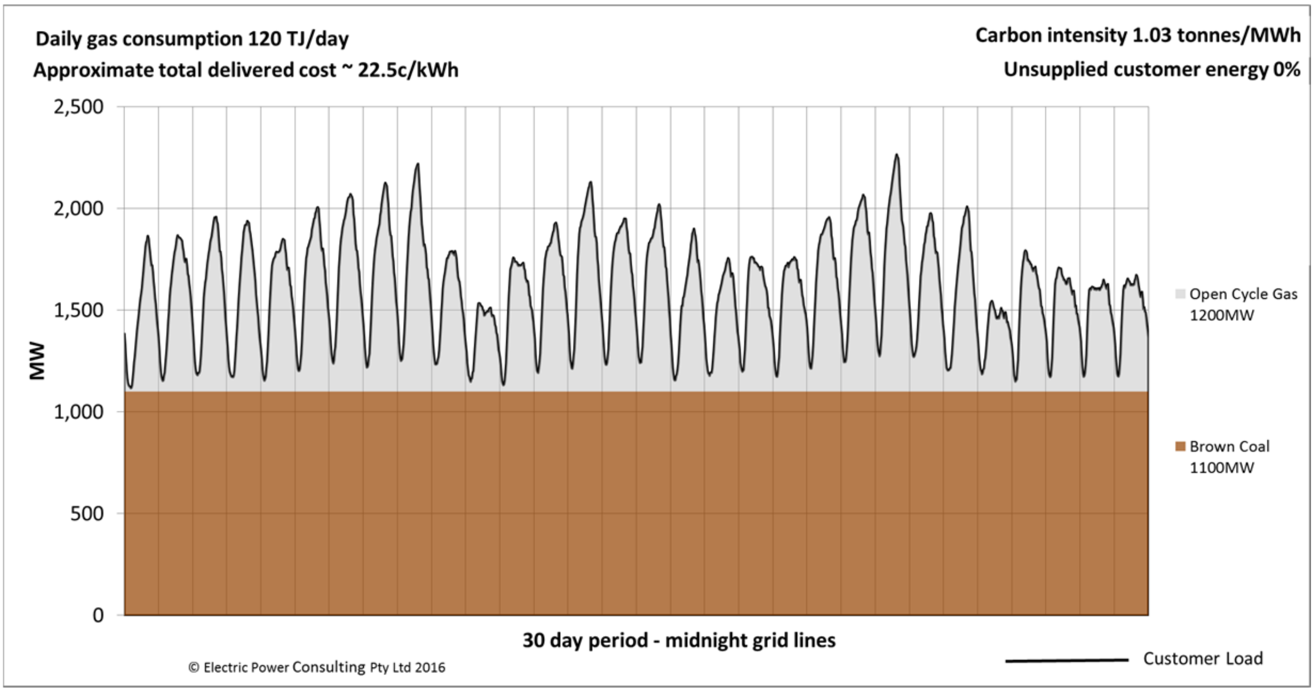
4.3.3 Now that older high cost despatchable generators are being challenged by intermittent renewable generators it is time to reassess the future of the energy only market. The energy only market is now operating in an environment that was never envisaged when the NEM was designed in the late 1990s.

4.4 Wind and Coal Generation Modelling

4.4.1 Modelling was undertaken to illustrate the interaction of wind generation in a power system about the size of the South Australia system with base load brown coal generation. The quantities shown in the modelling for delivered $ cost/delivered kWh, gas consumption and carbon intensity are approximate only and are the result of many assumptions and generator bidding strategies that are beyond the scope of this report. The figures shown should be used only for comparison purposes between modelled scenarios.

4.4.2 The essence of the interactions shown in the model is relevant to the South Australian situation. Figure 6 shows modelling with no wind generation and shows that base load brown coal operates efficiently up to level of the daily minimum load that typically occurs about 3:00am each day. The system load is shown for 30 days as the black line with the vertical gridlines placed at the midnight position. Open cycle gas is used in the model for peaking purposes. This represent the conventional generation mix with no intermittent renewables.

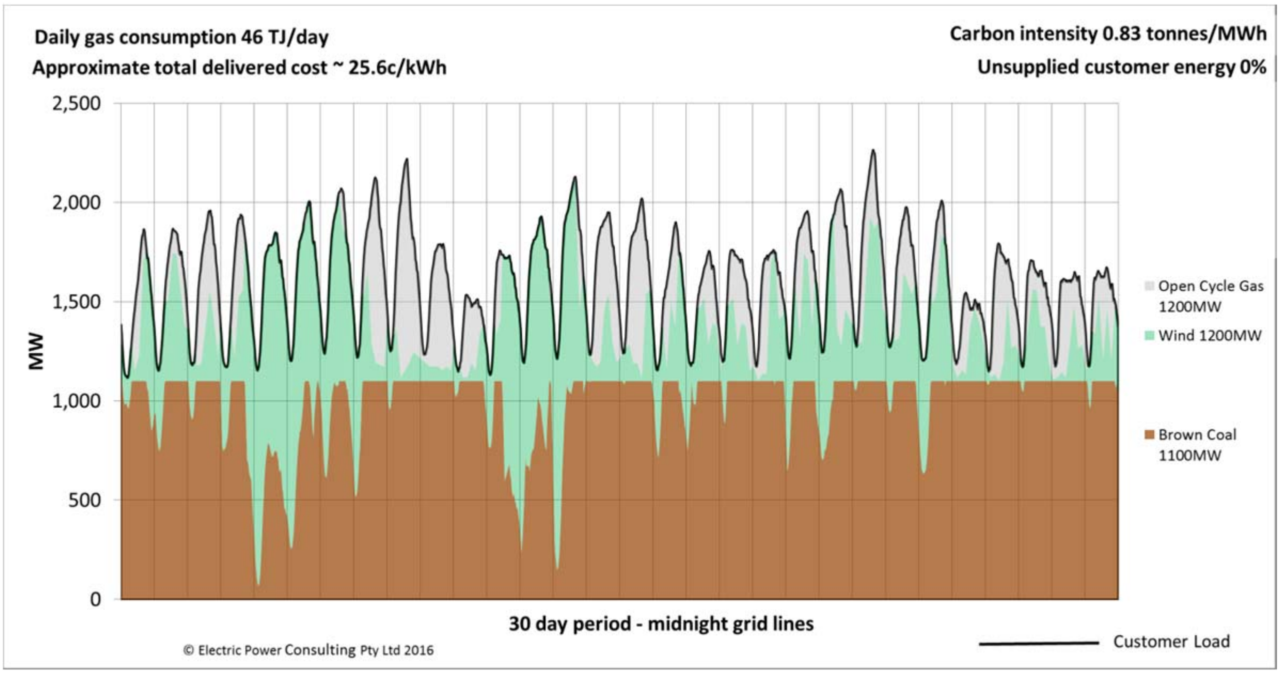
Figure 6 - EPC Generation Mix Model - Brown Coal with Open Cycle Gas and no Wind



4.4.3 Figure 7 shows the same system loads with large scale wind added to the generation mix. Enough wind generation has been added to generation mix to supply the peak load when the wind farms are operating at maximum output. The modelling shows that depending on the level of wind and the load, the brown coal plant is forced to ramp output up and down to uneconomic and unviable levels on a regular basis. Brown coal generation plants are not designed to operate in this environment. This scenario is not dissimilar to the situation faced by the Northern Power Station for the three year period prior to its closure.

4.4.4 Where intermittent wind generators reach output levels where they can supply near full load at times of peak output, major operational problems occur with the operation of the conventional base load plants. High wind penetration prevents base load generators operating near constant full output over long periods of time. This destroys the conventional business model and financial viability of the brown coal plant causing it to lose economic viability and then close. After closure of the coal plant, the wind generation cannot supply the load when wind speeds reduce to low levels causing a greater reliance on gas generation and a steep increase in pool prices. The result is higher average electricity costs. This is consistent with the Northern Power Station closure outcome.

Figure 7 – EPC Generation Mix Model - Brown Coal with Open Cycle Gas and High Penetration Wind



4.4.5 This is the scenario that needs to be kept in mind when developing new market structures. The closure of the Northern Power Station is not the major factor in assessing the effectiveness of the NEM. Competition from new technology is a tenet of modern business and needs to be accepted and encouraged where it leads to better outcomes for customers. The problem with the NEM in its present form is that it is encouraging investment in intermittent wind and solar PV generation that can damage the economic viability of base load power stations without providing the capability to replace the baseload output. Customers are being disadvantaged in the process.

4.4.6 The Northern Power Station closure highlights that a successful NEM needs:

a) market mechanisms to provide advance notice of large plant closures.

b) to incentivise new replacement despatchable capacity prior to old plant retirements.

c) market structures that encourage a mix of generation technologies that provide electricity supply reliability at low economic cost.

d) to prevent intermittent generation technology damaging the business model of despatchable generation that is needed to provide firm capacity to the NEM.

e) to provide electricity price stability.

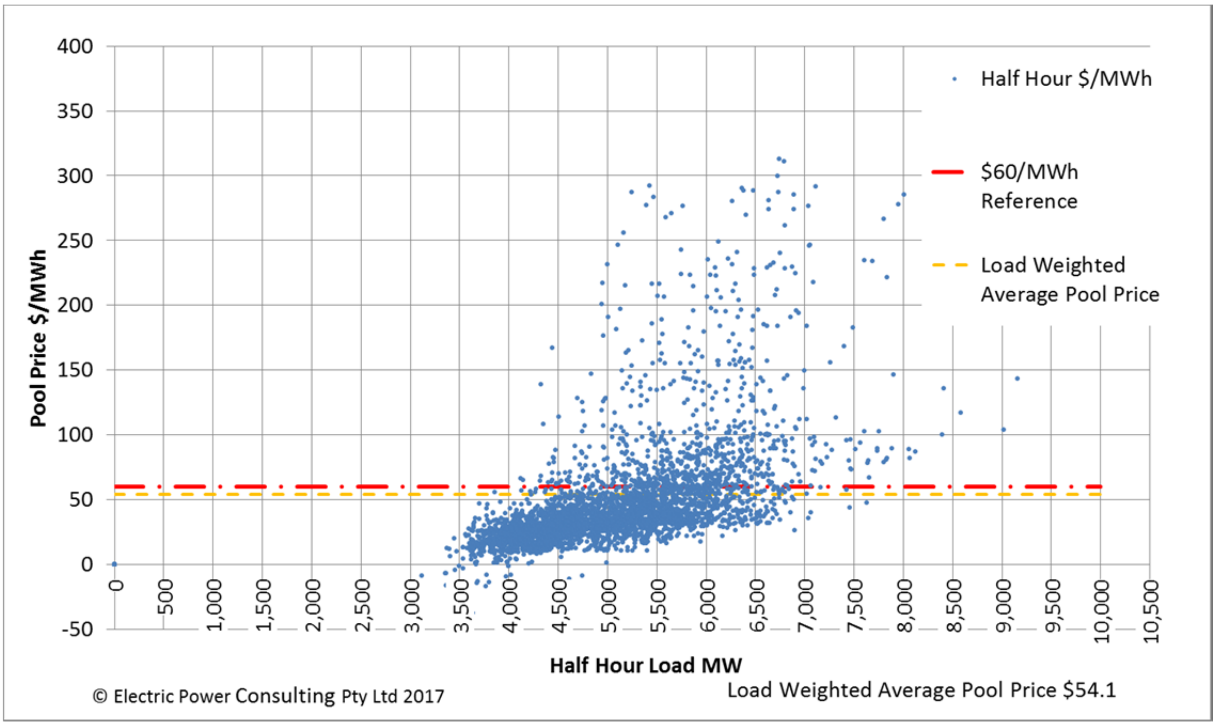
4.4.7 This report is aimed at providing mechanisms to delivering these outcomes.

5 NEM Insights from the Closure of the Hazelwood Power Station in Victoria

5.1 Analysis of Victorian pool prices in the period prior to announcement of the Hazelwood Power Station closure through to the present shows very similar trends to the South Australian example.

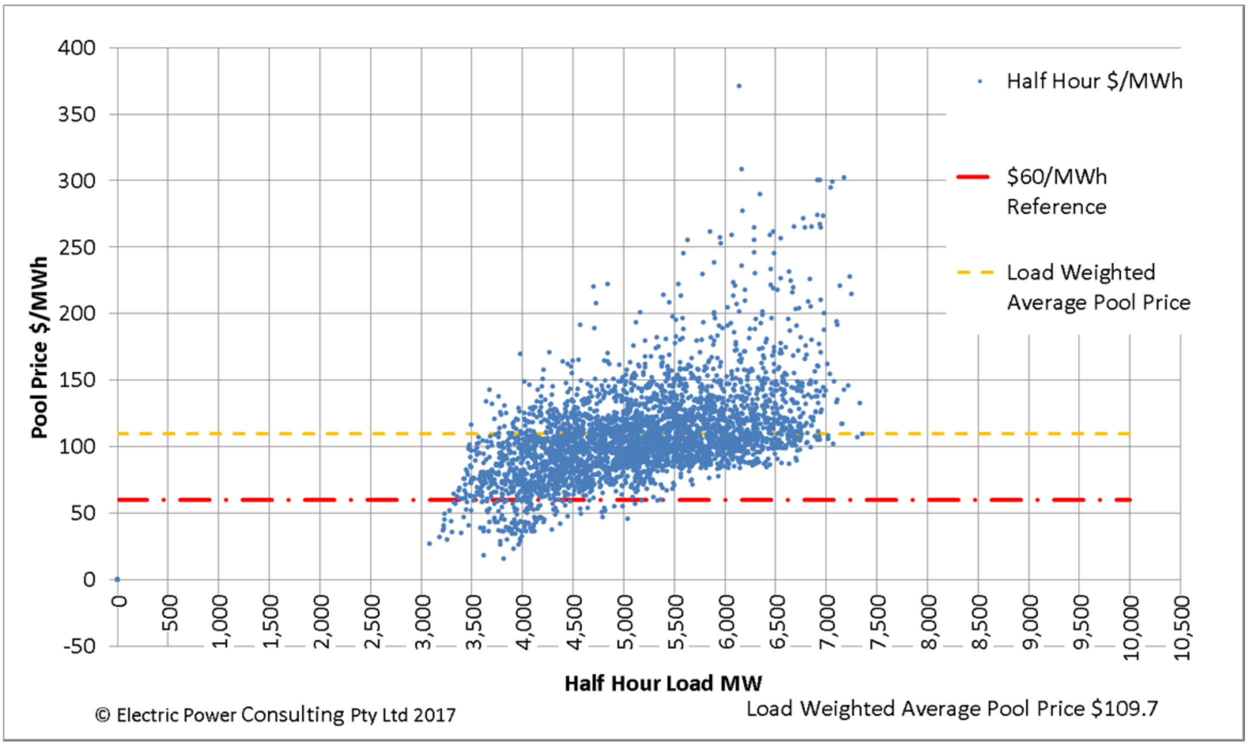
5.2 Figure 8 shows low pool prices in the 12 month period before the Hazelwood closure announcement. The load weighed average pool price is $54.1/MWh, well below the expected short run marginal cost of the power station.

Figure 8 – Victoria Pool Price Scatter Graph 4/11/2015 to 3/11/2016
(12 month period before the Hazelwood Closure Announcement)



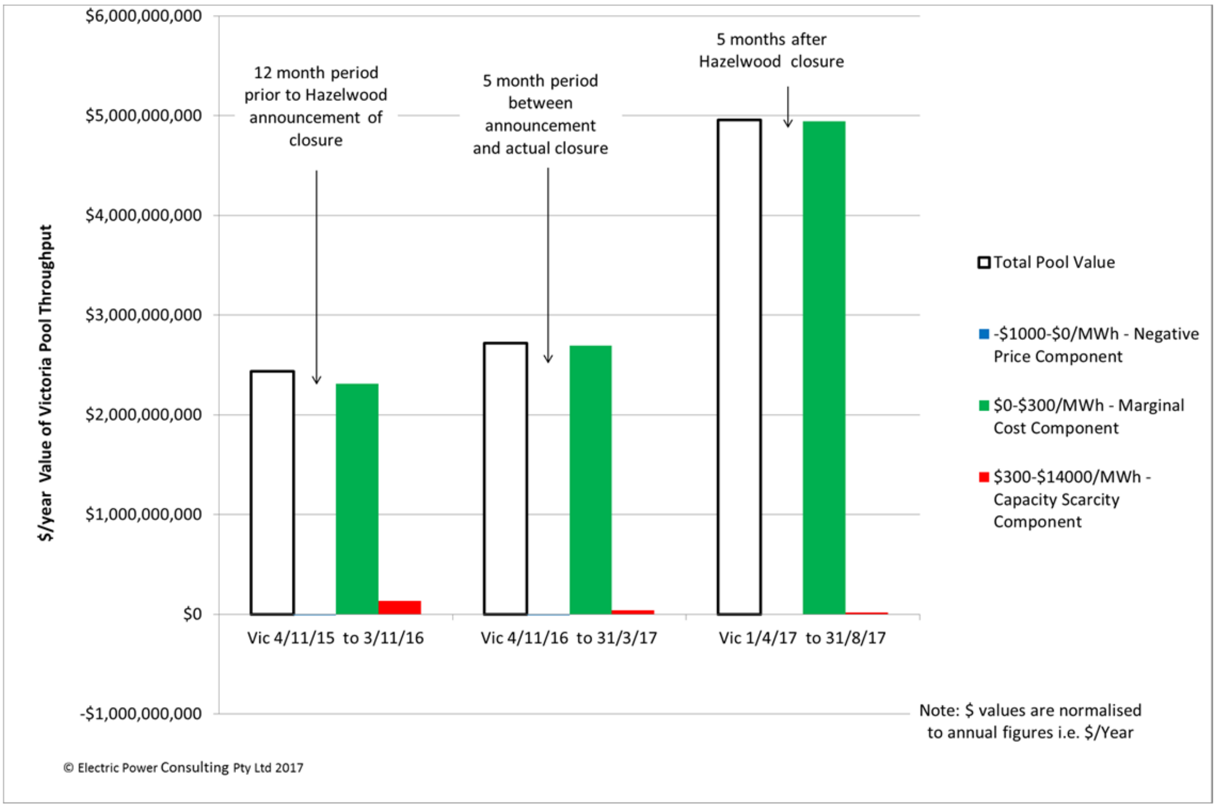
5.3 Figure 9 shows higher pool prices in the 5 month period after the actual Hazelwood closure announcement. Load weighed average pool price doubled to $109.7/MWh. It should be noted that this period does not include any summer months hence the likelihood of future elevated prices.

Figure 9 – Victoria Pool Price Scatter Graph 1/4/2017 to 31/8/2017



5.4 Figure 10 shows the Victorian pool components for the period before the closure announcement, the period between announcement and closure and the period after the closure. The closure of the Hazelwood Power Station has been associated with a steep increase in pool prices. This is further evidence that the energy only market has been a key ingredient in making the power station unviable and forcing closure without providing replacement capacity to meet the needs of the Victorian electricity customers.

Figure 10 – Victoria Pool Component Values



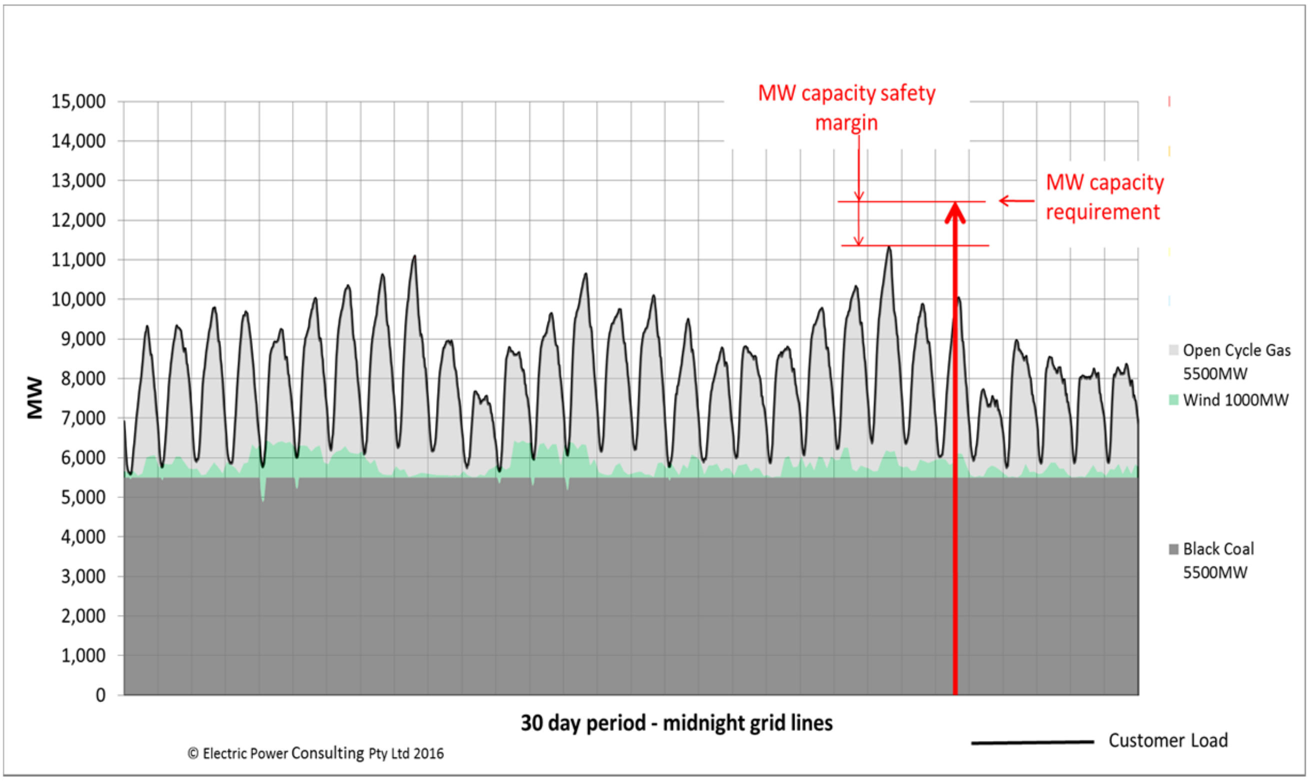
6 Why the NEM Needs a Combined Energy and Capacity Market

6.1 The Nature of Electricity Markets

6.1.1 The nature of markets is that suppliers and customers interact in ways that allow for an exchange of value. Under normal workings, interactions between customers and suppliers through the market mechanisms determines price, quantities and a specification of a product or services.

6.1.2 Electricity is a unique service that with current technology cannot economically be stored at grid scale (i.e. 1000s of MWs for days). Eventually this technology will evolve with batteries, large pump system schemes and/or other technologies. Although most electricity customers are charged on the basis of electric energy consumption (MWhs), they in fact only require electric energy at times when they want to use it. This leads to the concept of MW capacity. In the load curve shown in Figure 11, the MWh energy customers need is represented by the area under the curve shown in light grey (open cycle gas) and dark grey (black coal) while the MW capacity with a safety margin required to meet customer needs is represented by the arrow. Safety margins in the order of 10%-20% are indicative of levels used throughout the world.

Figure 11 - the Concept of Energy and Capacity



6.1.3 To meet customer needs, the power system must deliver both energy and capacity as the customer loads require. This means providing adequate MW capacity at times of maximum load in addition to matching the instantaneous supply demand balance at all times.

6.1.4 Since the formation of the NEM in the late 1990s it has operated as an energy only market. While marginal costs for most fossil fuel generators are in the $50-$150/MWh range, the NEM allows prices to increase to a Market Cap of $14,200/MWh to reflect the customer Value of Lost Load (VoLL). This has the effect of incentivising generators to:

a) supply the NEM when customer demand is high; and

b) provide long term price signals for future power station investment.

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6.1.5 Until recent times, available generator capacity has been adequate or even in abundance throughout the NEM. Hence the long term investment signal has not been important. In an oversupplied electricity market with abundant generation capacity, the energy only market forces prices down toward marginal fuel cost levels, providing immediate short term benefits for customers.

6.1.6 The down side of the energy only market is that pricing signals for long term generator investments are indirect and can be masked by randomness in weather patterns, noise from short term changes like new wind generation, uncertainty in the political environment and changes to customer load characteristics.

6.1.7 Many of the problems surfacing on the NEM today are the direct result of potential new generators not receiving strong enough long term pricing signals to enable investment in new generation plants with adequate despatchable capacity five to ten years ago.

6.2 What Happens if the NEM Lacks Sufficient Despatchable Generation?

6.2.1 If the NEM lacks sufficient despatchable capacity in any region to meet the customer maximum demands, the result will be:

a) customer supply interruptions. and

b) very high pool prices that will eventually flow onto customers.

6.2.2 Figure 12 shows a modelled hypothetical arrangement whereby the grid is supplied by intermittent wind generators only. The area shown in green is the part of the customer load that the wind can supply. The area shown in red represents the load that must be shed because of insufficient generation at times of low wind. The area shown in yellow represents spillage whereby wind generation is available for dispatch but cannot be used because the customers do not need it. This is a case of the wind generators being able to provide enough energy to meet customer needs but not having the despatchable capacity to supply customer loads at all times.

6.2.3 With storage, such a system could theoretically be made to work. Figure 13 shows how energy storage could possibly be used to absorb the energy when generation exceeds customer demand and then provide that energy when customer demand exceeds the wind generation. This is a case where the combination of intermittent wind generation and the storage combine to meet both the customer energy and capacity needs. Such a scheme would need very large investments which may further increase the cost of electricity to end use customers. In this example the wind generator provided the energy while the storage provides the capacity.

Figure 12 – Modelled 100% Wind Generation - Energy and Capacity Issues

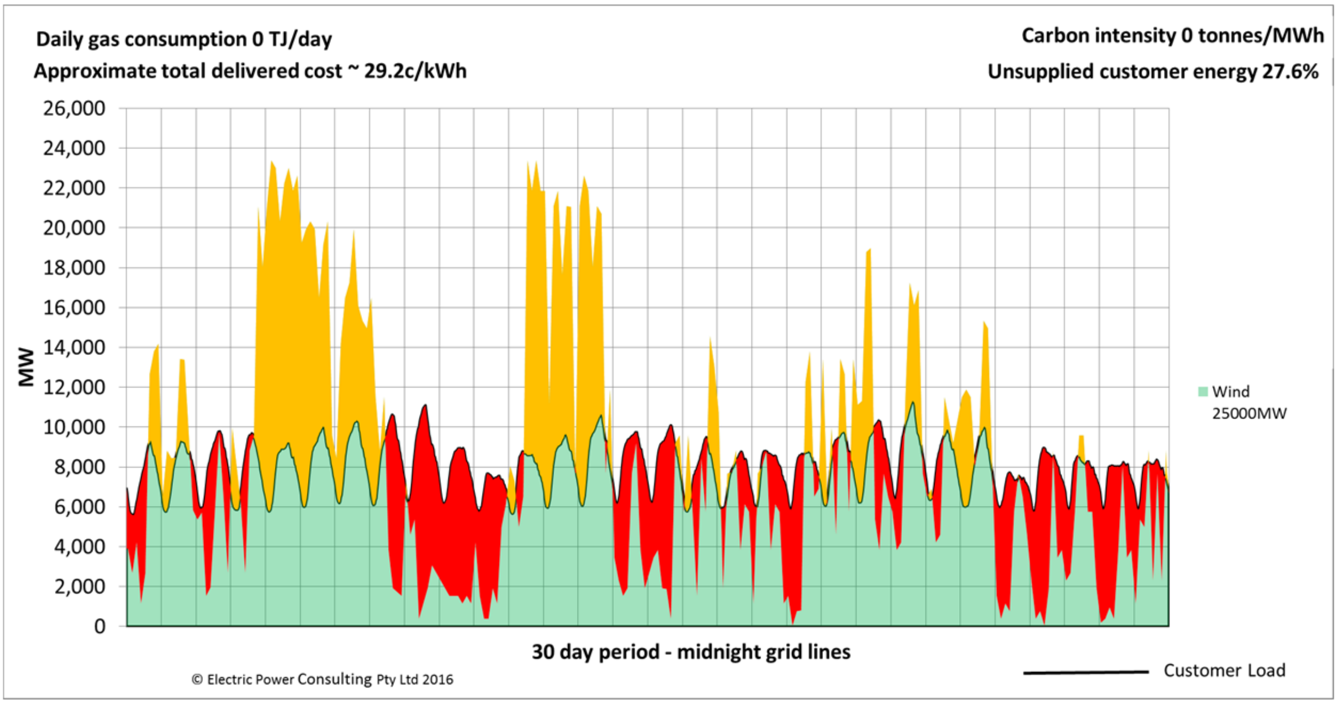
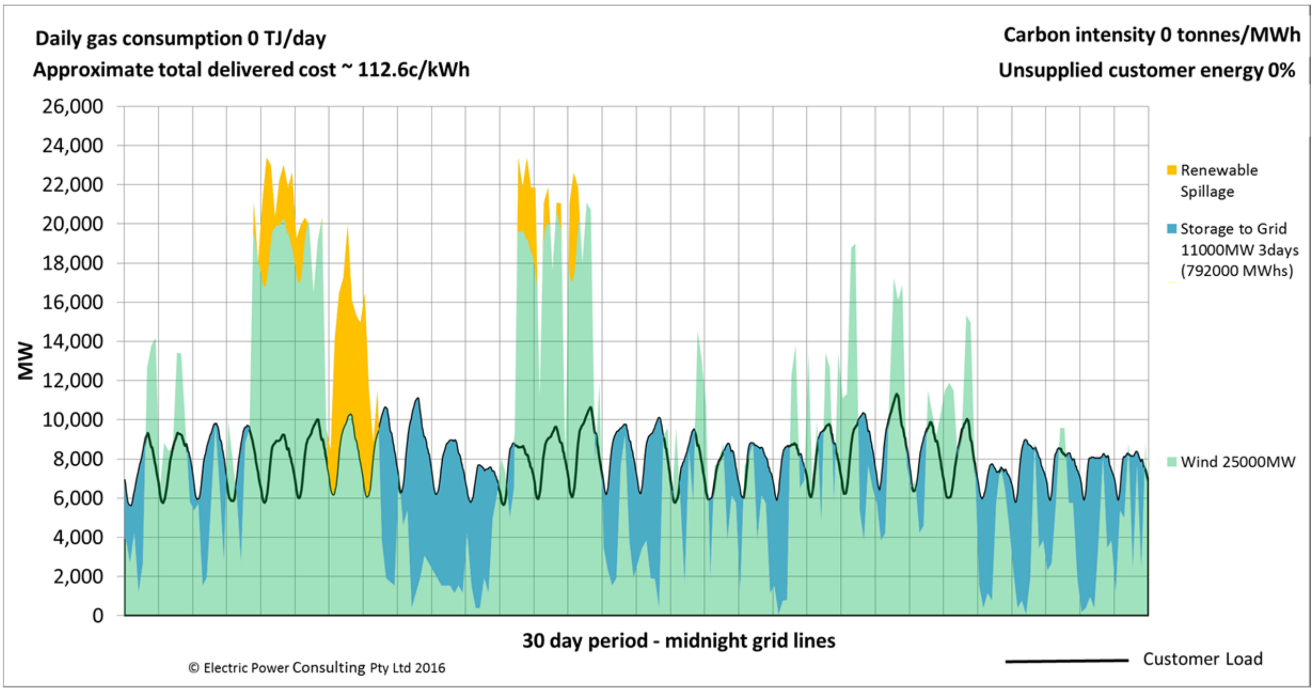


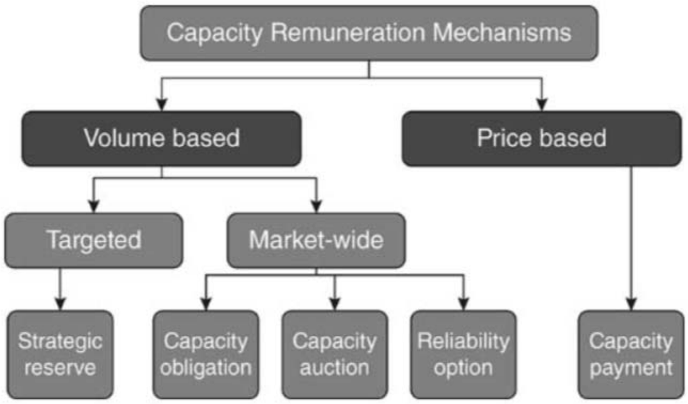
Figure 13 – Modelled 100% Intermittent Wind Generation with Storage



6.3 How does a capacity market operate?

6.3.1 Capacity markets come with a range of structures. The common element in all capacity schemes is that for a capacity payment ($/MW/year), generators commit to provide MW capacity to the market at some predetermined number of years in the future. Figure 14 shows the range of market types commonly used throughout the world. Generators who fail to meet their commitments under a capacity agreement generally face large penalties.

Figure 14 – Common Types of Capacity Markets



Source - Capacity Mechanisms in the EU Energy Market

6.3.2 Once committed to a capacity contract, the generator is obliged to bid their MW capacity into the energy pool. Because the energy market no longer needs to provide a cash flow to cover fixed costs or provide long term investment signals, the energy component of market can have a much lower cap (~$300/MWh in W.A.) compared to the cap on energy only market (now set at $14,200/MWh in the NEM).

6.3.3 Typically auctions are used to source capacity three, four or more years in advance, the aim being to provide sufficient lead time to build new generator capacity for the NEM.

6.3.4 On the customer/retailer side of a capacity market, customers pay for the capacity that they use. Typically this is based on a customer's contribution to the system MW maximum demand. Other charging mechanisms are possible.

6.3.5 The Finkel review (box 3.1) considered the capacity market options. The review stated that "such a reform should only be considered in circumstances of irresolvable failure of the energy-only market to bring forward sufficient new capacity to ensure reliability." In view of the market circumstances detailed in this report for the Northern Power Station and the Hazelwood Power Station closures without providing new despatchable capacity, market failure within the Energy Only NEM is apparent and needs to be corrected quickly before the process is repeated with the proposed Liddell closure in 2022.

6.4 What will Happen When a Capacity Market is Introduced into the NEM?

6.4.1 When introduced, a well-designed capacity market will change the way generator investment decisions are made. Capacity payments will create a higher degree of certainty for both customers and generators. Generators will be incentivised to build despatchable generation including conventional generation, pumped hydro and battery storage systems. Customer demand responses such as voluntary load shedding, load shifting, small scale generator and small scale battery output also need to be part of the capacity market.

6.4.2 Under a capacity market, if a generator was planning to exit the NEM, they would not bid their capacity into the market. In this way a capacity market would provide clear signals that a generator was planning to retire and exit the market giving many years advance notice. This is considered to be an excellent way of managing generator retirements consistent with the Finkel plan of requiring three year notice of generator retirements.

6.4.3 A well designed capacity market would provide the following:

a) certainty of available MW capacity for the NEM looking out at least three or four years ahead.

b) a lower cap on energy prices – less price volatility.

c) more cost and reliability certainty for customers.

d) less reliance on electricity financial instruments for generator/customer/retail controls.

e) certainty for financing and building new generation.

f) three or four years notices of generator retirements.

g) allow capacity contract trading between generators to cover contingencies and events not seen at the time of auction.

h) improve competition in the generation sector.

6.4.4 In the present environment with a shortage of generation capacity in some regions of the NEM, high $/MW/year capacity prices could be expected in the short term until the generation/load balance was restored. Over time it is expected that capacity prices would fall as an improved supply/demand balance is achieved.

6.4.5 Combined capacity/energy markets are more complex to manage than existing energy only markets. AEMO have demonstrated that they are capable of implementing such a market because they already have experience in Western Australia.

6.5 Where are Capacity Markets used around the World?

6.5.1 Capacity markets have been used in many large electricity markets for many decades. They are currently being used[2] or being planned for in Australia (Western Australia), United Kingdom, United States (PJM – Pennsylvania, New Jersey, Maryland), United States (Independent Operator new England), United States (New York Independent Operator), Spain, Portugal, Ireland, Greece, Italy, Ireland, Greece, Romania, France and many other countries throughout the world.

6.5.2 International experience[2] is showing that energy only markets have difficulty providing pricing signals that encourage the necessary investments in future long term generation capacity. When introduced, a capacity market will change the way generators invest and will place a very clear value on despatchability.

6.6 How Quickly Could A Capacity Market be Introduced into the NEM?

6.6.1 Realistically, if a plan were introduced in 2018, capacity auctions could be run for 2022. Such an auction would reset the entire electricity generation industry and set it up for certainty on a solid economic and engineering base.

6.6.2 Such a scheme would provide immediate benefits to the NEM by way of delaying the closure of existing fossil fuel power stations until replacement capacity can be sourced. The introduction of a capacity market would provide a “light” at the end of the tunnel that would assist in keeping critical generation in operation until replacements were in place.

7 Integration of the Finkel Clean Energy Target into the Pool Energy Market

7.1 LRET

7.1.1 The use of certificates from the LRET scheme has been a major driver for the push for grid scale renewable wind and solar PV generation in Australia. It has been so successful in achieving its objectives that most new generation built in the NEM over the past few years has been of the renewable intermittent generation type. With this success has come some unintended consequences.

7.1.2 Focussing mainly on wind generation because it represents the vast majority of grid scale renewable generation, the advantages and disadvantages of building high levels of wind in the generation mix are:

Advantages

a) very low carbon emissions.

b) generation of low cost MWhs at close to zero marginal cost

Disadvantages

a) intermittent generation – provides very little MW capacity when electricity customers need it.

b) forces despatchable generators to act as "dancing partners" lowering their efficiency and increasing their carbon emissions.

c) does not assist in matching generator output to customer demand.

d) needs battery, pumped hydro storage or similar to be as useful as despatchable generation.

e) damages the business model and financial viability of base load coal plants without the ability to replace them (as per the Northern Power Station scenario).

f) can lead to grid instability and major problems with grid protection , grid control and safe grid operations.

7.1.3 LRET certificates are created by renewable generators for all MWhs they produce. LRET certificates are valued on a market basis that can reach about $85/MWh. In addition to LRET certificate payments, wind farm and grid scale solar PV generators also receive a payment through the electricity pool. Hence renewable green grid scale renewable generators receive two income streams.

7.1.4 Figure 15 and Figure 16 shows an example of the two income streams in graphical form.

Figure 15 - LRET and Pool Value of for Large Scale Renewable Generations

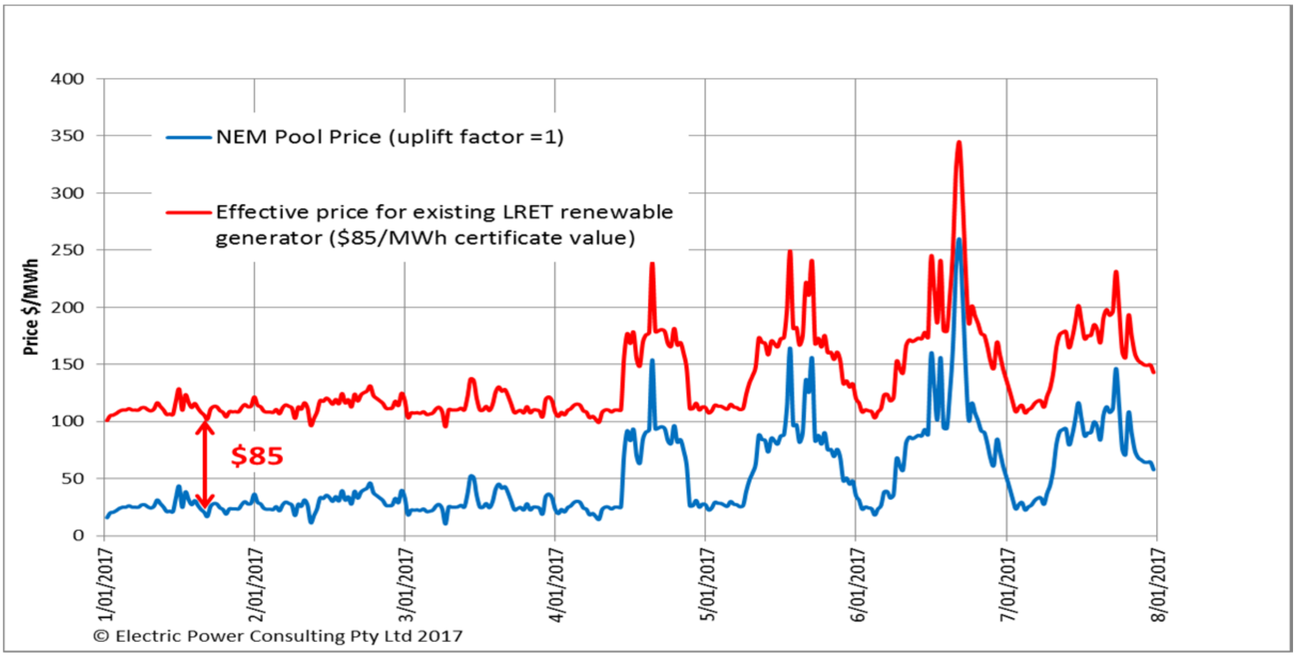
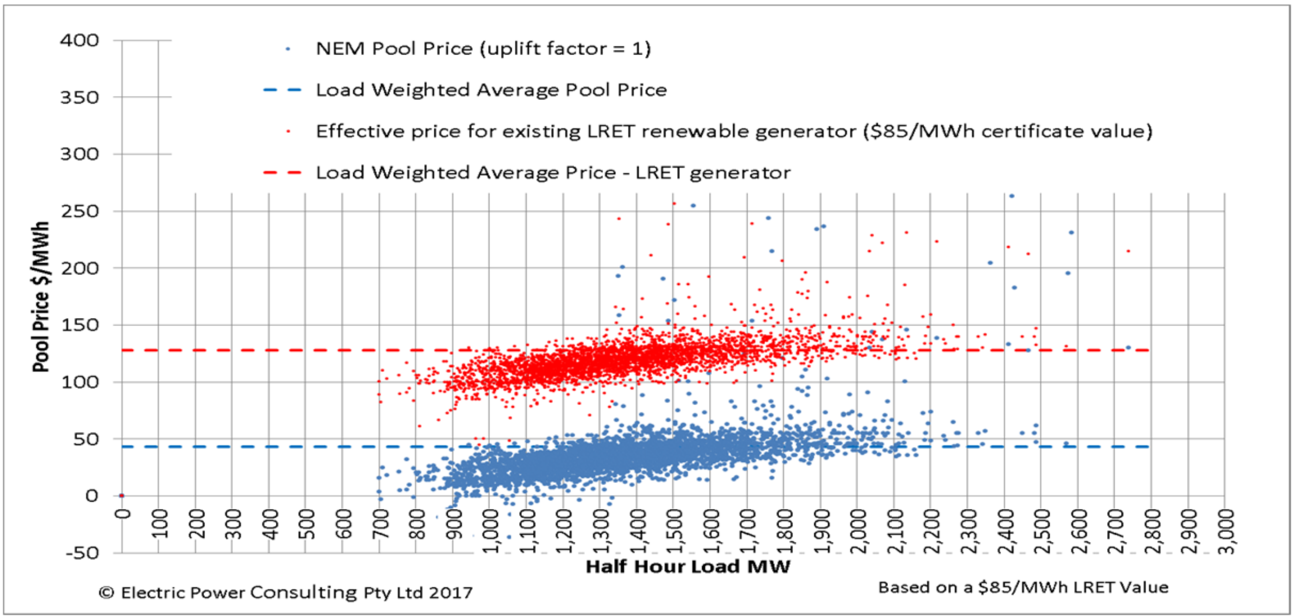


Figure 16 – Effective Renewable and Non-renewable MWh Pricing



7.1.5 Figure 15 and Figure 16 show that large scale renewable generator receive significantly more income ($/MWh) than conventional generators. For example, when the pool price is $40/MWh, the LRET generator receives $125/MWh which represents a price increase of 212%. At a pool price of $85/MWh, the LRET generators receives a price of $170/MWh, a price increase of 100%. These price increases have a substantial impact of end use customer electricity prices. As the percentage of wind energy increases, end use electricity customers can expect further increased costs.

7.1.6 The pool market provides price signals to all generators that are an essential element in matching load with supply. By contrast the LRET income stream for renewable generators are structured in such a way that it applies to all MWhs generated. LRET encourages renewable generation at any time, regardless of customer need.

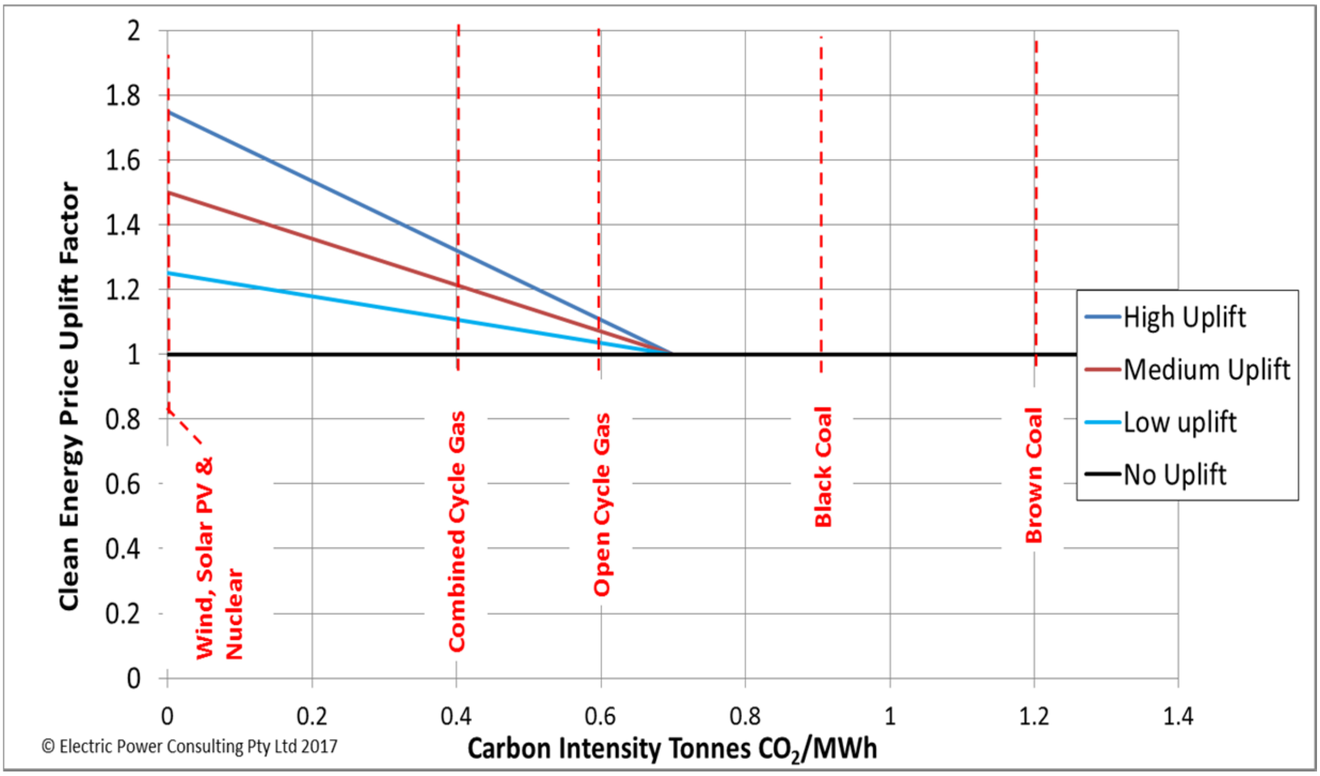
7.1.7 The differing structures of the LRET scheme and the pool put the two markets in direct conflict with each other. LRET remunerated intermittent renewable energy generators are paid a premium that stimulates generation output that adversely impacts on the efficiency of fossil fuel generators. This loss of efficiency not only increases CO_2 emissions of the fossil fuel generator, it undermines economic viability and can lead to the premature retirement of the generator whereby the NEM loses essential despatchable MW capacity. In the author's view, this is the mechanism for the premature retirement of the Northern Power Station in South Australia and the Hazelwood Power Station in Victoria.

7.2 Proposal for "Clean Energy NEM Integration"

7.2.1 A "Clean Energy NEM Integration" proposal has been developed to reward clean generation in an alternate way to the LRET. It is based on a modification of the Finkel Clean Energy Target approach. The primary aim of the proposal is provide incentives to clean generators that is in full alignment with pool market pricing signals. This proposal is designed as a modification of the Clean Energy Target. The proposal is not a tax and it works by providing clean energy generators with positive market based incentives.

7.2.2 The proposal uses clean energy uplift factors. Instead of rewarding green generators with certificates on a per MWh basis, green generators are rewarded by receiving a multiple of the pool price. The uplift factors are dependent on the CO_2 tonnes/MWh as shown in Figure 17. The slope of the line determines how advantageous the scheme is to green generators. The graph shows low uplift, medium uplift and high uplift options that governments could consider. Selection of the parameters determining the uplift factors could initially be set by government to achieve the balance between electricity costs and achieving green objectives. Over time uplift factors could be set by auction from potential new generators.

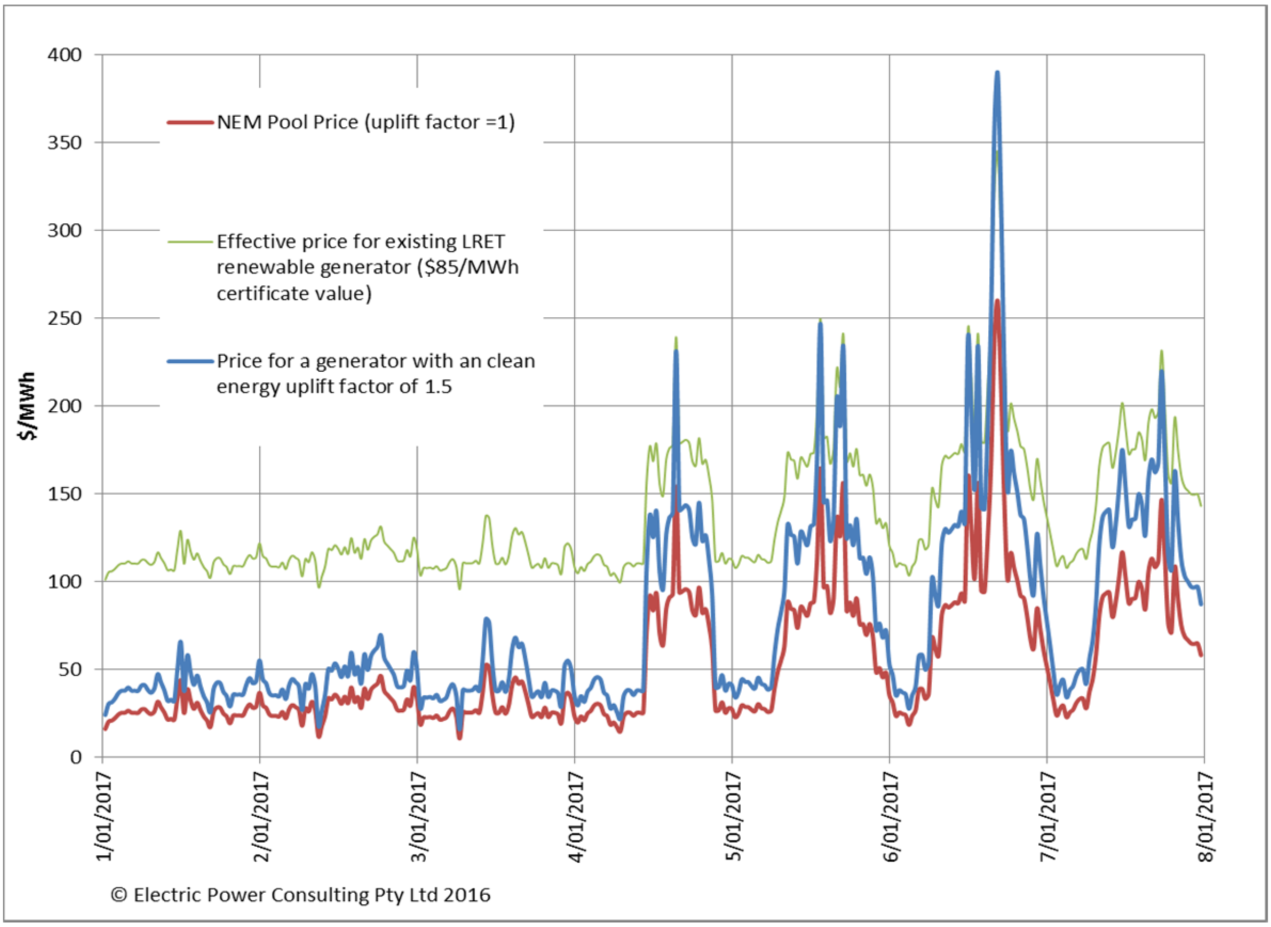
Figure 17 - Clean Energy NEM Integration - Uplift Factors



7.2.3 Figure 18 shows how the uplift factors would be applied to the pool price for clean energy generators. AEMO would fully administer the scheme as part of pool operations. Settlement prices would be adjusted to accommodate the generator bids and the respective uplift factors.

7.2.4 The Clean Energy Uplift Factor Scheme encourages and rewards clean energy in a way consistent with matching supply with demand. The scheme removes the exiting major conflict of the LRET Scheme and the Clean Energy Target Scheme with the pool. It is envisaged that the Clean Energy NEM Integration scheme would operate for new generators as a start-up incentive for the first 10 years of a generator's life. After the 10 year start-up period the generator Clean Energy Uplift Factor would revert to unity.

Figure 18 – Application of the Clean Energy Uplift Factor



8 Consistency with the Finkel Plan

8.1 The two proposals put forward in this report are excellent methods of implementing some of the key Finkel recommendations. Table 1 provides information on some of the key Finkel recommendations and how the proposals in this report would assist.

Table 1 – Summary of key Finkel Recommendations and the EPC method of Delivery

Finkel Recommendation	EPC Delivery Recommendation
Part of Finkel recommendation 3.2 - With the additional context that a Clean Energy Target can be implemented within an already well understood and functioning framework, and has better price outcomes, the Panel recommends a Clean Energy Target be adopted.	Best achieved with the proposed Clean Energy NEM Integration Scheme. The EPC approach has the advantage of incentivising all green generators to provide output to meet the second by second supply/demand balance.
Part of Finkel recommendation 3.2 - To support the orderly transition, the Panel recommends a requirement for all large generators to provide at least three years' notice prior to closure.	Best achieved with a Capacity Scheme. The case studies in this report show how the three year notice period could expose generators to huge losses when market conditions turn against them. EPC approach has the advantage of locking in existing generation capacity 3 or 4 years in advance or signally the opportunity for new generation.
Part of Finkel recommendation 3.3 - The Generator Reliability Obligation should include undertaking a forward looking regional reliability assessment, taking into account emerging system needs, to inform requirements on new generators to ensure adequate despatchable capacity is present in each region.	Best achieved with a Capacity Scheme. The EPC approach is to lock in despatchable generation capacity 3 or 4 years in advance. This is the main strength of a capacity scheme.
Part of Finkel recommendation 3.4 - The need for a Strategic Reserve to act as a safety net in exceptional circumstances as an enhancement or replacement to the existing Reliability and Emergency Reserve Trader mechanism.	Best achieved with a Capacity Scheme. The EPC approach is to lock in despatchable generation capacity 3 or 4 years in advance. This proposal would negate the need for a Strategic reserve.

9 Conclusions and Recommendations

9.1 The operation of the NEM in the lead up to the closure of the Northern Power Station in South Australia and the Hazelwood Power Station in Victoria highlights some market failures within the NEM and the LRET scheme. The main issue is the limitation of the Energy Only Market to provide sufficient pricing signals and incentives early enough to incentivise the construction of essential generator capacity by the time it is required to cater for power station retirements. In the new environment of large scale intermittent renewable generation, new approaches are needed to ensure customers have access to sufficient despatchable generation and load management resources to cater for all reasonable contingencies.

9.2 The LRET is shifting investment away from despatchable generation to intermittent renewables. Competition from large scale renewable generators brought about by the LRET is damaging the business model and financial viability of base load coal plants without providing the ability to replace them when they close. While competition is an essential part of all markets, in the NEM the competition needs to address both energy and capacity. With the NEM focusing primarily on energy through an energy only market, despatchable generator capacity is not being properly valued.

9.3 The LRET is a market that rewards renewable generators through renewable energy certificates. The certificates encourage renewable generators to maximise their output at all times, regardless of the customer need. This puts the LRET in conflict with the electricity pool that uses price mechanisms to match supply and demand at all times. Benefits can be achieved by aligning the price signals in both markets.

9.4 This report has proposed two major changes to the Finkel plan aimed at making the new scheme successful and sustainable in the medium and long term. The recommendations are:

c) adding a capacity market to the existing pool market.

d) Incorporating a "Clean Energy NEM Integration Scheme" in lieu of the LRET and the Clean Energy Target Schemes.

9.5 Both of these changes build on the base prepared by the Finkel plan. The changes will provide pricing signals that will guide investments into building an economic reliable power system with low carbon emissions.

10 References

1. Independent Review into the Future Security of the National Electricity Market. Dr Alan Finkel, http://www.environment.gov.au

2. Capacity Mechanisms in the EU Energy Market. Edited by Liegh Hancher et al. Oxford University Press 2015

3. Austrian Energy Market Operator (AEMO) dashboard - https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Data-dashboard#medium-term-outlook

Appendix 1 – Background on the Report Author Dr Robert Barr

Dr Robert Barr AM is a consulting engineer, director of his company Electric Power Consulting Pty Ltd and the current National President of the Electric Energy Society of Australia. Robert has over 42 years experience in the field of power systems and electricity distribution, is a fellow of Engineers Australia and a member of Consult Australia. Robert is an Honorary Professorial Fellow at the University of Wollongong and was awarded the title of Australian National Professional Electrical Engineer of the year in 2012. Dr Barr became a Member of the Order of Australia in 2013.