Centre for Energy and
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Payments for Closure

Should Direct Action include payments for closure of high emission coal-fired power plants?

by

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CEEM Working Paper 2013

October 2013

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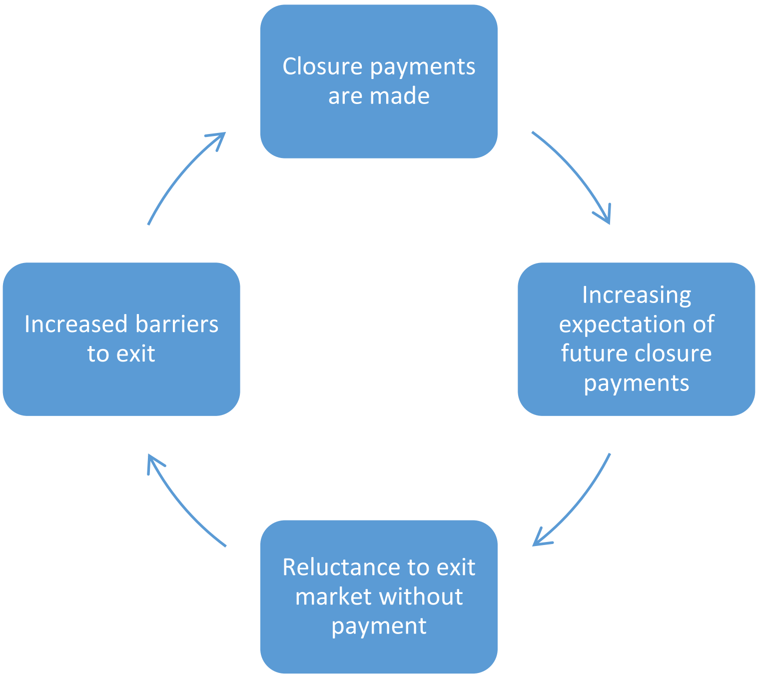
Executive Summary

Declining demand and rapid growth in renewable generation including large-scale wind and embedded photovoltaics has led to an apparent oversupply of generating capacity in the National Electricity Market (NEM) [1]. This has occurred within a broader context of growing climate change concerns, and the need to transition towards a low-carbon future electricity industry. Whilst falling demand has certainly contributed to emissions reductions, this oversupply of capacity is an issue of concern to many industry participants, including renewable proponents [2], since it acts to depress wholesale market prices and dampen signals for new investment. Discussion is growing around the potential need for government intervention to facilitate accelerated and orderly exit of incumbents, to reduce the market oversupply and ensure that wholesale market prices remain at levels necessary to ensure continued investment in low emissions technologies. A re-awakening of the former Federal Government's Contracts for Closure mechanism is typically raised as an option to address the oversupply.

Based upon the analysis presented in this paper, mechanisms based upon a payment for closure approach appear problematic, for the following reasons:

Payments for closure may create a vicious cycle that exacerbates barriers to exit. Upon payment for closure, remaining generators will have an increased expectation of further payments, and are likely to remain in the market longer than economically efficient until those payments are forthcoming. Unless the government intends to pay for the closure of every incumbent in the market, this cycle will need to be broken at some point by an unequivocal signal that no further closure payments will be forthcoming, at which point the market could return to reliance upon the usual market signals to exit. An approach that avoids this intervention in the first place is likely to be superior.



Payments for closure are unlikely to significantly reduce emissions. The closure of a power station does not produce abatement equivalent to the historical emissions of that plant. Because demand is relatively inelastic in the short term, the closure of a power station will result in other power stations being dispatched to fill that demand gap. Since renewable generators are typically energy constrained and gas-fired generators remain significantly higher cost, these replacement generators are likely to be of similar emissions intensity to the original generator. This means that emissions abatement directly attributable to plant closures is likely to be minimal.

Payments for closure may not be necessary. Arguably, the market is already responding appropriately to declining demand, with a number of generators moving to seasonal operation, mothballing and even retirement. These would seem to be efficient and cost effective responses that are in the interests of consumers. As long as investment in low emissions generation continues, the government could allow these market responses to continue unhindered. This would allow asset owners to determine the economically efficient timing and allocation of retirement of capacity based upon market signals.

If investment in low emissions technologies appears likely to stall, mechanisms that specifically target the support of ongoing investment could be applied. Thus, rather than market intervention to promote retirements and thereby raise wholesale prices, the Large-scale Renewable Energy Target (LRET) scheme could be strengthened. This could ensure ongoing renewable investment, while allowing normal market signals to continue to determine economically efficient retirements.

Government policy options

Given these challenges with payment for closure approaches, other options for facilitating appropriate investment in low emission generation and exit of older high emission plant would seem to include:

1. ***Increase the LRET Shortfall Charge and scheme duration.*** In the absence of a meaningful carbon price, the Shortfall Charge under the LRET is likely to be insufficient to support ongoing renewable investment. This is exacerbated by the approach of the 2030 scheme end date, which is now within the lifetime of generators installed today. Thus, if the carbon price is repealed, the LRET scheme will need to be strengthened, such as by increasing the Shortfall Charge and indexing it at CPI, and extending the end date of the LRET beyond 2030.
2. ***Articulate a vision for decarbonisation of the electricity sector.*** The Contracts for Closure scheme may have already exacerbated barriers to exit by creating a perception that future payments may be forthcoming. Industry discussion in support of closure payments exacerbates this perception. Furthermore, the 'option value' of remaining in the market is strongly driven by ongoing uncertainty. The government can mitigate these barriers to exit by seeking and then clearly articulating bipartisan support for a detailed vision of and commitment to decarbonisation of the electricity sector, consistent with the scale and speed of emissions reductions that is likely required to effectively address climate change. This could be signalled convincingly to the market via extension and expansion of the LRET as noted above, and a clear statement that payments for closure will not be forthcoming.

Implications for Direct Action

This analysis has important implications for the design of the Emissions Reduction Fund under the new Coalition government's Direct Action scheme. In considering which activities should be eligible for funding, it is essential that the Government considers:

1. The true abatement directly attributable to the relevant activity, and
2. Any perverse unintended consequences of funding the relevant activity.

The Coalition have indicated that they will "make incentives available for the oldest and most inefficient power stations to reduce their emissions in an orderly manner" [3]. In 2011 Greg Hunt indicated that "for reasons of energy security the Coalition would clean up rather than close down power stations" [4], although given growing industry concern around market oversupply, the Coalition may consider the inclusion of payments for closure under the Direct Action mechanism.

If payments for closure or reduction of generation at coal fired power stations are to be considered under this mechanism, it is essential to recognise that simply reducing output at a coal-fired power station does not necessarily reduce emissions. Due to the inelastic nature of electricity demand over the short term, when one generator reduces output, another generator will need to generate more to "fill the gap". In the present National Electricity Market (NEM), this is likely to be another coal-fired generator of approximately similar emissions intensity. Thus, accurate calculation of the attributable abatement will be heavily reliant upon complex electricity market modelling simulations to determine the aggregate system emissions removed when a power station reduces production (or retires), including assessment of the emissions intensity of generators likely to "fill the gap". Furthermore, simulations will be required to determine how much the original generator would have operated in the absence of the scheme, given that declining demand is likely to cause a reduction in production at many generators even in the absence of government incentives. Such modelling exercises have inherent uncertainties that can make their findings controversial and open to rent-seeking behaviour.

Furthermore, as discussed above payments for closure or reduction of operation at coal-fired power stations could exacerbate barriers to exit, creating an oversupplied market and inhibiting an economically efficient transition to lower emissions technologies.

Given these concerns, more effective ways for the Emissions Reduction Fund to support emissions reductions in the electricity sector could include:

- Reducing electricity demand through end-use efficiency projects
- Efficiency improvement at power stations (producing the same MWh at a lower greenhouse intensity)
- Renewable generation projects
- Hybrid renewable projects at fossil fuel power stations (producing the same MWh at a lower greenhouse intensity)
- Non-hybrid co-location of renewable energy projects at fossil fuel power station sites
- Projects that reduce network losses.

As with all processes of this nature, projects should also be additional (ensuring that the project is additional to what would have been undertaken in the absence of specific direct action support), and could be prioritised according to the relative costs of abatement, taking into consideration any co-benefits to the community, the environment or the economy. Ensuring additionality is a complex and inherently uncertain task but there are approaches that can improve the effectiveness of such policy measures. Finally, there are other measures to drive exit of older, highly polluting plants, beyond carbon pricing or payment for closure including emissions standards that are being pursued in other jurisdictions including the United States and Europe. These standards reflect the adverse direct health impacts of older, more polluting generation and such exit provides net societal benefits quite independently of their climate change implicaitons.

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Contents

1 Introduction

The sustainability challenge for the electricity industry

The recent IPCC Fifth Assessment Report Summary for Policy Makers has highlighted the need to effectively address our climate change challenges [5]. The International Energy Agency amongst others [6] has highlighted the role that the electricity sector must play in such a response, within a broader context of energy access, security and affordability. In particular, there are a range of low and zero, notably renewable, carbon emissions options available for electricity industry deployment.

The Australian electricity industry has amongst the highest greenhouse emissions per capita, and emissions intensity of electricity industries around the world, and will have a key role to play in any effective Australian contribution to the global emissions reductions that appear required to avoid dangerous warming. Furthermore, Australia has excellent renewable energy resources available which have, to date, seen only relatively modest uptake.

Low carbon transformation of the electricity sector is largely a question of investment. In particular, there are only limited opportunities to reduce the emissions of existing fossil-fuel plant. There are, however, some major challenges in appropriately driving such investment. Most generation options have significant capital costs by comparison with their operating costs. Furthermore, conventional generation is typically large scale and long-lived. Meanwhile, the electricity industry has to ensure that supply is available to meet demand of a non-storable good that travels instantaneously at all times and locations across a dedicated electrical network. As such, investment needs some measure of coherence with the exit of existing plants in order to ensure secure and reliable supply. Electricity industry restructuring towards more competitive market based arrangements can add to the complexity of investment and exit. In particular, such market arrangements often price wholesale electricity at the operating cost of the marginal plant. An unusual characteristic of conventional generation technologies in such markets is that old plants can still be highly competitive against newer plants and potential new entrants. This is an outcome of advantageous early siting and fuel arrangements, and the failure to price the generally higher environmental externalities of older plants.

As such low carbon electricity industry transformation in restructured electricity industries will require arrangements that ensure effective coordination of investment in new clean generation and exit of older higher emission plant. In theory, market arrangements coordinate investment and exit through prices that will offer profitable opportunities for potential low-cost new entrants, whilst reducing or entirely removing the profitability of high cost existing plants. Addressing climate change would require an appropriate price on carbon emissions. In practice, system and market operators generally require advance notice of pending plant entry and exit in order to assess its potential future security and reliability impacts. They also have the power to direct market participant operation should it be deemed necessary. Furthermore, there are political realities regarding plant exit such as regional jobs, and electricity pricing impacts that may limit the use of purely market mechanisms. For these and other reasons, a range of approaches have been seen to try and better direct plant exit.

Contracts for Closure

The Australian Government has previously pursued a "Contracts for Closure" approach with the stated intention of providing an orderly exit of older and high emission coal-fired generation from the NEM. This scheme aimed to permanently close around 2000 MW of highly emissions intensive generation capacity by 2020 via payments to particular plant owners from the Federal Government. The amount paid was to be determined by negotiation.[1] This measure was part of the Clean Energy Future package that included a carbon price. Part of the package included an energy security fund to provide transitional 'compensation' to high emission generators and offer voluntary Contracts for Closure. . The energy security fund was controversial with some key observers arguing against the need for compensation [7]. Others argued that Contracts for Closure was a necessary political compromise given a modest carbon price that would, by itself, be insufficient to drive exit of high emission plants [8].

Closure proposals were received by the Government from all eligible generators in early 2012. Negotiations ceased on 5 September 2012 with the announcement that no agreement had been reached. Again, there were differing views on the reason for this outcome. However, the expectation of a low carbon price, high gas price and high black coal price appear to have pushed up the asking price of brown coal generators beyond that which the Government was prepared to pay [9].

A re-awakening of Contracts for Closure?

In recent months there has been increasing discussion about reawakening the Contracts for Closure program. It was arguably one of the most prominent topics raised at the recent Clean Energy Week conference in July 2013 [1, 2, 10] and was featured in industry media in the following weeks [11, 12]. The Financial Review indicated in late July 2013 that "there is now growing support from both sides of politics to re-examine the merits of a contracts-for-closure scheme to overcome the barriers for older plants to exit the market to deal with the oversupply problem" [13].

[1] The stated intentions of the scheme were to "negotiate the orderly exit, by 2020, of around 2,000 MW of highly emissions-intensive coal-fired electricity generation capacity; provide certainty about the timing of closure of this highly emissions-intensive coal-fired electricity generation capacity and provide sufficient time to facilitate investment in replacement lower emissions electricity generation capacity; minimise the risks to energy security that may arise from an unplanned exit of electricity generation capacity from the market; achieve a value for money outcome on terms and conditions that are acceptable to the Commonwealth; ensure that appropriate arrangements are put in place by Eligible Generators to preserve workers' entitlements and meet all relevant State legal requirements, including requirements regarding site remediation." [26]

This discussion is being driven by the fact that the Australian National Electricity Market (NEM) appears to be oversupplied with generation capacity. Analysis by Nelson et al suggests that the NEM is oversupplied by more than 9GW (18% of installed capacity) at present [14]. This has eventuated due to an unanticipated and consistent trend of falling demand since 2009 [15], combined with Government policies designed to support ongoing renewable deployment including the Renewable Energy Target (RET) and various State Feed-in Tariffs for rooftop solar.

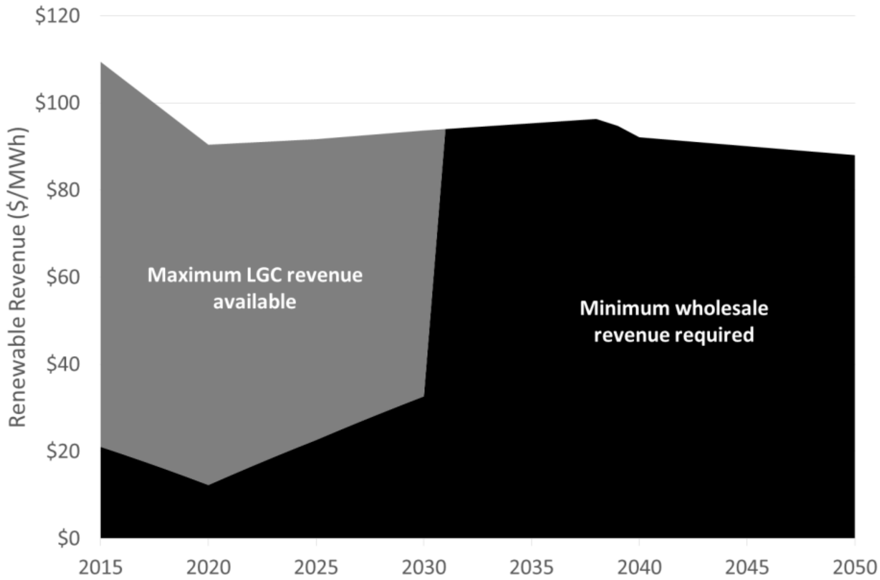
This oversupply has led to an absence of 'price spike' events in the NEM in recent years. While 2009-10 and 2010-11 saw in excess of 30 trading intervals with an average trading interval price exceeding $1000/MWh, 2011-12 saw only one major price spike event, and none occurred in 2012-13 [16]. In the NEM's energy-only market design, price spike events represent a significant potential source of generator profits and financial risk to retailers, hence providing an important signal for investment in new generating capacity.

Is there a problem?

It remains unclear whether the oversupply in generation capacity requires Government intervention. Arguably, the market oversupply causes low wholesale prices, and the owners of affected assets are in the most appropriate position to decide when and how it is most economically efficient for them to leave the market in response to those price signals.

However, some have argued that the oversupply of generation capacity constitutes a threat to continued investment in lower-emission, notably renewable, generation [2]. Large renewable generators are dependent upon revenue from both Large-scale Generation Certificates (LGCs) under the Renewable Energy Target (RET) and their energy. In theory, falling energy prices should drive higher LGC prices to ensure the RET is met. However, the relatively low value for the shortfall charge for liable parties who don't meet their LGC obligations means that project developers still depend on some minimum income from the wholesale market to be profitable, as illustrated in Figure 1. Furthermore, the RET ceases in 2030, which is already within the technical lifetime of renewable projects installed today. Retailers will be reluctant to sign long term PPAs beyond the end of the RET unless there is confidence of electricity prices exceeding $90/MWh. Given the prevailing uncertainty surrounding the carbon price this confidence is not likely to be forthcoming. In the absence of sufficiently long term PPAs (or confidence of sufficiently high LGC prices and electricity pool prices), renewable projects are likely to struggle to obtain financing.

Figure 1 - Minimum wholesale electricity revenue required to promote continued renewable investment



Source: Total renewable revenue required determined from levelised cost of least cost renewable technology in each year (wind and PV), sourced from Bureau of Resources and Energy Economics (BREE) Australian Energy Technology Assessment (AETA) 2012.

If the oversupply in capacity threatens the continued development of low emission technologies, yet Governments maintain a commitment towards low emission transformation of the Australian electricity sector, then policy intervention may be required to ensure that the NEM's low emissions transformation doesn't stall.

There are a range of possible market interventions to address this issue. If the present oversupply is seen as a temporary aberration, then payments for closure may be a suitable response. Payments for closure could effectively lead to the orderly retirement of a discrete capacity of generation within a short period of time. However, as discussed below, payments for closure may also exacerbate barriers to exit for the remaining plant. Thus, this approach could inhibit a longer term transformation of the power system towards low emissions technologies. As such, policies that directly support ongoing investment in renewables may be preferable, allowing normal market signals to continue unhindered. This could be achieved by, for example, strengthening the LRET via an increased shortfall charge and extended duration.

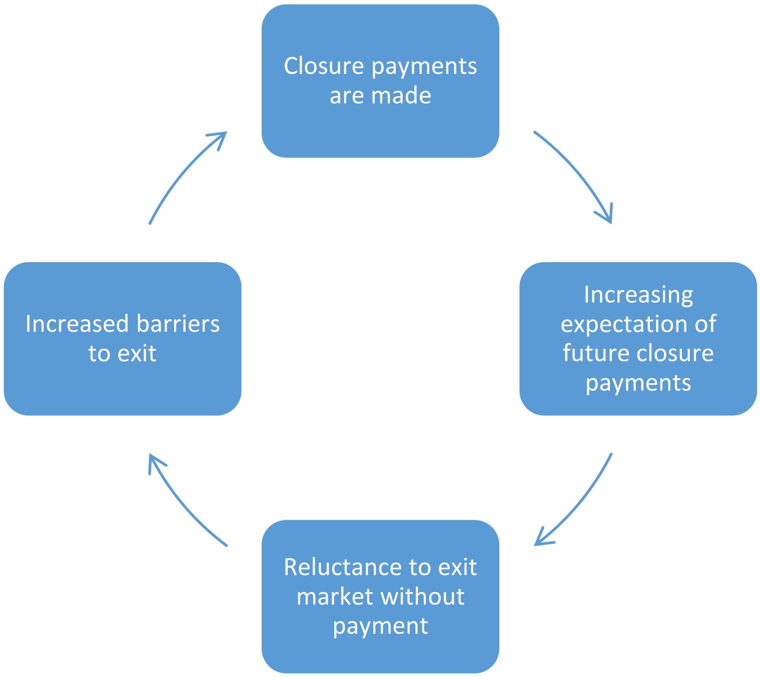
This paper proceeds by firstly examining some potential pitfalls of a payments for closure mechanism. It then discusses whether government intervention is necessary, and what forms it could usefully take.

2 Potential pitfalls of a Payments for Closure mechanism

Payments for closure exacerbate barriers to exit

Payments that compensate generators for early closure seem likely to exacerbate barriers to exit. Payments of this nature create an expectation that government payment is available upon exit from the market, creating incentives to remain in operation until payment is offered. This creates a vicious cycle; the more closure payments are made, the greater the expectation that they will be paid in future, and the greater the reluctance of generators to leave the market without compensation. This potential outcome is illustrated in Figure 2.

Figure 2 - A vicious cycle – Closure payments exacerbate barriers to exit



With around 75% of Australia's electricity currently being generated by emissions intensive coal-fired generation, it is clear that a rapid transformation of Australia's electricity system is required over the coming decades. This makes it essential to minimise barriers to exit and entry as far as possible. Payments for closure are likely to have the opposite effect.

If agreement had been reached in the original Contracts for Closure scheme, the first 2000 MW of particularly old and high emissions generation would have been paid to exit. The next round of potential exits would then have a higher expectation of Government payment to close. This vicious cycle then can only be broken by a clear signal from Government that they will not be making any more payments to exit. The later this occurs, the stronger the signal will need to be from Government to ensure sufficient market certainty that further payments will not be forthcoming.

Given that Contracts for Closure have already been pursued as a Government policy, there is already an expectation of potential future payments for exit, which is probably already exacerbating barriers to exit at present. Indeed, this may be playing a role in extending the present market oversupply.

The Government could aim to rectify any such barriers to exit already created by the Contracts for Closure scheme by seeking bipartisan support for a long term plan to transition the electricity sector to low emissions technologies. This should clearly specify that no government will make payments to incumbents to close. It could also include expansion and extension of the RET to beyond 2030, and increase the LGC shortfall charge, as an unequivocal signal to market that the ongoing entry of renewable technologies will be supported, and incumbents should respond to market signals appropriately.

Payments for closure are unlikely to significantly reduce emissions

Closure of the most emissions intensive power stations is unlikely to lead to significant greenhouse abatement. Given that electricity demand is relatively inelastic in the short term, demand will simply be met by the next generator in the dispatch merit order. In Australia, this will mean that the majority of the electricity no longer supplied by that retired generator is met by other coal-fired generators, which may not be significantly less emissions intensive.

For example, if payments for closure were made to Hazelwood power station, the electricity that would have been supplied might be instead sourced from a combination of the other coal-fired power stations located in Victoria (given transmission constraints to other market regions, and energy constraints on wind and hydro generation). The capacity-weighted emissions intensity of these power stations is only 15% lower than that of Hazelwood [17]. Thus, the closure of Hazelwood could reasonably be expected to produce only on the order of a 15% reduction in the historical emissions from that power station. This is especially true in an oversupplied market, where excess capacity is available from other similar power stations.

Furthermore, paying a power plant to simply reduce production (in order to reduce greenhouse emissions) sets a problematic precedent. This is broadly similar to paying a steel manufacturer simply to produce less steel, or farmers to plant less crops. In an environment where demand and price for that product may be fluctuating over time (such that production may have decreased during that period anyway) this is a particularly problematic way to expend public funds.

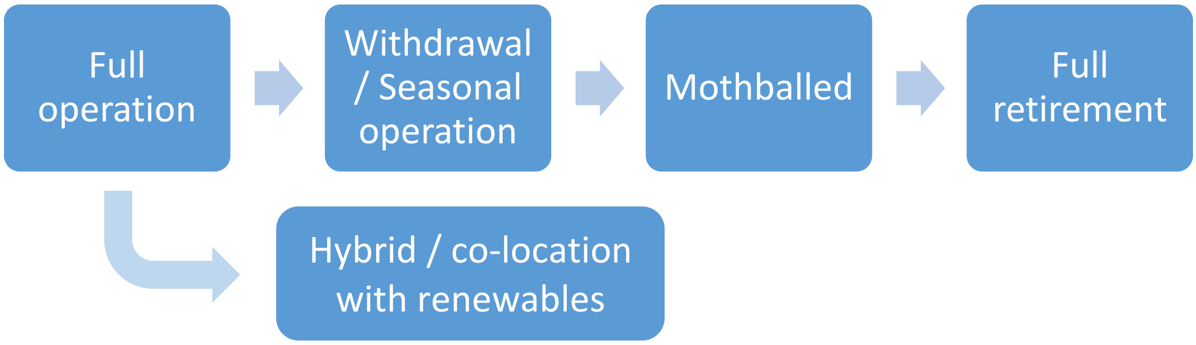
3 Is market intervention necessary?

An oversupply in generation capacity during a trend of declining demand indicates the presence of barriers to exit. Four types of barriers to exit are identified as being potentially present in the NEM:

1. ***Site remediation costs*** – When a generator retires permanently, if the owner wants to use or sell the site for another purpose, it will need to be rehabilitated to a sufficient standard. In many cases rehabilitation will include removal of asbestos in buildings and generator components (such as pipe insulation). The soil around ash dams may also require treatment to remove leachates and other contaminants, particularly at older power stations given the older dam linings and practices applied when these power stations were constructed. The coal mines associated with the power station will also require remediation. Where groundwater contamination has occurred (for example, with oil used to start generators that has been improperly stored) remediation is likely to be more challenging and costly. In summary, many old power plant sites will face potentially significant and uncertain remediation costs.
2. ***First mover disadvantage*** – Many older coal-fired generators have similar cost profiles, making it unclear which asset should leave the market first. When sufficient capacity is removed from the market, wholesale prices could be expected to recover. This creates an advantage in remaining in the market (even at a temporary loss), if there is a possibility that a competitor may exit first.
3. ***High sunk costs*** – Coal-fired power stations are capital intensive, with few alternative uses and limited scrap value, and therefore have high sunk costs. There is likely to be little ability to recover the majority of these costs upon market exit. This provides incentives for market participants to remain in the market as long as revenue exceeds short run marginal costs.
4. ***Option value*** – Generators may seek to remain in the market for longer periods (despite temporary losses) when there is significant uncertainty over future market conditions. Uncertainty leads to significant 'option value' from remaining in the market.

Generators may withdraw capacity temporarily (to seasonal operation or a mothballed state) to retain option value, whilst avoiding the majority of operating costs. This has the added benefit of deferring site remediation costs. The possible stages of unit withdrawal are listed in Figure 3.

Figure 3 - Stages of generator withdrawal from market



A selection of generators have already withdrawn capacity by various degrees in response to market conditions, as listed in Table 3.1. Several power stations have moved to full retirement, with others moving to seasonal operation and temporary mothballing. This suggests that barriers to exit were not significant in these cases, although it is acknowledged that there may be substantial variation between assets.

Table 3.1 - Generation capacity withdrawn from the NEM since April 2012

Generator Name	Region	Status	Notes
Collinsville	QLD	Retired	Deregistered 1 Jan 2013. In process of decommissioning and care and maintenance as of August 2013. Potential redevelopment as Collinsville Energy Park; renewables and gas under consideration [18]
Swanbank B	QLD	Retired	Retired May 2012; demolition anticipated. Same site as Swanbank A (decommissioned 2002; demolished 2006) and Swanbank E (CCGT; still in operation). Surrounding area now Swanbank Enterprise Park.
Munmorah	NSW	Retired	Retired, on standby since August 2010. Site to be maintained for future power station. No demolition; remediation decision subject to outcome of future sale.
Tarong	QLD	Mothballed	2 units withdrawn until at least October 2014 pending increase in wholesale electricity demand.
Playford B	SA	Mothballed	Withdrawn from March 2012 until viable. Solar thermal potential as above.
Wallerawang	NSW	Mothballed	One of two units mothballed until at least January 2014 [19]. Recently reported that this plant may be completely withdrawn in 2014 [20]
Gladstone	QLD	Withdrawn	All units operating only 8% of time since July 2012; at least 2 units offline 60% of time. Long-term

Generator Name	Region	Status	Notes
			contract with Boyne Smelters likely to dictate operation [21]
Energy Brix Morwell	VIC	Withdrawn	1 unit (70 MW) withdrawn from July 2012 until viable. Total plant output less than 30 MW since July 2012.
Yallourn	VIC	Withdrawn	1 unit withdrawn from October 2012, returned to service January 2013. Plant affected by major flood, fire, and industrial action [22, 23].
Northern	SA	Seasonal	Seasonal operation – operating only in summer. Option to repower Port Augusta power stations with solar thermal studied by Beyond Zero Emission [24]; federal funding for feasibility study unsuccessful as of July 2013 [25].

Notably, of the five generators eligible to enter into negotiation for contracts for closure (Playford B, Energy Brix Morwell, Hazelwood, Collinsville, and Yallourn) two of the five generators under consideration have since retired or mothballed (Playford B and Collinsville) with a third (Energy Brix Morwell) removing one unit from service. This suggests that the Contracts for Closure scheme may not have been required to facilitate market exit for these assets, and could have resulted in an unnecessary wealth transfer to the owners of these assets. It also highlights that information asymmetry during the negotiation process could lead to windfall gains by market participants.

Is mothballing of plant a problem?

Mothballing of units exacerbates uncertainty for potential new entrants. Typically, mothballed units will be able to return to service more quickly and at a lower cost than a new entrant attempting to establish in the market. This is likely to be a significant deterrent for the development of new gas-fired capacity in the NEM. In combination with the high domestic gas prices anticipated in the coming decades [26], this trend could mean that it is unlikely that significant new gas-fired generation capacity will be developed in the NEM in the absence of government intervention.

It could be argued that this is an efficient outcome, and therefore in the interests of consumers. The use of incumbent generation in a peaking role provides energy security at minimal cost, and contributes only marginally to greenhouse gas emissions. The emissions intensity of many peaking gas-fired generators is only moderately lower than that of many coal-fired generators.

Mothballed plant may deter investment in renewable generation in the period after the LRET scheme, or where the LRET shortfall charge isn't sufficient. Mothballed plant effectively "cap" wholesale electricity prices, since they can rapidly re-enter the market at low cost whenever prices exceed the necessary level. This could be addressed by an increase in the LRET, or the implementation of a sufficiently strong carbon price.

Addressing site remediation costs

When constructing or purchasing a generating plant, business should have factored in the site remediation costs. However, in cases where a plant is closing significantly earlier than originally anticipated, site remediation costs may constitute a barrier to exit. This may encourage mothballing and temporary withdrawal, rather than full retirement of plant.

It is difficult to assess whether site remediation costs constitute a significant barrier to exit. There is limited publicly available data on site remediation costs, and costs are likely to vary substantially from site to site. Furthermore, the degree of site remediation required is likely to depend upon the desired future use of the site.

In order to inform decision making on this issue, a sensible first step would be to collect and compile information on anticipated site remediation costs at each of the existing coal-fired assets in Australia, to understand the extent of this issue and its likely impact upon incumbent exit.

If site remediation is judged to be a significant barrier to exit, it may be appropriate for the Government to assist incumbents in paying a proportion of these costs. Importantly, this is distinct from closure payments because there would be no expectation of windfall gains to asset owners. Government payments would only go towards site remediation, and there would be no expectation of compensation for the anticipated future profits that the asset may have made if it continued operating. Therefore, as long as it is executed properly, a scheme of this nature should not exacerbate barriers to exit in the same manner as closure payments.

It is important to recognise that asset owners should have budgeted for site remediation, and government payment of these costs could therefore be argued to be a windfall gain for those investors. Note that the original Contracts for Closure scheme did have, as one of its objectives, ensuring that plant owners meet site remediation requirements. Thus, the government should proceed with caution, and consider whether the perceived barriers to exit are substantial, and determine whether this is the ideal manner in which to expend public funds.

Government funding of site remediation costs does create a moral hazard for developers of new generation assets and purchasers of existing assets. The policy would create a reasonable expectation for new entrant developers that future site remediation costs would be paid for by the Government, and could therefore lead to discounting of those costs in their decision to invest in a generation asset. This could be particularly problematic when market participants are considering the decision to invest in nuclear generation (which could be expected to have very high site remediation costs). Policies would need to be constructed with this in mind, drawing key learnings from other nations dealing with remediation of nuclear sites [27].

4 Implications for the Federal Government's Direct Action Plans for the electricity sector

The new Coalition Australian government has announced their intention to remove the carbon pricing scheme, and introduce an alternative approach called "Direct Action". Under this plan, they have indicated that they will "make incentives available for the oldest and most inefficient power stations to reduce their emissions in an orderly manner". This will be achieved via the establishment of an Emissions Reduction Fund, which aims to support 140 million tonnes of abatement per annum by 2020 [3].

There is potential for this to be interpreted as similar in implementation to the Contracts for Closure program, introducing the problems associated with that scheme discussed throughout this paper (such as exacerbating barriers to exit).

Most importantly, as discussed above, the abatement occurring as a result of power station closure should *not* be calculated based upon an historical baseline of operation, assuming that all of the historical emissions from the power station are "abatement". Other power stations will supply that electricity, may well have an only slightly lower emissions factor.

To properly determine the amount of emissions abatement as a result of a power station closure, it would be necessary to conduct simulations of the electricity market to determine which generators might increase production in response to that closure, and determine the corresponding reduction in aggregate system emissions. This would need to be calculated by comparison with an equivalent scenario where that power station remains in service (rather than by comparison to historical baselines). This will be a complex and uncertain process given the inadequacies of electricity market models, and therefore likely to be both controversial and open to rent seeking behaviour.

Given these concerns, more effective ways for the Emissions Reduction Fund to support emissions reductions in the electricity sector might include:

- Reducing electricity demand through end-use efficiency projects, although this has its own challenges as seen with various state government schemes incentivising energy efficiency improvements [28].
- Efficiency improvement at power stations (producing the same MWh at a lower greenhouse intensity) although, again, this has its own challenges in measuring additional actions beyond business-as-usual plant improvements [29].

- Renewable generation projects that are additional to those already incentivised by the RET
- Hybrid renewable projects at fossil fuel power stations (producing the same MWh at a lower greenhouse intensity)
- Non-hybrid co-location of renewable energy projects at fossil fuel power station sites
- Projects that reduce network losses.

As with all processes of this nature, projects should also be additional (ensuring that the project is additional to what would have been undertaken in the absence of support), and could be prioritised according to the relative costs of abatement, taking into consideration any co-benefits to the community, the environment or the economy.

It would certainly not be appropriate to pay for the closure of a fossil fuel generator and consider the full historical emissions profile to be abatement.

5 Conclusions

While a number of possible barriers to exit are identified in the National Electricity Market, the magnitude of the impact of these factors on incumbent behaviour remains unclear. A number of generators have recently moved to full retirement, highlighting that barriers to exit were not insurmountable in those cases. Temporary withdrawal of plant and mothballing behaviour appears prevalent, but it is unclear to what degree this is driven by avoidance of site remediation costs, or by market participants seeking to retain option value in light of ongoing policy and broader market uncertainty.

Policy makers should first and foremost consider the interests of consumers, which in the short term are well served by a large excess of capacity providing energy security and low electricity prices. However, the longer-term interests of consumers certainly include an effective response to climate change, and hence low-carbon electricity industry transition. This seems, in turn, likely to require a coherent and comprehensive policy framework which explicitly drives low carbon generation investment while ensuring that barriers to exit don't negate these efforts.

Mothballed plant may constitute a threat to investment in renewable generation where the LRET shortfall charge is not sufficient, and in the absence of a meaningful carbon price. While this could be addressed by closure payments, an increase in the LRET shortfall charge would ensure ongoing investment, while potentially retaining the benefits of mothballed plant for energy security.

Based upon the analysis presented in this paper, mechanisms based upon a payment for closure approach appear problematic. Payments for closure carry the following risks:

- ***Payments for closure may create a vicious cycle that exacerbates barriers to exit.*** Upon payment for closure, remaining generators will have an increased expectation of further payments, and are likely to remain in the market longer than economically efficient, until those payments are forthcoming. Unless the government wants to pay for the closure of every incumbent in the NEM, this cycle will need to be broken at some point by an unequivocal signal that no further closure payments will be forthcoming.
- ***Payments for closure are unlikely to significantly reduce emissions.*** The closure of a power station does not produce abatement equivalent to the historical emissions of that plant. Rather, other generators will increase generation to fill the demand gap. These replacement generators are likely to be similar in emissions intensity to the original generator, meaning that abatement is likely to be minimal.

This has important implications for the application of funds under the Direct Action scheme. Care should be taken to ensure that payments go to activities for which genuine emissions reductions can be attributed. Payments for closure or reduction of generation are problematic, since the emissions reduction is non-trivial to determine, and will likely be much smaller than the historical emissions associated with the plant. Furthermore, there are other measures to drive exit of older, highly polluting plants, including emissions standards that are being pursued in other jurisdictions including the United States and Europe,

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