

National Generators Forum:  
Submission to Garnaut Climate  
Change Review  
ETS Discussion Paper

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## 1. OVERVIEW

The National Generators' Forum (NGF) appreciates the opportunity to comment on the Garnaut Review's recently released Emissions Trading Scheme (ETS) Discussion Paper. The NGF supports the Australian Government's decision to introduce a market-based ETS to address the challenges of climate change. However, there are many important features of an ETS that will need to be developed and assessed in detail prior to its introduction.

The Garnaut Climate Change Review's Emission Trading Discussion Paper deals with many of these issues in some detail, although there will be much work to be done in translating theoretical concepts into an operational regime. Some of the critical features of an ETS are the target(s) and trajectories adopted by Government, yet the report is silent on these and many other extrinsic factors, noting only that they will be derived in later work. In some respects, this makes dealing with the intrinsic factors more uncertain at this point in time. The report does however provide some detailed insights into dealing with challenging exogenous issues.

This submission puts forward the key areas of agreement and disagreement that the NGF finds most important in relation to the Review's Emissions Trading Scheme Discussion Paper. The appendix to this report provides an overview of the Australian National Electricity Market (NEM) both in terms of its physical characteristics and NEM design and operation.

## 2. COMMENTS ON ETS DESIGN

The NGF agrees with the five principles outlined in the Discussion Paper that would guide the design of the ETS (pp.12-14). We agree that the observable outcomes sought from a well designed ETS include low transaction costs, price discoverability, emergence of forward markets, investor confidence, and efficient abatement.

The Discussion Paper outlines in a number of places the need to pursue other policy objectives through parallel processes. These relate to issues perceived as 'market failures' such as apparent opportunities to increase energy efficiency and adoption of renewable forms of energy. The NGF believes that any pre-emptive parallel measures should be carefully analysed, recognising they will have an impact on an ETS.

In respect of the intrinsic design features of the ETS listed in section 2.3, we agree with most of these features with one substantial exception. Under permit issuance, the report states that "governments can either release permits by allocating them at no cost to a range of potential recipients (e.g., households or businesses) or by selling them through a competitive process (auctioning)". The NGF does not believe this is an "either/or" choice by government. The government could do both effectively at one time and achieve a more effective range of policy objectives.

The NGF holds a fundamental difference of view on some of the extrinsic design features of an ETS listed in section 2.4 - including the section on "compensation". In particular the NGF notes the following (p.18):

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“Producers in the non-traded sectors will, on average and in general, be able to pass on to households most of the costs associated with their direct and indirect emissions. In some cases, firms with inflexible production structures could be faced with having to choose between passing on the price (and losing market share) or absorbing the cost of emissions at the expense of profitability. This potential change in production and the associated loss of profit has led some to argue for compensation from government”

We believe the Discussion Paper is cursory and almost dismissive of the enormity of this issue and the impact on many electricity generators who cannot pass through a carbon cost in full and who will lose a significant amount of market share due to changes in the dispatch order. The NGF strongly urges deeper consideration of these issues since, in the absence of measures to aid transition, the ETS will result in large wealth transfers out of the electricity sector with uncertain benefit to society.

These issues are discussed in greater depth in the remainder of this submission.

### **3. DESIGN OF AN AUSTRALIAN ETS PRIOR TO AN INTERNATIONAL AGREEMENT**

The NGF agrees with the majority of section 3 of the Review and in particular the possible approach to the staging of trajectories. In considering trajectories, the NGF wishes to emphasize the challenge of setting emissions reduction trajectories that are economically sound, technically feasible and deliver desired environmental outcomes. Simple linear trajectories, particularly in earlier years, are unlikely to match these requirements.

However the NGF disagrees with much of the Review's analysis in Section 3.5 (p.31 onwards).

First, our information on the pass-through achieved by generators in Europe is different to the 70 per cent quoted by the Review (p.33). ECN states that “CO<sub>2</sub> pass-through rates in Germany and the Netherlands for the period January-July 2005 have been estimated to vary roughly between 40 and 70 per cent.”<sup>1</sup> More generally, the NGF believes that the Review's thinking on cost pass-through and transition aid has been corrupted by the approach to allocation taken in the EU ETS. Unravelling what went wrong in the EU ETS is an important issue in the design of the Australian ETS and it is disappointing that the Discussion Paper failed to provide an objective assessment of the EU ETS. We see several important distinctions between the EU ETS and the proposed Australian ETS as follows.

- The EU ETS covers only 40 per cent of emissions. This limited scheme took more than five years to design and the EU still got it wrong. Phase 2 appears to be no better and it is only in the next phase beyond 2012 that the EU appears to be heading in the right direction.
- The EU failed to understand business behaviour, and allocated excessive permits for free without understanding cost pass-through.

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<sup>1</sup> CO<sub>2</sub> Price Dynamics – ECN Paper – March 2006

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- The EU is failing to achieve virtually any abatement despite the huge cost, due to the setting of inadequate targets and procedures, including flawed national allocation plans.

Second, we do not agree that “free allocation would be highly complex, generate high transaction costs, and require value-based judgements” (p.33). It is certainly possible for Australia to administer a free allocation scheme prior to the introduction of the ETS in 2010, and there are many more complex problems to solve than the administrative allocation of permits. It should be noted, that with respect to electricity generation, and in contrast to the trade-exposed energy-intensive industries, only a small number of players (less than 50) are involved. It would be quite feasible to accommodate electricity generation considerations in any macro-economic assessment of impacts to disadvantaged groups.

Third, the NGF submits that while there is an equity case for administrative allocation to the household sector, there is also an equity case for shareholders who are significantly disadvantaged. However, this is not our principal position. The key issue to be addressed is that of dynamic efficiency of investment and the added risk premium that will be built into future investment in the absence of transitional assistance. The sector seeks transition assistance only for the real loss of asset value and is not seeking to obtain windfall gains. We deal with the issue of transition assistance in greater detail in section 5 of this submission.

Fourth, we disagree with the Review’s analysis with respect to the method of permit allocation and the impact of allocation method on electricity prices. This is discussed below in section 3.1.

### **3.1. Method of permit release: auction or free allocation**

The Discussion paper recommends that permits should be auctioned, rather than ‘grandfathered’ or otherwise administratively allocated. The proposal suggests that some revenues from auctioned permits would be transferred to certain industries (TEEIs) and some would be returned to Australians in various forms, including payments to households, to “declining communities”, to encourage new technologies, and to finance public infrastructure.

The Discussion Paper argues that the decision whether permits should be auctioned or issued free to emitters is not primarily an issue of economic efficiency. Rather, the impact of an ETS on the price of goods and services, including on electricity generators, is said to be independent of the approach adopted for allocating permits.

The assumption that prices will be the same, irrespective of how permits are allocated, follows from the observation that once an emitter has a permit, the marginal cost of using that permit is the implied tax on carbon. This is simply because the emitter faces a choice between using the permit itself and emitting one unit of carbon, or selling the permit to someone else (thereby obtaining payment of the price for emitting one unit of carbon). The opportunity cost of using the permit is therefore the carbon price, and so that carbon price will enter into the emitter’s output and pricing decisions, regardless of whether it originally paid for the permit or was gifted it. As a result, if the carbon price is positive (i.e. there is a tax on carbon), then emitters’ prices will rise to reflect the opportunity cost of using permits, quite regardless of how they came to obtain those permits.

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While this reasoning is correct, it rests on a number of assumptions. To begin with, it assumes that the method of allocation has no effect on market structure and conduct – in other words, that the relationship between prices and marginal costs is unchanged by the method of allocation. However, this is not necessarily the case. There are some circumstances where auctioning might change the behaviour of emitters in their respective output markets relative to gifting. These effects are complex and depend on the specific industry context. However, given the economic importance of key emitting industries such as the electricity supply industry, they cannot be dismissed lightly.

First, the price bid for permits may act as a signal of pricing behaviour in subsequent periods (i.e. the process of auctioning creates an “equilibrium selection” effect).

In an oligopolistic industry setting there is usually no unique “equilibrium” pricing outcome. For instance, the existence of multiple theoretical equilibria is a well-known phenomenon in electricity wholesale markets such as the NEM, in which electricity generators sell their output.<sup>2</sup> It is therefore relevant that in such an industry context, some experimental studies have found that auctions create upward pressure on prices.<sup>3</sup>

Two studies by Offerman and Potters find a clear and positive relationship between entry fees and consumer prices when licenses are allocated via an auction process as opposed to being “gifted”. Specifically the authors found that:

- In the short term, where licenses had been auctioned, participants charged significantly higher prices than if they had been gifted.
- Over the long term, when the entry licenses had been re-allocated a couple of times, the difference in average price levels tended to become much smaller, but the positive correlation between entry fees and prices remained.

Second, the need to finance the purchase of permits may affect the financial structure of emitters and change their investment and output decisions.

It is uncertain what prices permits would attract in an auction. If firms must take on greater levels of debt as a result of buying permits, their investment and output decisions would be expected to change. The effects of leverage on firm behaviour are complex and not fully understood. That said, there are models in which higher levels of leverage induce certain patterns of pricing behaviour and in any event, lead to higher price-cost mark-ups than would otherwise prevail. One intuition underpinning these outcomes is that firms that are more indebted have more to lose from a price war. Since each firm knows that, high price equilibria prove more durable than would otherwise be the case.

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<sup>2</sup> CSEMWP-122 Natalia Fabra, Nils-Henrik von der Fehr, and David Harbord, "Designing Electricity Auctions" (February 2004).

<sup>3</sup> Offerman, Theo and Potters, Jan J.M., "Does Auctioning of Entry Licenses Affect Consumer Prices?: An Experimental Study" (May 2000). Center for Economic Research Working Paper No. 2000-53. Theo Offerman, Jan Potters (2006), "Does Auctioning of Entry Licences Induce Collusion? An Experimental Study", *Review of Economic Studies* 73 (3) , 769–791.

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The introduction of a carbon price will adversely alter the value of some firms' assets, with that change in asset value translating into a reduction in shareholders' equity (as the value of other balance sheet items, such as debt, is presumably fixed in nominal terms). Even absent payment for permits, this will, so long as everything else is unchanged, weaken the balance sheet position of net losers – which in some industries may be the majority, if not the entirety, of the firm population. Unless that weakening is offset, these balance sheet effects could themselves alter firm behaviour, including through the effect of corporate financial structure on the extent of price rivalry.

Third, and importantly, the up-front payments required to obtain permits may induce early exit of some capacity, or bring about a change in industry structure as more liquidity constrained emitters are sold to less liquidity constrained emitters.

It is widely expected that the introduction of an ETS will result in profound structural changes in industries such as the generation sector.<sup>4</sup> At the same time, the initial auction price is uncertain. The experience in EU ETS markets, for instance, suggests that the projections upon which allocations were based embodied far more uncertainty than was acknowledged, resulting in unexpected and 'wild' swings in permit prices.<sup>5</sup> As a result, it is entirely possible that an auctioning process in which the price of permits turns out to be significantly higher than anticipated will induce rapid changes to the current structure of the Australian generation sector.

These risks are all the greater when the difficulties associated with an initial auction are recognised. In an approach in which all or most of the initial permits are auctioned, the initial auction will occur without any clear price reference points (as there will be no pool of already traded permits). As a result, that auction is likely to impose considerable uncertainty on participants, as well as requiring them to incur substantial costs so as to participate in the auction process. Those costs are largely a deadweight loss, as the process itself merely serves to transfer income from firms that require permits to the auctioning authority. There is no reason to think that those costs will be trivial, especially if the ETS has wide coverage, so that a broad range of firms need to participate in the auction.<sup>6</sup> The outcome could therefore be a process that is inefficient on at least three counts:

- 1) In the immediate, because the uncertainty associated with prices may make the auction outcomes inefficient, as participants under- or over-bid<sup>7</sup>;
- 2) Those outcomes might also be secured only at a substantial deadweight cost in terms of the transactions costs participating in the auction imposes on firms; and

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4 For instance, a study for the National Generators Forum concluded that even under idealised least cost conditions, for deep cuts in emissions to 96 Mt per annum in 2050, the total production from existing technology coal plants in 2050 is projected to drop from 144 TWh to 25 TWh. CRA International, "Analysis of Greenhouse Gas Emissions in the Australian Electricity Sector", Report To National Generators Forum, September 2006.

5 Hepburn, C. & Grubb, M. & Neuhoff, K. & Matthes, F. & Tse, M., 2006. "Auctioning of EU ETS Phase II allowances: how and why?," Cambridge Working Papers in Economics 0644, Faculty of Economics (formerly DAE), University of Cambridge.

6 Of course, the costs of participation could be reduced by allowing firms to pool their bids, but this would create a risk of collusion and introduce potentially non-trivial distortions of its own.

7 Having a sequential auction does not resolve this problem, as the very fact of making the auction a repeated event gives bidding decisions a strategic character that can itself distort outcomes.

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- 3) The changes in behaviour induced by the auction in terms of altering equilibrium outcomes in oligopolistic or imperfectly competitive markets.

Overall, these costs cannot be simply dismissed or ignored. Rather, it is apparent that the risks of a failed auction process are considerable, both for participants, but also more generally for consumers and taxpayers. The option of allocating at least a share of initial permits via an administered process would seem to constitute a legitimate approach to reducing the inherent uncertainty of an auction and mitigating potentially drastic impacts on the affected industries. Additionally, it can help mitigate the sovereign risk associated with introducing a policy that substantially devalues assets that investors purchased in good faith in response to signals sent through government decreed market design, and hence reduce the cost of capital in the future.

The Discussion Paper does not deal in any detail with the auction design process nor auction frequency, although it does allude to frequent short-term auctions. Irrespective of partial administrative permit allocation, auction frequency is an important issue for electricity generators committed to forward contracts a long way in advance. The Review will need to consider this issue carefully in order to minimise cost and uncertainty.

## **4. IMPACTS ON ECONOMIC ACTIVITY**

In the NGF's view, section 5 commencing on p.47 relating to the impacts of the carbon price on the economy and in particular on stationary energy and the existing and future generation supply, is the most seriously flawed in the Garnaut Emissions Trading Scheme Discussion Paper. It does not demonstrate the depth of understanding of the Australian electricity market that is necessary to make recommendations that have a high degree of integrity.

The NGF wishes to comment on several issues in this section of the Discussion Paper as set out below.

### **4.1. Existing generation supply**

On p.49 of the Discussion Paper it is stated that "there is some expectation that existing coal generators are likely to remain competitive on a SRMC basis for some time". This is not the case. Some generators, especially brown coal generators, will be unable to compete on a SRMC basis. A significant number of coal-fired plants will also lose significant volume over time, consistent with the purpose of the emissions trading scheme, leading to early market exit. Even very efficient brown coal plant is projected to lose around 35 per cent of generation by 2015 and 60 per cent by 2020 under a linear reduction scenario that achieves a 60 per cent cut by 2050 for the electricity sector alone.

### **4.2. Future generation supply**

The section on p.50 on future generation supply is fundamentally important. The point is correctly made that the dynamics of the Australian gas market will be profoundly affected by the potential large scale LNG export facilities on the east coast, exposing Australian gas to high international prices. This is already occurring in Western Australia where gas for electricity generation is becoming much more expensive.

The report goes on to state that the level of the overall carbon constraint will determine the rate at which lower emission technologies become competitive for new generation supply. While this is true, a more important factor constraining the entry of new generators is the lag times involved in approvals and construction, and the pool price signals arising from the supply-balance. The Discussion Paper appears to assume that entry and exit will occur with perfect information, and without lags or impediments. Clearly this is not the case. The existing generation sector comprises very large plant with high capital value. The generation sector is characterised by large, “lumpy” investments, as they both enter and leave service in the NEM, and there must always be more supply capacity than demand to ensure reliability of supply.

The Discussion Paper also implies that any reduction in coal base-load generation in the early years will be taken up by existing gas generation. While this may be the case in selected parts of the country, such as Newport and Pelican Point power stations, it is more generally not true for gas turbine peaking plant due to limits of the design and duty cycles. Nor is it a simple question of converting open cycle gas turbines to a combined cycle mode for which they were never designed.

The key point is that there is not a seamless, endless, smooth or instant transition to a new world of low emissions electricity supply. Without some form of transitional assistance, the electricity supply process will become uncertain and disjointed.

Finally the report states that “more remote supply, such as wind and geothermal, will generate a need to review the mechanisms that trigger the construction of transmission lines”. The NGF suggests caution in dealing with such infrastructure development issues. The existing rules are that remote generators bear the cost of their shallow connection to the shared network. A more likely situation to arise is that of a radically different congestion regime in transmission; and it is likely that a further review will be needed.

The NGF recommends that the Review’s final report further examines the issue of infrastructure development, be that in relation to transmission lines, gas pipelines or pipelines for carbon dioxide disposal.

### **4.3. The impact of other policy measures**

In section 5.2 of the Discussion Paper (pp.48-52), there is a discussion on schemes complementary to the ETS, such as MRET and the Queensland gas scheme. Although statements are made that these schemes efficiently deliver a least cost outcome, albeit within their design objectives, and, that “at least in the medium term, the result is likely to be a higher cost to achieve the same level of overall carbon constraint that would have been achieved in the absence of MRET”, the Discussion Paper lacks economic robustness in assessing the impacts, costs and benefits of such measures in relation to an emissions trading scheme. It would appear that the Review implicitly accepts the validity of such industry development measures.

Mainstream economic theory would hold that efficiency should be the primary test in designing policy tools and climate policy is no exception.

Industry development whether for renewables, gas or energy efficiency should be assessed and funded if necessary using mechanisms that do not distort the carbon price signal, the electricity market generally and the effectiveness of an ETS.

An important issue is that the introduction of a domestic ETS and parallel complementary measures may impact on the short-term security of electricity supply. The short-term contingency and regulation reserve currently accounts for less than 1 per cent of energy market trading volumes. However, the shift in capacity and generation mix that will prevail under an ETS and other parallel measures may subject the system to much higher risk of failure and will therefore require a higher reserve and a substantially increase in associated costs.

The combination of the ETS and other parallel measures also raises some difficult issues with respect to long term supply reliability. First, as the NEM largely relies on base load coal capacity that may prove uneconomic under a combination of an ETS and other measures, the capacity of the NEM to meet demand during the early stages of the ETS is questionable. For instance, if some coal stations shut down in a particular region, the regional reliability standard of 0.002 per cent may not be achievable unless alternative generation capacity such as combined cycle gas comes online in anticipation of such closures and can provide timely supply replacement. Additional supply could be imported from other regions, but those imports will be limited by the existing transmission capacity. Substantial new investment in transmission capacity could be required to deliver ongoing supply and forecast growth in overall electricity demand.

Second, if a substantial amount of wind and/or solar generation enters the market the long-term reliability of the grid could be compromised because these sources are intermittent. This issue is significant because almost 60 per cent of all new demand between 2010 and 2020 will need to be met from such sources.

In summary, the NGF envisages some formidable new issues emerging for the sector when an ETS is introduced in Australia. As discussed previously in this submission, these issues need to be carefully analysed and the appropriate transition mechanisms put in place.

#### **4.4. “Compensation” to the non-traded sectors**

The approach to “compensation” for the non traded sector taken by the Discussion Paper (p.54) gives the NGF its greatest problem. In particular, the Discussion Paper does not recognise the introduction of the ETS as an issue of sovereign risk. The definition of sovereign risk provided in the Discussion Paper is at once too narrow and too wide. By sovereign risk, the NGF means the risk to an investor when a government, by considered policy action, causes a specific class of investments or assets to become stranded and thereby lose value.<sup>8</sup> Under this definition, the introduction of an ETS causes very substantial sovereign risk.

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<sup>8</sup> This is, of course, similar to the standard definition of a retroactive tax change – the classic reference being Feldstein, M. (1976) “On the Theory of Tax Reform” *Journal of Public Economics* 6:77-104. As Feldstein points out, absent compensation, the risk of such changes will induce “inefficient precautionary behaviour”, including by increasing the cost of capital to all entities exposed to that risk.

Evaluated at today's replacement costs, the cumulated investment in Australia's coal fired stations amounts to tens of billions of dollars. These investments were not made with a view to operation in a carbon-constrained world. Investments have also included extensive and capital intensive mid-life refits over the past 10 years in response to market requirements. At the time the investments were made, they were based on an expectation of capital cost recovery over a long timeframe. However, many coal-fired stations in the NEM have not completed this capital cost recovery period, and will be left stranded in the face of the ETS. This is one of the basic arguments for structural assistance to generators to partly offset the long-term losses in foregone sales that would otherwise have been earned in the energy market created by the government under the NEM.

The report also states that there is no economic reason to provide "compensation" to existing emitters (p.54). Generators fundamentally disagree with this statement. There is a strong case on grounds of dynamic efficiency and ensuring the reliability of electricity supply to Australian industry and households. These issues are discussed in sections 4.4.1 to 4.4.4 below.

#### **4.4.1. Impact of carbon price on NEM generation mix and electricity prices**

In a perfectly competitive market, the price for a product or service will reflect the efficient costs of producing that product or service. If efficient costs rise, ignoring other constraints such as contracts and regulation, prices will rise also. In such a model, the market price is set by the (short run) marginal costs of the marginal producer supplying the market; in general terms the NEM also works in a similar way as the price is set by the marginal generator except that the price is not always equal to the short run marginal cost of production. Under this outcome, all generators receive the marginal price and this yields economic rents to all those generators whose average costs are lower than the short run marginal cost of the marginal generator (i.e. the infra-marginal generators). This is an important point when considering the impact of an ETS on the generation sector because such rents contribute to meeting producers' fixed costs.

With the introduction of an ETS, the infra-marginal generators are "levied" an additional charge. However, it is expected that the marginal generator(s) will not receive such a charge (e.g. hydro) or the charge will be limited (e.g. gas fired generation) and therefore their offers to the market will not alter significantly. In other words, while the costs of the infra-marginal (gas and especially coal) generators will rise (because they will be "burning" permits that they could have sold to emitters in other markets), the market prices they receive at peak times will not rise, or will not rise proportionately (because that peak price is set by generators who emit less).

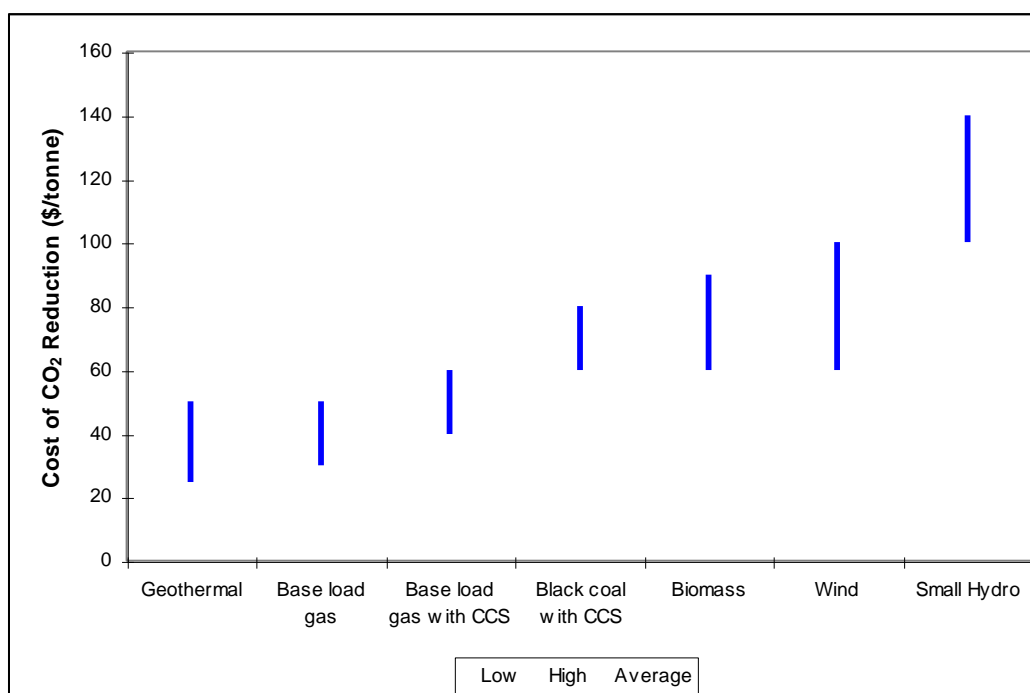
Of course, there may be times under an ETS regime when an infra-marginal generator becomes the marginal generator. However, it is anticipated that when the coal-fired generators are at the margin, their volumes sold will not increase sufficiently to cover higher average variable costs (and may actually decrease) and the ability to capture long run costs will be impeded in this instance as well.

Clearly, the ability of generators in the NEM to pass on their costs has been a significant issue over the history of the market. Base load generation has significant fixed costs and lower variable costs. The imposition of an ETS therefore needs to be carefully implemented in such a way that does not damage the supply of electricity while transitioning to a lower emissions future. This is further explained in the following analysis.

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Carbon prices and the generation mix are intricately linked because different generation technologies are rendered potentially uneconomic at different carbon prices. [Figure 1](#) gives an indicative assessment of the cost of emission reductions. The cost of emission reductions is developed as a range to reflect uncertainties about the capital and operating costs. As the figure demonstrates, the carbon price needs to rise substantially over time to pull most forms of renewable energy into the mix.

**Figure 1: Indicative Cost Range of CO<sub>2</sub> Reduction for Clean Technologies**



Base load gas with and without CCS is likely to be the first large scale source of emissions reductions (with the exception of geothermal which may have a relatively limited resource potential or very high transmission costs) to be encouraged under the ETS. Beyond the initial phase of the ETS when minor abatement may be achieved by adjustments within the current system (for example, a switch from existing brown coal to existing black coal generation), the NEM is likely to witness a major influx of gas based generation. However, this will be tempered by resource limits on both the volume of gas and how much gas fired base capacity (both generation and transmission) might realistically be built over a relatively short period. Moreover, a major increase in gas demand by generation will raise gas prices. Such an effect would be exacerbated by any linkage of the east coast gas market to international markets via the potential production and export of LNG from Queensland. These factors would suggest that gas alone is unlikely to be adequate in meeting the long-term target.

Coal with CCS and most renewable technologies, including wind, are projected to be economic at a carbon price in the range of \$60-140/tCO<sub>2</sub>. The long-term carbon price is expected to rise rapidly post-2030 as gas capacity resource limits are approached. The underlying change in capacity and generation mix that the ETS will bring about will of course be reflected in the NEM prices. Generators will need to recover their substantially higher capital expenditures through higher energy prices.

#### **4.4.2. Impact on existing coal generation assets**

The high emissions intensity of existing coal generators in Australia renders most, if not all, of that generation uneconomic in the long run under an ETS. The timing of the impact varies between power stations because they have different vintages, technologies, sizes, and configurations, and hence substantially different cost and emission characteristics.

At relatively low carbon prices (around \$20-30/tCO<sub>2</sub>) and current black coal and gas prices, brown coal becomes less competitive than black coal, and becomes uncompetitive compared to gas. Since some of the brown coal stations have high fixed O&M costs, these stations will become unprofitable under increasingly high carbon prices and will be shut down progressively. This is a clear aim of the ETS but this will lead to issues in relation to system security and reliability and wider issues for the labour force employed in the plant and servicing mines.

The long-term loss in net revenue for black coal stations will vary depending upon the efficiency, emission intensity and cost structure of the plant. Less efficient older coal stations may lose up to 40 per cent of the long-term net revenue potential that they might otherwise have expected.

#### **4.4.3. Why are these effects problematic?**

It may well be asked why the closure of coal fired stations is problematic in the sense that the purpose of the ETS is to achieve abatement. As discussed above, it is not the eventual transition of the generation sector out of higher emissions forms of power generation that is at issue but rather the pace at which this occurs.

The NGF has recently undertaken extensive sectoral modelling in which it has explored the impact on the electricity sector of achieving a 60 per cent cut in emissions from the sector by 2050 and approximately a 20 per cent cut by 2020, as well as other less stringent scenarios. Such studies are not capable of indicating the likely economy-wide carbon price but they do provide a good indication of the likely impact on the sector itself of the modelled carbon prices. The carbon prices commenced at \$20/t CO<sub>2</sub> in 2010 and rose to \$80/t CO<sub>2</sub> by 2030 and \$150/t CO<sub>2</sub> by 2050. This resulted in the average pool price rising to \$100/MWh by 2030. The simulation resulted in a high impact on brown coal generators immediately with a strong impact on black coal generators over the following decade.<sup>9</sup>

Reduced generation, and potential closure of, existing brown and black coal stations will have far reaching consequences for the NEM overall and some regions in particular that goes beyond pure economics.

Closure of any of the major coal stations in Victoria will lead to a loss of at least 10,000GWh/y of generation, or a 20 per cent loss of the State's existing generation requirement. This shortfall will need to be met through imports from other states and major gas based capacity developments that are constructed in a timely manner.

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<sup>9</sup> The NGF is willing to share the modelling results with the Review Secretariat.

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An increase in imports puts significant additional pressure on the NEM transmission infrastructure. While additional transmission capacity can be built in due course, or existing transmission line capacity can be enhanced, such expansions will take considerable effort and time and are not currently planned. The current physical capacity can certainly accommodate additional transfers – however there needs to be a critical examination of the implications of such transfers on reliability of supply.

If regions become reliant on imports to support its peak demand, a loss of interconnection may breach the security standard in the short term and the State may also breach the long term 0.002 per cent reliability standard.

Increasing gas based generation capacity may address these security and reliability concerns. However, the construction of around 2,000 MW of base load gas capacity in a short time span is a major undertaking. Ensuring the availability of long-term gas supply, pipeline infrastructure, and construction of power stations, may potentially take many years and would need to be planned well ahead of the closure of brown coal power stations.

In the longer term (post 2020), it is envisaged that carbon prices will rise to a point where most black coal stations would also find it difficult to compete with gas and other clean technologies. Beyond 2030, these stations would also face major reductions in dispatch volume and might need to be closed depending on the emissions reduction targets finally chosen by the government. Therefore, the near term trend in Victoria is likely to be revisited in other States.

The long term security and reliability of the NEM critically hinges on a successful resolution of brown coal capacity issues in Victoria and South Australia.

Lack of adequate base load capacity in the system would have unintended consequences such as an increase in NEM price volatility because any loss in generation and transmission capacity would leave the system with very little reserve margin. Therefore, even if the system is secure, pool prices may jump more frequently to thousands of dollars. While retailers and direct customers could hedge their positions by purchasing financial contracts, a lack of base load capacity would render the contracts market tight and the forward contract prices would also reflect higher expected prices in the spot market. Were this to result in a lower degree of contract cover, bidding behaviour in the NEM would change in ways that would tend to increase price-cost margins.

Therefore, apart from a security/reliability concern, the overall health of the NEM in terms of remaining a competitive marketplace needs to be assessed if it loses a significant share of its existing base load capacity through coal plant decommissioning.

In addition to finding physical solutions, such as enhancing interconnection and building cleaner forms of generation capacity, there is also an argument for other transitional arrangements. If the existing coal capacity is of value from a security and reliability perspective for a sufficiently long time, some form of transitional assistance may be warranted.

In summary, we recognise that the ability of the system to cope with abrupt losses of large segments of capacity is an important issue. System security in the short term and reliability in the longer term may pose real challenges to the future of power supply in Australia. These issues need to be adequately addressed through a detailed analysis of the market to ensure appropriate information is available to decision makers. This is crucial so that replacement and expansion of transmission and generation capacity can be anticipated and planned in a timely way to cope with any loss of base load capacity. A phased displacement of higher greenhouse gas emitting plant in the longer term is possible with adequate planning, transitional assistance and examination of alternatives to ensure that the NEM continues to provide secure and reliable power supply.

#### **4.4.4. Transitional Arrangements**

In the NGF's view, the need for suitable transitional arrangements arises for the reasons set out below.

- Existing coal station owners face a major issue of stranded investment as their multi-billion dollar assets face being shut down, in many cases well ahead of their engineering life with a possible negative impact on system security.
- One way of offsetting generator loss would be to administratively allocate permits. There is a range of alternative methods for calculating the number of permits under an allocation system, but any methodology should measure the net loss to the generators' business relative to what their profitability would have been without the ETS. Coal generators may lose substantial volumes under the ETS but the volume losses can vary widely across generators. Since a part of the ETS costs could potentially be passed through to the pool price, generators may be partially compensated and the calculation and allocation of permits should also take these interactions into account.
- While allocation of permits may provide an adequate means to offset losses faced by generators, this does not necessarily solve other issues that may jeopardise the operation of the NEM. What is required is a system that guarantees a smooth change out, or modification, of carbon intensive capacity. Under an ETS, owners of emissions intensive stations for example may find it more attractive to opt out of the market. In such an event, the NEM will have to cope with a major loss in generation capacity especially in Victoria and South Australia in the near term. There may be several unintended consequences associated with this including:
  - a breach in the short term security standard if for example Victoria and South Australia become highly reliant on imports and loss of interconnection leaves the system inadequate to meet demand;
  - a breach in the long term reliability standard if for example Victoria and South Australia cannot replenish their generation capacity and therefore cannot keep the expected unserved energy below 0.002 per cent of the total energy threshold; and

- even if these security and reliability standards are met, there may be an increase in pool price volatility and sustained high pool/contract prices due to the lack of sufficient base load capacity and competition in the NEM, or parts therein.

Given the severity of some of these consequences, it is imperative that detailed assessments are made to avoid these undesirable outcomes. A phased retirement of the existing coal capacity will likely minimise the risk of such outcomes. There also needs to be a similar detailed assessment on the veracity of assumptions made about replenishing any lost capacity with cleaner forms of generation. This needs to encompass a wide range of gas supply infrastructure and pricing, a realistic assessment of what renewable technologies can deliver, the time in which clean coal technologies are likely to be available in Australia, the rate at which new capacity can be introduced in the NEM and the maximum build that can realistically be achieved for technologies such as CCS. Transitional arrangements need to be designed based on the answers to these critical questions.

## **ACKNOWLEDGEMENT**

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## APPENDIX 1: THE AUSTRALIAN NATIONAL ELECTRICITY MARKET

### A1.1 Physical Characteristics

The Australian National Electricity Market (NEM) is a wholesale electricity spot market in which generators and retailers (and major direct end-users) sell and buy electricity. The NEM covers the electricity market in New South Wales, Victoria, South Australia, the Australian Capital Territory, Queensland and Tasmania. At present the NEM includes 62 major generation facilities and 43 market customers.

The NEM commenced operation in December 1998 and has been successfully operating around the clock to supply electricity to nearly eight million end-users. In 2006-07, 196,000 gigawatt hours of electricity valued at \$11.5 billion was traded in the NEM.

The National Electricity Market Management Company (NEMMCO) operates the NEM. Generators bid their available generation volume in the spot market in real time. As the market operator, NEMMCO is responsible for clearing the market to determine the spot price. Generators are paid only for the cleared energy volume, that is, there is no separate payment for their available capacity unlike the situation in some overseas electricity markets. Further details on the mechanics of spot price setting are provided in the next section.

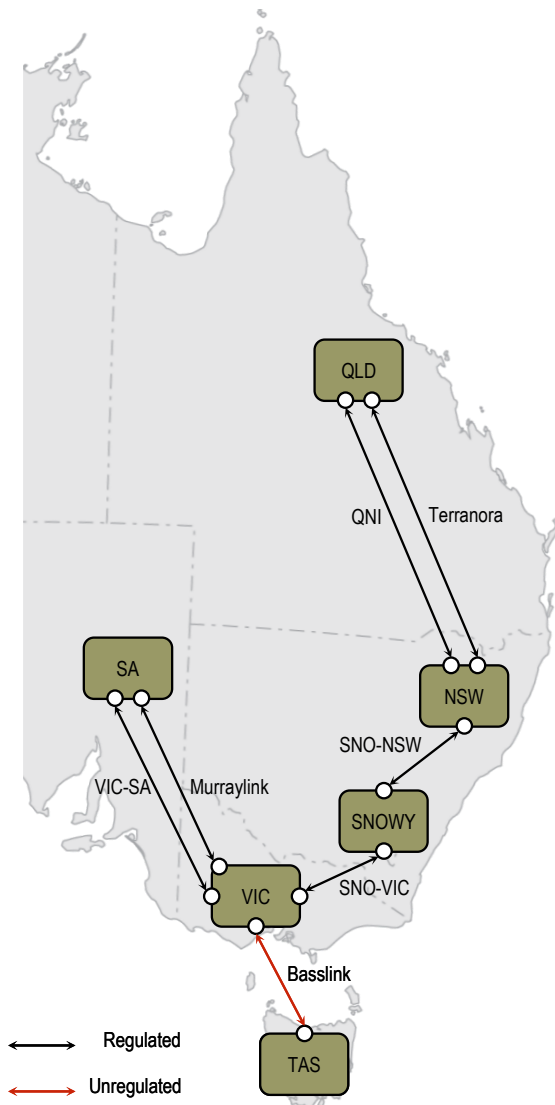
Today, the total generation capacity in the NEM is approximately 40 gigawatts, valued at over \$30 billion. Since its inception, the market has successfully attracted new investment to meet growing electricity demand (150,000 gigawatt hours in 1999-2000 to 196,000 gigawatt hours in 2006-07).

The NEM currently operates as an interconnected system with spot prices set every five minutes for each of the six regions<sup>10</sup> shown in Figure A1. Most of the 'interconnectors' are presently regulated assets with the exception of Basslink which is unregulated and bids its capacity in the NEM. Although the interconnection capacity among the NEM jurisdictions has improved considerably over the past ten years (with the addition of Basslink, QNI, Murraylink and Terranora), there is still the potential for congestion on some corridors, such as between Victoria and South Australia.

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<sup>10</sup> The Snowy region will be abolished from 1 July, 2008 leaving the NEM consisting of five regions.

**Figure A1: Configuration of the National Electricity Market**



Source: Chattopadhyay (2006)

The distribution of generation and demand across the NEM regions varies a great deal as set out below.

- New South Wales accounts for 39 per cent of the total energy requirement and is heavily dominated by black coal generation.
- Queensland consumes 26 per cent of the NEM total energy and also has a generation mix dominated by large base load coal, although gas is playing a more significant role following the introduction of the Queensland Gas Scheme to promote gas based generation in Queensland.
- Victoria accounts for 24 per cent of the total energy requirement and its generation primarily relies on brown coal generation in the La Trobe valley.

- South Australian demand accounts for approximately 6 per cent of NEM energy requirements. Its generation is a more even mix of gas and brown coal. Although South Australia accounts for a relatively small share of energy, the pattern of demand is quite distinct from other regions because of the number of extreme temperature days that occur in the State. As a result, South Australia has a distribution of load that has a distinctly high peak load relative to total energy use.
- Tasmanian demand accounts for a relatively small share of approximately 5 per cent of the NEM output. It produces over 95 per cent of its regional generation from hydro resources and the remainder from gas.

Overall, 90 per cent of total NEM demand is distributed among three major states. This demand is met primarily using black and brown coal generation, which accounts for approximately 60 per cent and 25 per cent of the NEM total generation respectively. The remainder is met by a mix of gas (7 per cent), hydro (7 per cent) and other renewables (1 per cent).

The carbon emissions intensity (tonnes of emissions per megawatt hour) in the Australian electricity sector is relatively high because of the dominance of coal in the generation mix. Emissions intensity for brown coal falls in the range of 1.2 - 1.6 tonnes/MWh. Emissions intensity for black coal stations range from approximately 0.9 - 1.1 tonnes/MWh. The current NEM emission intensity (the average emission intensity across the total generation volume) is around 1 tonne/MWh.

NEM demand over the next ten years is projected to grow between 1.9 per cent and 3.4 per cent per annum depending on the growth rate of the Australian economy. It follows that a substantial reduction in carbon dioxide emissions would require large scale investment in low carbon sources such as gas (which is about half as emissions intensive as black coal), zero emission energy sources such as wind, biomass, solar and geothermal, and potentially clean coal and gas technologies that capture and permanently store carbon dioxide in underground sinks.

## A1.2 An overview of the NEM design and operation

The NEM is one of the most advanced electricity markets in the world. It uses a comprehensive methodology to ensure that the market meets demand at the lowest possible cost and that the system has enough reserve generation to ensure that any major loss of generation or transmission capacity can be covered in a timely and economically efficient way.

The key features of the NEM design and operation are as follows.

- **The NEM is an 'energy only' market:** Generators need to reflect all their generation related costs including any fixed capital costs through their supply offers for energy. This gives a very strong signal to generators to ensure that they are available when prices are high and has driven the very significant increases in generator availability. There is no separate payment for making capacity available as occurs in Western Australia and some overseas markets, most notably in North America. Generators' supply bids typically have ten bands with increasing offer prices for incremental generation.

- **Setting energy spot prices in the NEM:** As the market operator, NEMMCO runs a real-time auction every five minutes that takes into account the supply offers from all generators and demand for the period. The market clearing engine, known as the NEM Dispatch Engine (NEMDE), optimises the selection of offers that meet demand at the lowest possible cost for the five-minute period. The spot price for the five-minute period reflects the marginal cost for the period. This means that it is typically the offer price for the marginal generator that will be called on to meet any increment in demand in that period. The NEM uses a price cap, called value of lost load (VoLL), on energy spot prices that is currently set at \$10,000/MWh, and a negative cap set at -\$1,000/MWh.
- **Behaviour of electricity spot prices:** Wholesale market spot prices for electricity vary due to changes in demand and supply. These variations are accentuated because of the inability to commercially store large quantities of electricity and are affected by the time of day, day of the week and the season – for instance, late at night there is typically a significant amount of spare capacity and therefore prices are low. Peak prices are substantially higher because supply capacity is close to demand and more expensive generation fuels such as gas are called into the generation mix. The generators called upon at peak typically have low fixed costs but high variable costs, and the need to cover these costs, as well as cover the fixed costs in a small number of hours in service, make the increase in price particularly marked as demand approaches total supply. There are also many other factors such as water shortages that may limit generation from cheaper resources such as hydro and even some coal stations. Transmission constraints may also prevent low cost generation available in one region from meeting the demand in another region. Prices may also be affected by a sudden loss of generation or loss of an interconnection, or a major surge in peak demand. These events, combined with the lack of any significant demand response to price in the short term, may drive the spot price up to the VoLL. Prices in the NEM have exhibited a high degree of volatility in the past.
- **Financial contracts:** The uncertainties in pool prices pose significant business risks for both generators and retailers. This is especially so because generators' costs are largely fixed (which means that facing highly variable, and correlated, output volumes and prices is risky), while retailers, who buy and then re-supply power, have largely fixed revenues (so that fluctuating input prices have the potential to severely squeeze their margins). Both parties usually enter into financial contracts of some form to hedge their mutual position against price volatility risks. Generators that have a large share of their capacity locked into contracts that guarantee a fixed price for the bulk of their generation are far less dependent on spot price outcomes. Similarly, wholesale energy purchase costs form a significant part of the cost incurred by retailers, and having certainty around these costs is paramount to their businesses. In addition to base load contracts, retailers also buy other products such as 'cap' contracts that protect them from volatility in NEM prices during peak hours. Some retailers have even gone to the extent of buying/building their own peak generating station to develop physical hedges against peak price volatility. Contract portfolios for generators and retailers are commercially confidential and therefore it is not known what share of the NEM generation capacity is contracted. However, there are some studies and surveys that estimate that up to 80 per cent of base load capacity is contracted (see for example Anderson and Hu, 2006 and Intelligent Energy Systems, 2004).

- **Short-term security measure:** The available spare generation capacity that can be ramped up quickly for each subsequent five minute period is called the frequency control ancillary services (FCAS). FCAS is scheduled together with projected energy demand to cater for any unforeseen events such as a major generation/transmission outage. This is a short-term security measure that needs to be observed for all hours of the day. Generators also put in offers for FCAS that differ depending that differ depending on the speed at which such reserve generation can be ramped up (e.g., 6 seconds, 60 seconds, 5 minutes). Apart from contingency reserves, generators also provide frequency control services to deal with small random fluctuations in demand. NEMDE simultaneously clears both energy and reserves for the five-minute period and sets a price for reserves. Reserve requirements vary depending on the time of day but the total reserve is on average approximately 850 MW for the whole NEM (which is a small fraction of peak demand). Reserve prices are typically a very small fraction of the energy price because provision of reserve has little direct cost. As a consequence, total reserve market trading is around 0.5 per cent of energy market trade at present.
- **Medium term reliability of supply:** While the NEM is fundamentally a short-term trading arrangement that leaves generation investment and asset maintenance decisions to the market participants and/or potential new investors, there is a longer term process in place as part of the NEM design to ensure that there is a sufficient foresight built into the design so that system reliability is not jeopardised. NEMMCO publishes a medium term projected assessment of system adequacy (MT PASA) that provides a two year projection of system reserve (or spare generation capacity). If MT PASA predicts a shortfall in forecast reserve, NEMMCO can respond, for example by entering into a reserve capacity agreement with generators or issuing directions to change any planned maintenance. There is also a broader annual unserved energy criterion that stipulates that the system should deliver 99.998 per cent of the energy in each region – that is, the expected unserved energy in each region should not exceed 0.002 per cent of the forecast energy requirement each year. This criterion sets the short term reserve requirement and in turn guides NEMMCO to secure additional reserve capacity with generators if required.