Submission

The Climate Institute

Independent Review into the Future Security of the National Electricity Market

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The Climate Institute welcomes the opportunity to provide input to the Independent Review into the Future Security of the National Electricity Market.

This submission comprises two parts: first, a detailed discussion of the five priorities we believe the review needs to address, which are summarised below, and second, responses to a selection of questions from the Independent Review's Preliminary Report. For further information regarding any of the issues covered in this submission, please contact Olivia Kember, Head of Policy at The Climate Institute, at 02 8239 6299 or okember@climateinstitute.org.au.

Five priorities for the future security of the national electricity system:

1. **Stable and predictable climate policy is critical to efficient investment in the electricity system and therefore to solving the energy trilemma of security, affordability and decarbonisation.**

   In response to the ongoing lack of clarity over the electricity sector's emissions reductions requirements and delivery mechanisms over the next few decades, investors are deferring expenditure on new and existing assets until clearer policy signals emerge. This results in the deterioration of energy security and affordability, leading to higher costs which are borne by energy users and the public at large. Reducing these costs is likely to require more than a single policy.

   To date, experience of carbon markets around the world and in Australia indicates that, as standalone mechanisms, they struggle to drive the investment changes needed to decarbonise electricity systems. This suggests that, while carbon markets may be an essential part of a climate policy package, they need features that increase the effectiveness of long-term price signals, such as long-term legislated emissions constraints, and they need to be buttressed with other policies. For example, a carbon market could be back-stopped with regulations that clearly define conditions under which emissions-intensive generators must retire. This could be done with the expectation that the regulations should not need to have an impact, because the carbon market would be the primary driver of retirements, but the presence of the regulation increases the strength and clarity of the investment signal and provides greater certainty of achieving expected emission reductions.

2. **Investor attention to the emissions reductions required under the Paris Agreement indicates that policies will not be considered stable and predictable unless they are consistent with electricity decarbonisation before 2050.**

   Investors are increasingly cognisant of the implications of the Paris Agreement for energy investments. The Financial Stability Board's task force on climate-related financial disclosures (FSB TCFD) was established in 2015 to develop an appropriate framework for companies to report on their exposure to several types of risk associated with climate change, including transition risks and physical risks. The FSB TCFD's recent draft report warns that "the utility sector's asset valuations are most at risk from the disruptive impact of the policy, technology, and portfolio changes that will occur over the next two to three decades as policies, technology, and markets shift to a low-carbon energy system."[1] Institutional investors representing $1 trillion in assets under management have begun requesting electricity companies disclose their financial resilience to transition scenarios consistent with the Paris Agreement's <2°C and 1.5°C global temperature goals.[2] Last week in a speech on climate risk a representative of the Australian Prudential Regulation Authority noted that APRA will be expecting its regulated entities to consider the potential impact of climate-related risks under different scenarios and over different time horizons, with a particular focus on Paris Agreement-consistent transition scenarios.[3]

   Scenario analysis by CSIRO indicates that the electricity system will be required to contribute at least 50 per cent of total national emissions reductions under <2°C and <3°C scenarios.[4] Multiple analyses by CSIRO[5], the Climate Change Authority[6], The Climate Institute[7], and the International Energy Agency[8] show that the sector's emissions intensity will need to approach 0.1tCO2e/MWh by 2040. However, the government's current 2030 target suggests that the emissions intensity of the electricity sector would decline only to 0.55tCO_2e/MWh by 2030. Investors will likely draw various inferences from this research: that policy settings will have to adjust to drive much steeper emission reductions beyond 2030; that the 2030 target itself may be revised to drive more emission reductions before 2030; that the electricity sector will have to reduce emissions by a more than proportionate share of the national target; or indeed all of the above. To encourage efficient investment, emissions reduction policy for the electricity should be set with parameters that are demonstrably consistent with the objectives of the Paris Agreement.

3. **Improve the predictability and timeliness of coal generator exit to smooth the impacts of the energy sector transition.**

   A key stressor of the electricity system is a mismatch in timing and type between exiting and incoming generators. New large-scale generation tends to require at least 3-5 years to plan, finance and build; recent generator retirements have occurred barely six months after they are announced. Although further retirements are inevitable even in the absence of climate policy, any effective emissions reduction policy will either directly or indirectly drive emission-intensive generators out of the market and incentivise new replacement capacity. However, few climate policy types can be relied on to do this smoothly. Without a strategy for orderly retirements, it is likely that Australia will continue to suffer the significant social, economic and environmental costs of disorderly transition. A first step is for policy makers to recognise the need for future emissions-intensive generator retirements to be done on a transparent schedule consistent with the security, reliability and decarbonisation of the electricity supply, and the ability of affected communities to prepare for and manage the impacts of closures.

4. **Electricity system planning needs to recognise full decarbonisation before 2050 as a long term goal, and test options for investment against compatibility with this objective.**

   The planning processes currently undertaken by energy agencies tend to focus on the impacts of incremental change to the existing system. This approach is inappropriate for a system that is rapidly transforming, has multiple possible future pathways, and needs to achieve decarbonisation alongside traditional goals of energy security and affordability.

   Decarbonising the electricity supply to an emissions intensity of less than 0.1tCO2e/MWh before 2050, as required by Australia's international climate commitments and as increasingly expected by energy investors, is an objective that can be reached via many pathways. Incorporating this objective into planning frameworks allows the sector to better understand what those pathways might be, the degree of required transformation from the current situation, and the risks, opportunities and areas for reform associated with decarbonising electricity while maintaining security and affordability. Draft guidance from the Financial Stability Board's taskforce on climate risk recommends that corporations test their performance under a <2°C scenario as well as other challenging scenarios.[9] A similar approach should be considered by energy agencies.

   An obstacle may be the current National Electricity Objective. Its lack of the decarbonisation element of the energy trilemma may explain why energy agencies have failed to consider the risks to efficient investment and the long term interests of consumers of specific emission reduction targets and climate change scenarios. The NEO and its associated rules should at a minimum be updated to encourage consideration of the costs and benefits of emissions reductions targets as well as the costs of emissions reductions policies. Consideration should also be given to incorporating into the NEO a clear 1.5-2°C-consistent decarbonisation objective.

5. **The risks posed by climate change to electricity security urgently need to be assessed and managed.**

   Climate change affects the performance of electricity infrastructure, the availability of essential resources such as water, and levels of electricity demand. Analysis indicates that the extreme temperatures of 2015 will become the "new normal' by 2030 on the current emissions trajectory, and by 2040 under all emissions trajectories.[10] Decreased water availability due to climate change will reduce usable capacity of 81-86 per cent of world thermo-electric generators worldwide during 2040-2069.[11] Maintaining security of the electricity system requires incorporation of plausible climate conditions into risk management at both the level of the individual asset and the system as a whole. Climate risk management needs to address changes in extremes, variance and threshold exceedance. Some limited attempts are underway to incorporate climate change risks. But given the interconnectedness of the elements of the electricity system, more holistic risk assessment and management is needed.

Section 1

1. Stable and predictable climate policies are critical to efficient investment in the electricity system and therefore to solving the energy trilemma of security, affordability and decarbonisation.

The Preliminary Report rightly notes that climate policy uncertainty is a key hindrance to investment in the electricity system. The lack of clarity regarding the required emissions reductions from the sector over the next few decades is leading investors to defer expenditure on existing assets as well as new assets until clearer policy signals emerge.

This uncertainty has already inhibited electricity sector investment for at least several years. In 2014, PricewaterhouseCoopers surveyed banks about the conditions for the energy supply industry in debt markets. PwC found that despite good conditions in the broader debt markets, electricity suppliers, particularly generators, struggled to access capital. The three key reasons were policy uncertainty, lower than expected demand, and environmental concerns. The introduction and repeal of the carbon price and the review of the Renewable Energy Target (RET) "significantly increased the level of uncertainty in the market for banks that lend to generation assets. Some banks cited these events as further entrenching of banks' position of supporting only corporate energy companies and projects with long-term PPAs".[12]

Prolonged climate policy uncertainty leads to the deterioration of energy security and affordability in several ways:

+ Operations and maintenance spending on emissions-intensive assets is likely to be minimised, potentially resulting in assets more prone to unexpected outage and more vulnerable to extreme events, and a more fragile electricity system. These impacts are unlikely to be visible until they occur, and so will not be addressed through planning or operational processes.[13]
+ Ad hoc retirement of the most marginal assets occurs without signals to ensure appropriate replacement energy services are available, increasing the fragility of the system, and presenting challenges to system operations, financial arrangements and investment.[14] [15]
+ The balance of supply and demand tightens, raising prices and potentially leading to supply shortages.[16]
+ The costs of financing investments rise, raising project costs and deterring investment. Modelling for the federal government noted that climate policy uncertainty could increase risk premiums for energy projects by around 400 basis points,[17] and warned "A higher risk premium implies less investment in these sectors which reduces the supply of production capacity in this sector and causes electricity prices to rise. This raises the cost of production in each energy sector which feeds into higher input costs across the economy."[18]
+ Investments that proceed may be resilient to future climate policy changes but sub-optimal from a societal or system perspective. CSIRO has found that ongoing climate policy uncertainty affected investors' choices such that electricity prices were 17 per cent higher by 2050 than in the scenario with a predictable climate policy framework.[19]
+ Pre-existing problems in the electricity market, such as limited competition, may be exacerbated, as potential solutions may be deferred until climate policy uncertainty is resolved.[20]

Few of these costs have been quantified, so it is difficult to assess their collective impact. However, the studies cited above, as well as Australia's recent experience of price and security shocks, indicate that the costs of uncertainty are already significant and will grow if climate policy remains unclear. As illustrated by blackouts in South Australia, the retirement of Hazelwood, and the freeze of investment under the RET, among other concerns, these costs are paid by energy users and the public at large.

Reducing the costs of policy uncertainty is unlikely to be done through a single climate policy. Broadly, policies need to incentivise new clean energy services, enforce the timely retirement of high-carbon capacity, minimise costs and fairly allocate them. Carbon pricing mechanisms such as an emissions intensity scheme or emissions trading scheme are in theory best positioned to tackle most of these objectives, though it should be noted that market barriers may also need specific policy interventions.

However if such a policy were to be established, it would only be effective if investors were confident that it would deliver price signals of sufficient robustness.[21] Almost all examples of carbon pricing in Australia and around the world suggest that, as currently implemented, emissions markets are too volatile and weak to provide the long-term signal necessary to affect major electricity investment decisions.

The IEA has noted: "After more than a decade of using carbon markets globally, carbon pricing policies are not delivering their theoretical potential. Realistically achievable carbon prices in the short to medium term do not appear high enough to drive the investment and operational changes needed to decarbonise electricity systems... in some OECD countries where electricity demand is not growing, a large amount of spare conventional power generation capacity has led to low load factors, low electricity wholesale prices, and mothballing of plants; this also makes the case for market-based low-carbon investment more tenuous."[22]

This suggests that, while emissions markets are an essential part of a policy package, they need features that diminish volatility and increase long-term price signals, such as long-term legislated emissions constraints, and they need to be buttressed with other policies. Multiple policies in theory increase costs by diminishing efficiency; however, if they significantly reduce the range of investment uncertainty and provide clearer guidance as to required emissions reductions, these benefits may more than compensate. Back-stopping an emissions market with, for example, regulations that clearly define conditions under which emissions-intensive generators must retire, could be done on the basis that the regulations should not need to have an impact, because the emissions market would be the primary driver of retirements, but the presence of the regulation increases the strength and clarity of the investment signal and provides greater certainty of achieving expected emission reductions.

2. **Investor attention to the emissions reductions required under the Paris Agreement indicates that policies will not be considered stable and predictable unless they are consistent with electricity decarbonisation by or before 2050.**

The Paris Agreement defines the long-term objective of collective action as limiting global warming to "well below" 2°C above pre-industrial levels, with a commitment to pursue action to limit warming to 1.5°C. To achieve these goals, countries agreed to achieve net zero emissions. Australia will consider its long-term emissions pathway as part of the 2017 climate change policy review.

Investors are increasingly cognisant of the implications of the Paris Agreement for energy investments. The Financial Stability Board's climate disclosure task force (FSB TCFD) was established in 2015 to develop a framework for appropriate disclosure by companies of their exposure to several types of risk associated with climate change. The FSB TCFD's recent draft report warns that "the utility sector's asset valuations are most at risk from the disruptive impact of the policy, technology, and portfolio changes that will occur over the next two to three decades as policies, technology, and markets shift to a low-carbon energy system."[23] In conjunction with similar bodies in the US, Europe and Asia, Australia's Investor Group on Climate Change (IGCC), whose members collectively represent $1 trillion in assets under management, equivalent to half of Australia's entire superannuation pool, has set out guidance for investors in electricity supply companies to improve climate risk management. Suggested questions for companies include:

+ Has the company undertaken a <2°C (or 1.5°C) scenario stress test?
+ Does the company assess the impacts of such scenarios on the company's full portfolio of power generation assets and planned capital expenditures through 2040, including the financial risks associated with such scenarios?
+ How robust is the strategy in relation to technology such as a rise in energy storage possibilities or to changes in water availability?
+ Is there a timeline for the phase out of coal-fired power plants?
+ How is the company revaluing assets as projected closure dates approach to avoid large, sudden write-downs?
+ How is the company managing capital provisioning for site remediation?[24]

APRA recently described its evolving approach to climate risk along similar lines, though with a focus on the systemic implications for the financial sector. APRA representative Geoff Summerhayes noted in a speech that "The [Paris] agreement provides an unmistakable signal about the future direction of policy and the adjustments that companies, markets and economies will need to make". Mr Summerhayes noted that APRA will be expecting its regulated entities to consider the potential impact of climate-related risks under different scenarios and over different time horizons, with a particular focus on Paris Agreement-consistent transition scenarios.[25]

Investors and financial regulators are also increasingly aware that by defining a long-term temperature objective, the Paris Agreement has implicitly defined the total net amount of greenhouse gas emissions the world can release. This amount is termed a global 'carbon budget'. Budgets can be smaller or larger, reflecting greater or lesser probability of achieving a desired temperature goal. National carbon budgets can be derived by applying ethical and economic considerations: for example, the fair allocation of emissions across countries, and the economic risks of targeting larger or smaller budgets. Sectoral carbon budgets may be derived by examining sectoral emissions reduction under an idealised technology-neutral economy-wide policy consistent with the desired temperature goal. A key consideration for emissions reduction policy is how to "spend" a carbon budget over time; slower emissions reductions in the short term imply steeper declines in the future, and vice versa. Box 1 below outlines the relationship between the Paris agreement's temperature goal and the timeframe for emissions to decline to net zero.

How the Paris Agreement's temperature goal sets deadlines for global net zero emissions

Article 2 of the Paris Agreement sets the objectives of keeping global temperature rise "well below 2°C" and pursuing efforts to achieve 1.5°C. Article 4 of the Agreement sets out the emissions objective that would enable these temperature goals to be met: global net zero emissions within the second half of this century:

> *In order to achieve the long-term temperature goal set out in Article 2, Parties aim to reach global peaking of greenhouse gas emissions as soon as possible, recognizing that peaking will take longer for developing country Parties, and to undertake rapid reductions thereafter in accordance with best available science, so as to achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century, on the basis of equity, and in the context of sustainable development and efforts to eradicate poverty. (Emphasis added)*

It would be false to interpret this as an option to delay net zero emissions until 2100. Article 4 requires countries to undertake emissions reductions in accordance with the best available science, and the best science currently available clearly shows that limiting temperature rise to 1.5-2°C requires:

+ global carbon dioxide emissions (primarily from energy use) to reach zero around 2050 and
+ all greenhouse gases (including methane, HFCs, etc.) to reach zero by around 2070.[26]

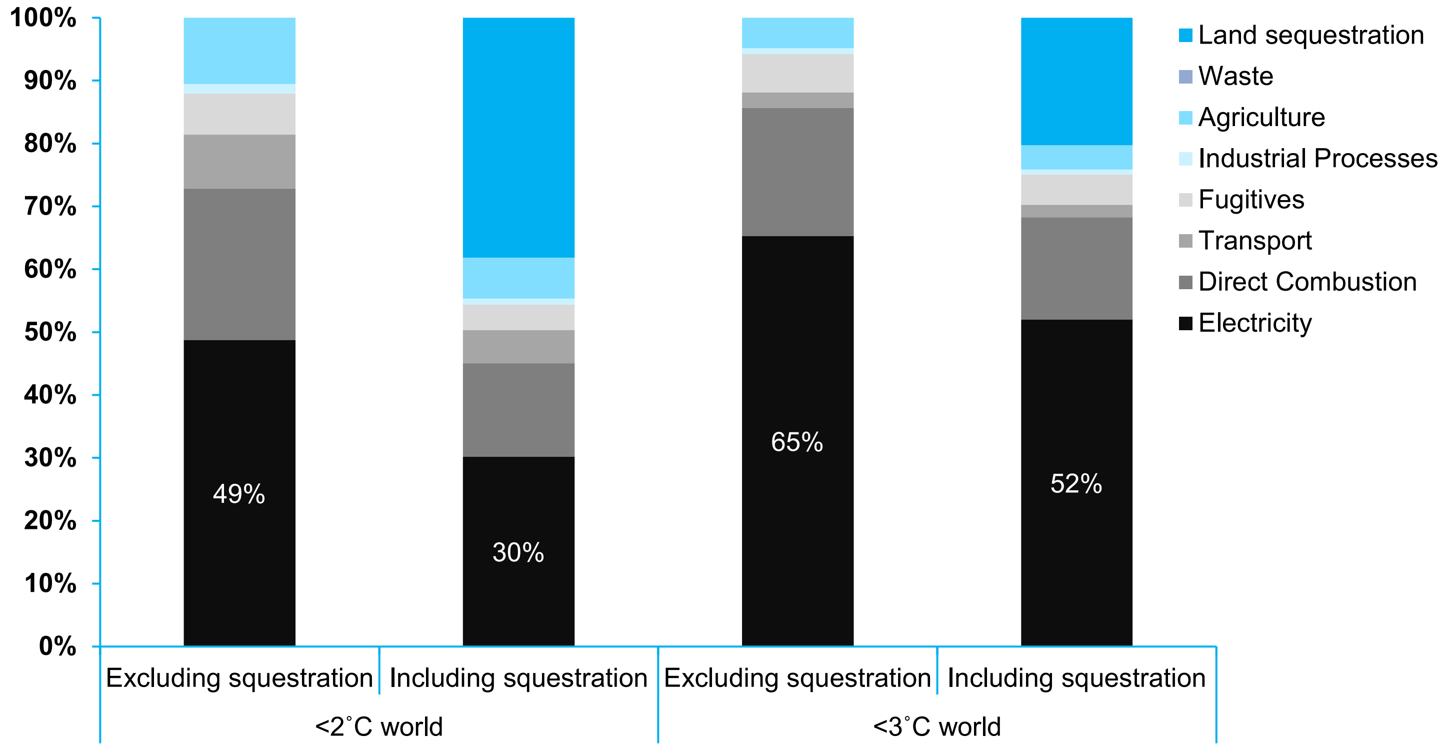
Article 4 also recognises that developing countries will take longer to achieve this goal, implying that developed countries like Australia need to achieve it earlier.

Meta-analysis of emissions allocations finds that by 2050 developed countries would need to have reduced their emissions by 80-160 per cent below 2010 levels, with the range primarily due to different approaches to equity.[27]

The full decarbonisation of Australia's electricity sector is necessary to meet carbon budgets - national, sectoral, or global - consistent with the Paris Agreement. Electricity decarbonisation is a strategic priority for national emissions reduction because it is the biggest source of emissions, has a multitude of technological options available to reduce emissions, and is a pre-requisite for decarbonising other sectors (e.g. zero emissions electric vehicles and buildings).

Under scenarios which limit warming to well below 2°C, or even less than 3°C, the electricity sector is a very significant source of emissions reduction. Previous modelling by Treasury in 2008[28] and 2011[29] found that the electricity sector would be responsible between 45-52 per cent of national abatement to 2050 under a range of scenarios. More recent work by CSIRO indicates the sector needs to contribute a similar share (though in <2°C scenarios with very strong growth in land sector abatement this may be less) (Figure 1). However, these estimates do not include abatement in other sectors provided through clean energy electrification. For example, in the <2°C CSIRO scenarios illustrated in Figure 1, around 20 per cent of the transport sector's energy demand is met by decarbonised electricity.

Figure 1: Contribution of the electricity sector to national abatement under <2°C and <3°C scenarios.[30]



Separate analyses of electricity decarbonisation by CSIRO,[31] the Climate Change Authority[32] and The Climate Institute[33] find that the emissions intensity of Australia's electricity supply needs to approach 0.1tCO2e/MWh by 2040 for emissions reduction targets consistent with a <2°C rise in average global temperatures. Figure 2 shows estimates from these studies for <2°C scenarios, as well as the IEA's global estimate[34], compared with the current emissions intensity of electricity generation in Australia, and the emissions intensity associated with a proportionate contribution by the electricity sector to the federal government's current national emissions reduction target of 26-28 per cent below 2005 levels by 2030 and to the Australian Labor Party's target of 45 per cent below 2005 levels by 2030. Figure 3 shows estimates for <3°C scenarios.

Figure 2: Emissions intensity of the electricity sector under scenarios consistent with limiting global warming to <2°C

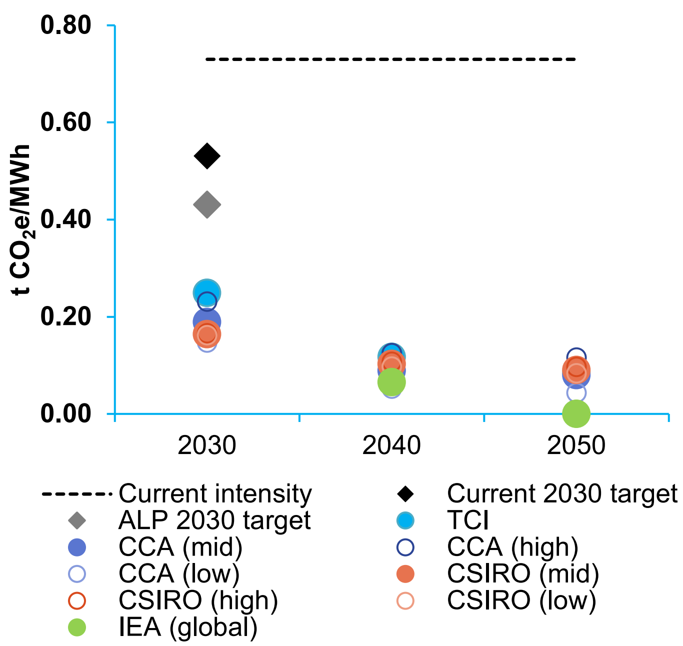
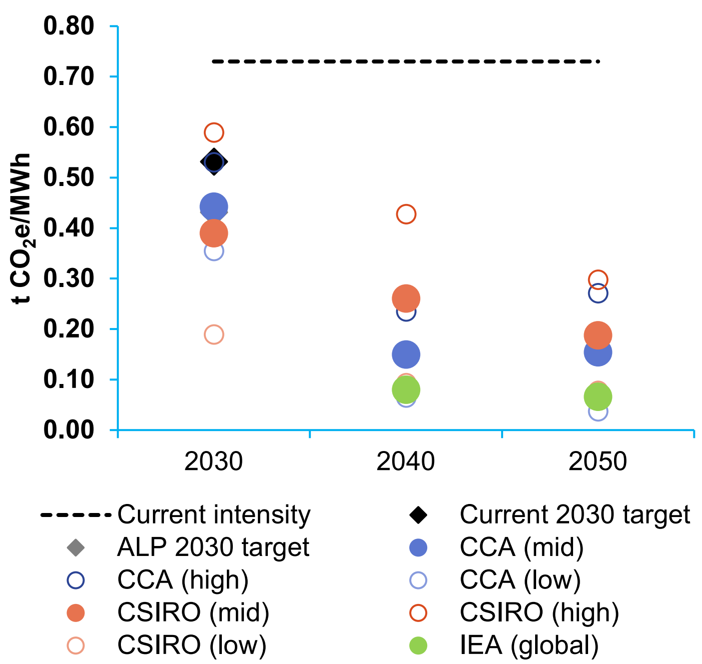


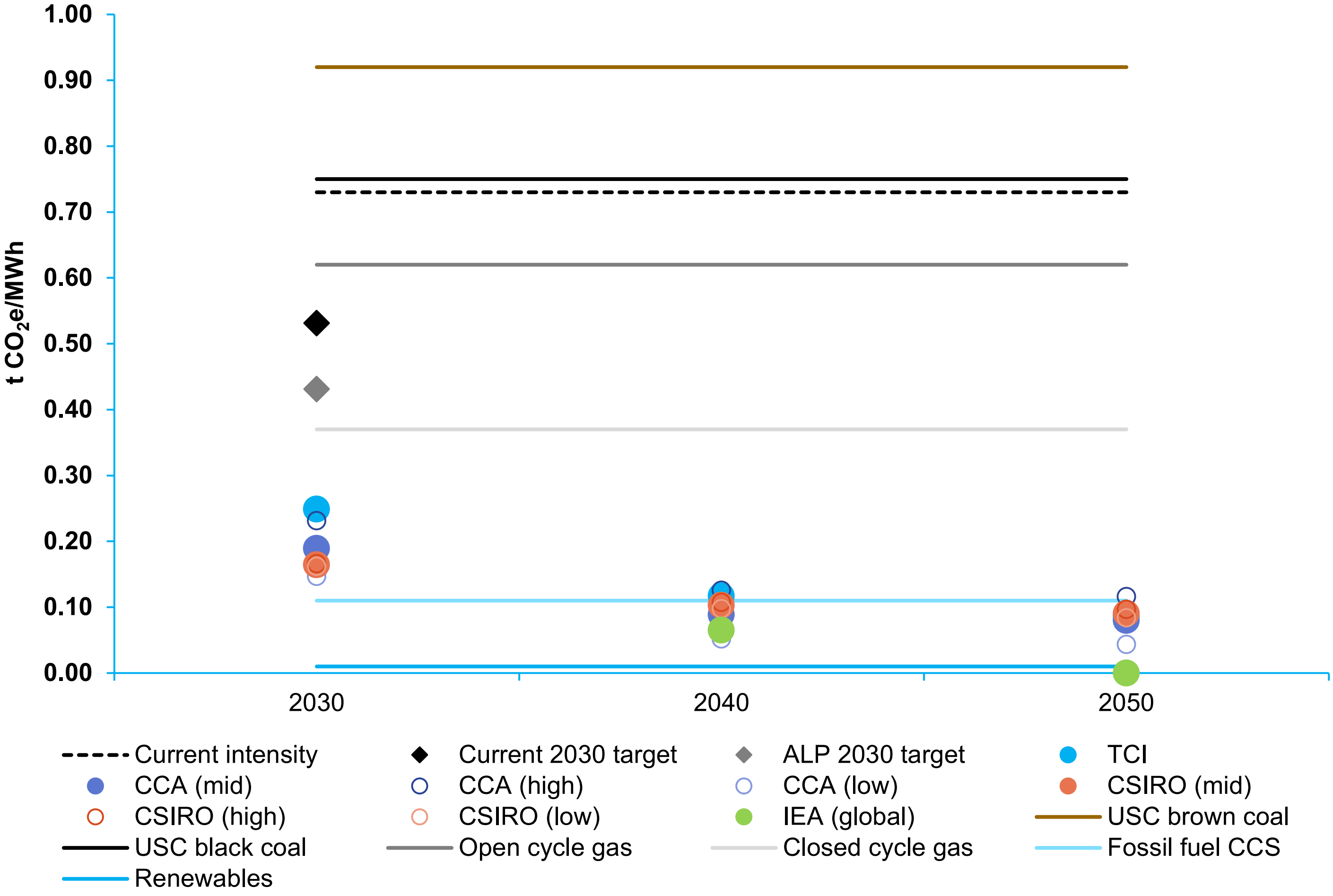
Figure 3 Emissions intensity of the electricity sector under scenarios consistent with limiting global warming to 3°C



Investors will likely draw various inferences from this research: that policy settings will have to adjust to drive much steeper emission reductions beyond 2030; that the 2030 target itself may be revised to drive more emission reductions before 2030; that the electricity sector will have to reduce emissions by a more than proportionate share of the national target; or indeed all of the above.

These risks will clearly affect views of the economic viability of specific energy technologies. Figure 4 shows selected technologies' emissions intensities compared with the average intensity of the total power supply over time required in <2°C scenario. The most advanced ultra-supercritical coal generators have emissions intensities significantly above the required average intensity for even a <3°C rise in temperature (Figure 3). An efficient closed-cycle gas turbine generator represents a major decrease in emission intensity from the current grid average, but is still well above the required intensity. This may not preclude some role for gas-fired generators operating at low capacity factors, for example for peaking and balancing purposes. The addition of carbon capture and storage (CCS) to coal and gas-fired generators would overcome these technologies' carbon risk but would also increase their costs. These considerations indicate that an essential prerequisite for efficient investment in the electricity system is for government policies is that are clearly compatible with the decarbonisation requirements of limiting warming to 1.5-2°C.

Figure 4: Emissions intensity of energy technologies compared with average emissions intensity required under <2°C scenario.



3. **Improving the predictability and timeliness of coal generator exit smooths the impacts of the energy sector transition.**

Greater attention to the exit pathway of emission-intensive generators is urgently needed. A key stressor of the electricity system is a mismatch in timing and type between exiting and incoming generators. New large-scale generation tends to require at least 3-5 years to plan, finance and build; recent generator retirements have occurred barely six months after they are announced. Policy and market planning processes urgently need to ensure that future closures are signalled with much more advance warning and clarity. Further retirements are inevitable. While generators may exit for commercial reasons even in the absence of climate policy, companies will also factor in the potential for future climate policies to drive retirements. For example, Hazelwood power station's parent company Engie explained the generator's closure as "in line with Engie's strategy to gradually end its coal activities", noting that the power station had been operating in difficult market conditions.[35]

When generator exits occur without timely provision of replacement energy services, energy users may face price and security shocks. The extent of these depends on the ability of other market participants to quickly recalibrate their activities to fill the gap. Table 1 lists coal generator retirements since 2012. From 2012 to 2015, surplus capacity in the market drove generators out of the market, and prevented their exits from having much of an impact on energy provision. However, the retirement of seven coal generators, along with the temporary withdrawal of gas-fired generation, did a great deal to reduce the surplus. Subsequent retirements have had much more severe consequences.

For example, the exit of Northern power station is a key contributor to ongoing price and security concerns in South Australia, because remaining generators have not provided sufficient replacement supply at critical peak times (e.g. 8 February 2017) and the remaining technology mix has created demands on existing market mechanisms, such as delivery of ancillary services and forward contracting, that were not sufficiently anticipated.[36] Forward wholesale prices have soared above $100/MWh.[37]

The exit of Hazelwood power station in March is projected to raise wholesale prices by 55 per cent in Victoria and Tasmania, and 40 per cent in South Australia.[38] AEMO has projected that Victoria and South Australia may suffer energy shortages by summer 2017-18, unless NSW coal generators increase their output and withdrawn gas generation is returned to service.[39]

One obstacle to effective recalibration of remaining energy service providers is the ambiguity of generators' signals to the market. No reduction in operations may occur before an exit is announced. Alternatively, before retiring, generators may reduce operations or be "mothballed". Capacity that is temporarily withdrawn in this way can be fairly quickly returned to the market if conditions make this attractive. This means that although mothballing or reduced operations can indicate potential exits from the market, they are not much use as an indicator of the need for investment in replacement energy services. Confirmation of retirement may not occur for several years after an asset has been mothballed, and then may happen just a few months before the asset retires.

Table 1: Emissions-intensive generator retirements since 2012

Coal generator	State	Size (MW)	Date of closure announcement	Date of closure	Notice period
Collinsville	Qld	190	June 2012	December 2012	6 months
Munmorah	NSW	1400	July 2012	July 2012	None. Munmorah had been on standby (i.e. not dispatching) at time of closure announcement
Wallerawang C	NSW	1000	Jan 2014	November 2014 (generation ceased in April 2014)	10 months, with 4 months' notice before production ceased. Half of Wallerawang was mothballed in Jan 2013
Redbank	NSW	151	Oct 2014	Oct 2014	None
Energy Brix	Vic	170	July 2014	August 2014	1 month
Anglesea	Vic	150	May 2015	Aug 2015	3 ½ months
Playford B	SA	240	June 2015, confirmed October 2015	May 2016	7 months. Playford had been mothballed since 2012.
Northern	SA	520	June 2015, confirmed October 2015	May 2016	8-11 months
Hazelwood	Vic	1600	Nov 2016	March 2017	5 months

Any effective emissions reduction policy will directly or indirectly drive emission-intensive generators out of the market, and incentivise new replacement capacity. However, few climate policy types can be relied on to do this smoothly. As noted above, market policies that price or limit emissions may not be seen to be strong enough to drive generator replacement; on the other hand, if such a policy is strong enough it may nonetheless allow for significant ambiguity as to which emissions generator will exit and when - or it may drive multiple retirements within a short timeframe.

It should be acknowledged that policies that enforce schedule for exit of emission intensive generators need to consider the risks not just of insufficient retirements to reach the decarbonisation goal but also of premature or simultaneous retirements that occur before sufficient replacement energy services are provided. Without a strategy for orderly retirements, it is likely that Australia will continue to suffer the significant costs of disorderly transition. The first step is for policy makers to recognise the need for future emissions-intensive generator retirements to be done on a transparent schedule consistent with the security, reliability and decarbonisation of the electricity supply.

A critical related concern is the need for communities to be ready for the retirement of generators in their area. The implications of generator retirements (and the energy transition more broadly) for regional economies and communities may be seen as outside the scope of the Finkel review's focus on energy security. However, it is obvious that transforming the electricity supply will have significant impacts of workers and communities. New energy services will create opportunities for industry growth and employment, but regions where emissions-intensive generation is currently an important contributor to economic activity are highly vulnerable to economic hardship if steps are not taken to ensure these regions' economic health throughout the energy transition. Providing these communities with sufficient time and resources to plan and implement an economic transition strategy is vital.

It is important that the benefits of the energy transition are accessible to all Australians, and that the costs of the transition are equitably shared. Communities deserve the transition outside of the electricity market to be at least as well-managed as the transition within the market. The Finkel review addresses the former; the 2017 climate policy review needs to address the latter.

4. **Electricity system planning needs to recognise full decarbonisation before 2050 as a long term goal, and test decisions against their compatibility with this objective.**

The planning processes currently undertaken by energy agencies tend to focus on the impacts of incremental change to the existing system. They tend to use assumptions within a limited range of plausibility and model variations to a central business-as-usual scenario.[40] This approach is inappropriate for a system that is rapidly transforming, has multiple possible future pathways, and needs to achieve decarbonisation alongside traditional goals of energy security and reliability. The 10-20-year timeframe used by energy agencies is also inappropriate for investment in assets with 30-50 year operating lives. Current planning processes are decreasingly useful because they produce outputs that overstate continuity, underestimate the scope and speed of potential change and prevent consideration of a desired long-term outcome. In other words, they are biased towards the status quo at a time when the status quo is no longer tenable.

Decarbonising the electricity supply to an emissions intensity of less than 0.1tCO2e/MWh before 2050, as required by Australia's international climate commitments and as increasingly expected by energy investors, is an objective that can be reached via many pathways. Incorporating this objective into planning frameworks allows the sector to better understand what those pathways might be, the degree of required transformation from the current situation, and the risks, opportunities and areas for reform associated with decarbonising electricity while maintaining security and affordability.

It is encouraging that AEMO is considering adapting its National Transmission Network Development Plan (NTNDP) to look out to 2050. However, the approach it proposes for consideration of decarbonisation in the 2017 NTNDP is illustrative of the tendency to choose conservative assumptions rather than stress-test decisions against credible risks. AEMO currently proposes to apply an emissions reduction trajectory whereby electricity emissions fall by 28 per cent below 2005 levels in 2030 and continue along the same trajectory thereafter.[41] This implies emissions in the National Electricity Market in 2050 of nearly 80 million tonnes, well above the emissions and emissions intensity of <2°C-consistent decarbonisation.[42] Limiting examination of climate policy-driven transformation in this way wastes an opportunity to examine the generation and transmission requirements of a fully decarbonised electricity system and understand how specific transmission investments might be differently valued under a decarbonsation scenario, compared with less transformational scenarios. Draft guidance from the Financial Stability Board's taskforce on climate risk recommends that corporations test their performance under a <2°C scenario as well as other challenging scenarios.[43] A similar approach should be considered by energy agencies.

It is likely that a key factor in the energy agencies' overly cautious approach to decarbonisation consideration derives from its absence from the National Electricity Objective, which addresses two aspects of the energy trilemma, security and affordability, but neglects the third.

In *Applying the Energy Objectives* the AEMC defines emissions reduction as an example of broader policy objectives which are not taken into account in the AEMC's rule-making or recommendations. Its explanation is as follows: "Lowering emissions requires governments to make value judgements using information on the economy as a whole and the welfare of the population. Therefore, governments should decide what a particular emissions reduction target should be given the targets broad societal impact. Our role is to act as an adviser to government on the features and impacts of alternative emissions reduction mechanisms that can achieve a particular emissions reduction target set by governments. When considering and comparing different mechanisms, we consider their consistency with preserving the efficient operation of the energy markets, and promoting the long-term interests of consumers."[44]

It is understandable that the AEMC takes no view on the appropriateness of national emissions reduction targets. However, the AEMC's approach means that its analysis fails to consider the risks to efficient investment, and thereby the long-term interests of consumers, associated with any specified emissions reduction targets. It does not consider what share of a national target is most likely to be required of the electricity system. Nor does it consider the risks to the electricity market of the physical impacts of climate change. To be clear, we are not suggesting that the AEMC propose emission reduction targets for the electricity sector. But we think its analysis of emission reduction mechanisms needs to be grounded in more thorough analysis of the risks, costs and benefits over time of particular emission reduction and climate change scenarios.

This submission does not propose specific changes to the text or the interpretation of the NEO, nor how any update should be operationalised. But we wish to point out that the following points should enter into consideration of any changes that may be made to the NEO:

+ Climate policy that is stable enough to promote efficient investment is fundamentally in the long-term interest of consumers. While energy agencies may remain agnostic regarding the appropriateness of particular climate policy settings they should still conduct stress-tests of the risks to the electricity market associated with a range of climate policy and climate change scenarios.

+ Electricity decarbonisation itself is in the long-term interest of consumers. Climate change will have an increasingly costly impact on energy security (see point 5 below for more detail). While global warming depends on the actions of other countries as well as Australia, domestic decarbonisation is an important signal of our expectations for other countries to play their part addressing climate change.

The NEO and its associated rules should at a minimum be updated to enable consideration of the costs of insufficient emissions reductions as well as the costs of emissions reductions. Consideration should also be given to incorporating into the NEO a clear 1.5-2˚C-consistent decarbonisation objective.

5. The risks posed by climate change to electricity security urgently need to be assessed and managed.

Climate change affects the performance of electricity infrastructure, the availability of essential resources such as water, and levels of electricity demand. All of these have significant implications for Australian energy security, particularly as peaks in electricity demand (when the system has least redundancy) coincide with extreme temperatures (when the system is under the most severe stress).[45] Analysis indicates that the extreme temperatures of 2015 will become the "new normal' by 2030 on the current emissions trajectory, and by 2040 under all emissions trajectories.[46] Decreased water availability due to climate change will reduce usable capacity of 81-86 per cent of world thermo-electric generators worldwide during 2040 – 2069.[47] Maintaining security of the electricity system requires incorporation of plausible climate conditions into risk management at both the level of the individual asset and the system as a whole. Climate risk management needs to address changes in extremes, variance and threshold exceedance.

Some attempts are underway to incorporate climate change risks: the Energy Networks Association, for example, has developed climate risk management guidance for network operators. AEMO's 2017 NTNDP scenarios include limited consideration of temperature changes and water availability.[48] Given the interconnectedness of the elements of the electricity system, more holistic assessment is needed. As noted above, scenario analysis incorporating higher degrees of climate change should be incorporated into system resilience assessments and management processes.

Section 2

1.1 How do we anticipate the impacts, influences and limitations of new technologies on system operations, and address these ahead of time?	The planning processes currently undertaken by energy agencies tend to focus on the impacts of incremental change to the existing system. This approach is inappropriate for a system that is rapidly transforming, has multiple possible future pathways, and needs to achieve decarbonisation alongside traditional goals of energy security and reliability. It is more likely than not that the entry of new technologies into the electricity system will not be gradual but will be characterised by tipping points. Incorporating the goal of decarbonisation (i.e. emissions intensity below 0.1tCO2eMWh before 2050) into planning processes can help clarify the required contributions of types of technologies, such as intermittent and dispatchable renewable energy technologies, storage, transmission, and ancillary service technologies that will be needed to ensure progressively cleaner, secure and affordable energy. More broadly, stress-testing expectations against challenging scenarios of climate policy, climate change, and technology transformation (such as very rapid electric vehicle uptake), enables (and requires) planners to start working out how to address potential implications for the energy system.
2.2 How do we best meet the needs of vulnerable and hardship consumers?	Affordability risks for low income and vulnerable consumers are rising, due to multiple drivers of higher retail prices, but also due to barriers preventing these consumers from being able to manage their energy costs. To date, attention has primarily focused on pricing, which indeed needs to be efficient, and avoid inequitable allocations of costs. Stable climate policy to encourage efficient investment in generation and demand response needs to be complemented with reforms to other components of the electricity bill to address cross-subsidies and improve competition. However, the price of electricity is only part of the story. What really hurts vulnerable households is the total cost of securing their energy needs, and that is also influenced by how much energy is consumed and when; eligibility for and provision of concessions; and housing circumstance (e.g. renting) as well as housing design. Much more attention needs to focus on these aspects. For example, eligibility for concessions is not well correlated with energy hardship, and most state concession frameworks are not responsive to price changes. Options that could significantly reduce vulnerable consumers' energy costs, such as investments in more energy efficient equipment or solar PV, may not be just financially out of reach, but obstructed by split incentives. An important contributor to energy hardship is being in rental housing, because the tenant may not be able to make changes to energy inefficient design, construction and equipment - and due to uncertainty of length of tenure the benefits of these investments may well not be felt by the tenant anyway. The Climate Institute, with the Australian Council of Social Service and the Brotherhood of St Laurence, is working on a cross-sectoral project to explore means by which the transformation of the electricity system can be made more accessible to and more equitable for low income and vulnerable Australians. This is currently in an early stage. We would be delighted to provide more information about its progress to the Independent Review.
3.1 What role should the electricity sector play in meeting Australia's greenhouse gas reduction targets?	The Paris Agreement defines the long-term objective of collective action as limiting global warming to "well below" 2°C above pre-industrial levels, with a commitment to pursue action to limit warming to 1.5°C. To achieve these goals, countries agreed to achieve net zero emissions. Australia will consider its long-term emissions pathway as part of the 2017 climate change policy review. Under scenarios which limit warming to well below 2°C, or even less than 3°C, the electricity sector is a very significant source of emissions reduction. Previous modelling by Treasury in 2008[49] and 2011[50] found that the electricity sector would be responsible between 45-52 per cent of national abatement to 2050 under a range of scenarios. More recent work by CSIRO indicates the sector needs to contribute a similar share. However, these estimates do not include abatement in other sectors provided through clean energy electrification, suggesting that the electricity sector contributes an even greater share of national emissions reduction. Separate analyses of electricity decarbonisation by CSIRO[51], the Climate Change Authority and The Climate Institute find that the emissions intensity of Australia's electricity supply needs to approach 0.1tCO2e/MWh by 2040 for emissions reduction targets consistent with a <2°C rise in average global temperatures.

3.2 What is the role for natural gas in reducing greenhouse gas emissions in the electricity sector?	Separate analyses of electricity decarbonisation by CSIRO[52], the Climate Change Authority and The Climate Institute find that the emissions intensity of Australia's electricity supply needs to approach 0.1tCO2e/MWh by 2040 for emissions reduction targets consistent with a <2°C rise in average global temperatures. An efficient closed-cycle gas turbine generator represents a major decrease in emission intensity from the current grid average, but would be well above the required intensity within less than two decades. This may not preclude a limited role for gas-fired generators operating at low capacity factors, for example for peaking and balancing purposes, but for a gas generator to operate at a high capacity it would need the addition of carbon capture and storage (CCS). Climate policies can ensure that gas plays an appropriate role in the decarbonisation of the electricity sector by setting parameters that are clearly consistent with the temperature objectives in the Paris Agreement.
3.3 What are the barriers to investment in the electricity sector?	The Preliminary Report rightly notes that climate policy uncertainty is a key hindrance to investment in the electricity system. The lack of clarity regarding the required emissions reductions from the sector over the next few decades is leading investors to defer expenditure on existing assets as well as new assets until clearer policy signals emerge. This uncertainty has already inhibited electricity sector investment for several years. In 2014, a survey of banks by PwC found that despite good conditions in the broader debt markets, electricity suppliers, struggled to access capital. The three key reasons were policy uncertainty, lower than expected demand, and environmental concerns. The introduction and repeal of the carbon price and the review of the RET "significantly increased the level of uncertainty in the market for banks that lend to generation assets.[53] Investors are increasingly cognisant of the implications of the Paris Agreement for energy investments, and are seeking disclosure from electricity suppliers of performance risks under scenarios where the Paris commitments of 15-2°C are achieved. This suggests that climate policies inconsistent with the objectives of the Paris Agreement will not be considered investment-grade as they imply the necessity of future policy adjustments.
3.4 What are the key elements of an emissions reduction policy to support investor confidence and a transition to a low emissions system?	Stable and predictable climate policy is critical to efficient investment, but policy settings need to be consistent with the commitments of the Paris Agreement for investors to consider the policy stable. The electricity system will be required to contribute at least 50 per cent of total national emissions reductions under <2°C scenarios, and the sector's emissions intensity will need to approach 0.1tCO2e/MWh by 2040 While carbon markets can be part of a climate policy package, they need features that diminish volatility and increase long-term price signals, such as long-term legislated emissions constraints, and they need to be buttressed with other policies. One of these is a strategy for to ensure that emission-intensive generation retirements and replacements are transparent, predictable and orderly. A first step is for policy makers to recognise the need for future emissions-intensive generator retirements to be done on a transparent schedule consistent with the security, reliability and decarbonisation of the electricity supply. Electricity system planning needs to recognise full decarbonisation before 2050 as a long term goal, and test options for investment against compatibility with this objective. Decarbonising the electricity supply to an emissions intensity of less than 0.1tCO2e/MWh before 2050, as required by Australia's international climate commitments and as increasingly expected by energy investors, is an objective that can be reached via many pathways. Incorporating this objective into planning frameworks allows the sector to better understand what those pathways might be, the degree of required transformation from the current situation, and the risks, opportunities and areas for reform associated with decarbonising electricity while maintaining security and affordability. Draft guidance from the Financial Stability Board's taskforce on climate risk recommends that corporations test their performance under a <2°C scenario as well as other challenging scenarios[54]. A similar approach should be considered by energy agencies. The NEO and its associated rules should at a minimum be updated to enable analysis of the costs and risks of *insufficient* emissions reductions as well as the costs of emissions reductions. Consideration should also be given to incorporating into the NEO a clear 1.5-2°C-consistent decarbonisation objective.

3.5 What is the role for low emissions coal technologies, such as ultra-supercritical combustion?	Separate analyses of electricity decarbonisation by CSIRO[55], the Climate Change Authority and The Climate Institute find that the emissions intensity of Australia's electricity supply needs to approach 0.1tCO2e/MWh by 2040 for emissions reduction targets consistent with a <2°C rise in average global temperatures. Even the most advanced ultra-supercritical coal (USC) generators have emissions intensities significantly above the required average intensity for even a 3°C rise in global temperature. Only with the addition of carbon capture and storage would USC meet decarbonisation requirements. Without CCS, there is no role for USC in Australia's generation mix. Moreover, a USC coal plant would take up to a decade to build, by which time other forms of generation will also be cheaper and more suitable for integration into a modern electricity system (e.g. more flexible, see next point).
4.2 Should the level of variable renewable electricity generation be curtailed in each region until new measures to ensure grid security are implemented?	The IEA notes that the successful integration of variable renewable energy depends less on its share of total generation than on the flexibility of the power system into which it is integrated. Flexibility comes from the ability of exiting power generators to adjust their output, the responsiveness of demand, availability of storage and responsiveness of the transmission and distribution grid. This suggests that curtailment of renewable technologies is a poorly targeted response to a systemic challenge. As the IEA points out, "a comprehensive and systemic approach is appropriate for resolving system integration challenges …[and] a co-ordinated transformation of the entire system can reduce integration costs."[56]
4.3 Is there a need to introduce new planning and technical frameworks to complement current market Operations?	Decarbonising the electricity supply to an emissions intensity of less than 0.1tCO2e/MWh before 2050, as required by Australia's international climate commitments and as increasingly expected by energy investors, is an objective that can be reached via many pathways. Incorporating this objective into planning frameworks allows the sector to better understand what those pathways might be, the degree of required transformation from the current situation, and the risks, opportunities and areas for reform associated with decarbonising electricity while maintaining security and affordability.
7.1 Is there a need for greater whole-of-system advice and planning in Australia's energy markets?	Yes. The fragmentation of responsibility across multiple actors has led to piecemeal rather than comprehensive and strategic analysis. The failures of existing advice and planning processes to provide timely advice on the implications of trends such as network expenditure increases, declining demand, coal generator retirements, emerging transformation of regional generation mixes indicates that the current approach to advice and planning is not just inadequate but a major hindrance to successful transformation of the electricity system.
7.5.2 Should the NEO be amended?	It is likely that a key factor in the energy agencies' overly cautious approach to decarbonisation consideration derives from its absence from the National Electricity Objective, which addresses two aspects of the energy trilemma, security and affordability, but neglects the third. It is understandable that the AEMC takes no view on the appropriateness of national emissions reduction targets. However, the AEMC's approach means that its analysis fails to consider the risks to efficient investment, and thereby the long-term interests of consumers, associated with any specified emissions reduction targets. It does not consider what share of a national target is most likely to be required of the electricity system. Nor does it consider the risks to the electricity market of the physical impacts of climate change. This submission does not propose specific changes to the text or the interpretation of the NEO, nor how any update should be operationalised. But we wish to point out that the following points should enter into consideration of any changes that may be made to the NEO: + Climate policy that is stable enough to promote efficient investment is fundamentally in the long-term interest of consumers. While energy agencies may remain agnostic regarding the appropriateness of particular climate policy settings they should still conduct stress-tests of the risks to the electricity market associated with a range of climate policy and climate change scenarios. + Electricity decarbonisation itself is in the long-term interest of consumers. Climate change will have an increasingly costly impact on energy security (see point 5 below for more detail). While global warming depends on the actions of other countries as well as Australia, domestic decarbonisation is an important signal of our expectations for other countries to play their part addressing climate change. The NEO and its associated rules should at a minimum be updated to enable consideration of the costs of insufficient emissions reductions as well as the costs of emissions reductions. Consideration should also be given to incorporating into the NEO a clear 1.5-2°C-consistent decarbonisation objective.

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