CEFC SUBMISSION TO THE INDEPENDENT REVIEW INTO THE FUTURE SECURITY OF THE NATIONAL ELECTRICITY MARKET

FEBRUARY 2017

1.1 EXECUTIVE SUMMARY

Australia's electricity system is seeing significant new investment. Renewable energy is entering the market at increasing scale, replacing ageing generation infrastructure and contributing to meeting Australia's carbon reduction commitments. The cost of producing electricity from renewable resources has declined significantly over recent years and remains on a rapid downward trajectory. Despite strong growth in renewable energy generation, electricity market design continues to reflect a system dominated by high-emissions thermal generation. Market rules need to be updated for an electricity grid with a growing share of renewable energy to promote a reliable and affordable electricity service. At the same time, investment is required in technologies and infrastructure such as grid-scale storage and transmission to better integrate and optimise high levels of renewables.

The CEFC was established to facilitate increased flows of finance into the clean energy sector. The CEFC supports the development of a resilient, balanced and secure electricity system through its investment activities, which include large-scale renewable energy, energy storage and other initiatives. Drawing on our experience as a specialist clean energy investor, this submission highlights the following themes:

MARKET DESIGN TO SUPPORT SECURITY AND RELIABILITY

1. High levels of renewable penetration are technically feasible and are consistent with maintaining energy security
2. Strengthened transmission is necessary to facilitate a secure high-renewables electricity system
3. To minimise costs to consumers and maintain energy security, policies should support investment in renewables and storage to prepare in advance for coal capacity withdrawals
4. Demand management is important for boosting system resilience and lowering costs

TECHNOLOGY TO TRANSFORM THE ELECTRICITY SECTOR

5. Technology costs for renewables and storage are continuing to decline
6. Energy storage will play an important role in an electricity system with high renewables penetration
7. Biomass can deliver baseload renewable energy using established technology
8. The electricity system has lower-cost opportunities to reduce emissions than other sectors and is capable of bearing more than its proportionate share of the national emissions reduction burden to 2030

BARRIERS TO INVESTMENT

9. Policies to drive the long-term transition must be bankable
10. New fossil-fuel generation in Australia would be unlikely to find private sector finance at an acceptable cost.

MARKET DESIGN TO SUPPORT SECURITY AND RELIABILITY

2.1 HIGH LEVELS OF RENEWABLE PENETRATION ARE TECHNICALLY FEASIBLE AND CONSISTENT WITH MAINTAINING ENERGY SECURITY

A number of studies (AECOM 2012, AEMO 2013, Elliston 2013, Lenzen 2016, Teske 2016, Blakers 2017) have considered the technical challenges of a high penetration of renewable energy in the Australian electricity system. The studies have found that while an increasing share of renewables will mean changes to the way the grid is managed, there are no technical barriers to achieving energy security with a very high share of renewables.

Variable renewable energy output can be managed by promoting geographic diversity of energy sources. Geographic diversity assists because over larger areas, weather conditions are less correlated. In principle, over a sufficiently large area and with adequate transmission links, an electricity system could operate entirely with renewable energy resources. In practice, even a system with high levels of geographically diverse renewables will require energy storage and demand management for energy security and reliability.

Managing a growing share of renewables in the generation fleet will also depend on a strengthened transmission system and is likely to also involve a range of dispatchable renewable energy and storage technologies such as pumped hydro, biomass, grid-scale batteries and concentrated solar power. Depending on the cost path of these technologies, there is likely to be an ongoing role for some gas-fired generation to support variable renewable energy during the transition to a low-carbon electricity system. Integrating a higher share of renewable energy will also be facilitated by improvements to wind and solar forecasting, improving markets for frequency control and ancillary services, promoting demand management and making other changes to market rules such as aligning market dispatch and settlement intervals (the five-minute settlement rule change request).

2.2 STRENGTHENED TRANSMISSION IS NECESSARY TO FACILITATE A SECURE HIGH-RENEWABLES ELECTRICITY SYSTEM

The National Electricity Market comprises five interconnected regional markets. Investment in transmission upgrades between and within regions will promote improved access to high-quality renewable energy resources and enhance grid stability. A recent paper for the CEFC (Jacobs CEFC 2016) looked at a range of published studies and found that under a range of emissions reduction targets, significant upgrades of interregional transmission capacity would be required to allow exploitation of the available renewable resources to replace the retiring coal generation fleet.

Investment in strengthening transmission interconnections between regions will help balance supply and demand, reduce price volatility, promote access to least-cost renewable energy resources and boost system redundancy in a grid with high renewables penetration. Augmenting interconnectors to South Australia and Tasmania would lead to a wide range of market and system security benefits. For example, augmenting South Australia's interconnectors would add resilience and potentially avoid system stress during periods of high demand, and a second interconnector across Bass Strait could unlock additional value in Tasmania's hydro system by allowing it to provide energy storage services for the mainland states.

Regulation of transmission investment should facilitate higher renewables penetration. Without changes, however, the Regulatory Investment Test for Transmission (RIT-T) is unlikely to deliver sufficient timely investment in transmission infrastructure to cope with the needs of Australia's future electricity system. As currently implemented, the RIT-T favours smaller upgrades to transmission capacity; it does not adequately consider the option value of proposed new investment; it uses inappropriately high discount rates; and it does not consider all relevant externalities. In addition, its single-asset focus means it cannot take into account the synergistic benefits of multiple augmentations, despite studies such as AEMO's National Transmission Network Development Plan finding greater total net benefits when transmission investments are coordinated to create a more interconnected NEM. The COAG Energy Council has announced a review of the Australian Energy Regulator's RIT-T guidelines to better reflect the system benefits of upgrade options, including benefits relating to system security and renewable energy and climate policies.

2.3 TO MINIMISE COSTS TO CONSUMERS AND MAINTAIN ENERGY SECURITY, POLICIES SHOULD SUPPORT INVESTMENT IN RENEWABLES AND STORAGE TO PREPARE IN ADVANCE FOR COAL CAPACITY WITHDRAWALS

Over time, decarbonising the electricity system will involve decreasing the share of fossil-fuel generation and increasing the share of renewable energy. If ageing coal-fired generation capacity is withdrawn before new renewable energy capacity is available to meet the shortfall, prices are likely to be higher and more volatile. To facilitate a smooth transition to a high-renewables system and avoid price spikes, policies should support early investment in renewables to prepare in advance for coal capacity withdrawals.

Meeting Australia's emissions reduction targets will require significant new investment in electricity infrastructure, and whatever the technology, the transition will involve higher economic costs than business as usual. Economic modelling exercises over recent years (most recently Jacobs CCA 2016) have consistently found that there are policy tools available to minimise the cost impact on consumers.

2.4 DEMAND MANAGEMENT IS IMPORTANT FOR BOOSTING SYSTEM RESILIENCE AND LOWERING COSTS

Incentives for demand management – changing the time profile of demand or reducing peak demand through voluntary load reduction – are important for adapting to a higher level of renewables penetration. As well as providing flexibility to smooth demand in response to variations in renewable energy output, demand management can reduce the need for peaking generation and network assets that are only built for infrequent episodes of peak demand and potentially avert crises during periods of system-wide high demand. But the incentives to provide demand management services are currently weak in Australia.

The CEFC is working with a number of demand management technology providers, and we welcome the Australian Energy Regulator's move to develop a new incentive scheme to promote demand management.

TECHNOLOGY TO TRANSFORM THE ELECTRICITY SECTOR

2.5 TECHNOLOGY COSTS FOR RENEWABLES AND STORAGE ARE CONTINUING TO DECLINE

A highly competitive global market for component manufacturing and ongoing improvements in solar cell efficiency have significantly driven down **solar** costs. **Wind** costs have declined with better capacity factors and longer project lives. A recent global expert survey (Wiser 2016) forecasts a further 24% reduction in wind technology costs in real terms by 2030. Larger rotors, better rotor design, taller towers, lower financing costs and more durable components are all expected to continue to contribute to lower wind costs in coming decades.

While wind and solar technology costs have declined and are expected to continue to decline, fuel and equipment costs for thermal generation technologies are not declining.

2.6 ENERGY STORAGE WILL PLAY AN IMPORTANT ROLE IN AN ELECTRICITY SYSTEM WITH HIGH RENEWABLES PENETRATION

Grid-scale storage – such as pumped hydro, grid-scale batteries, solar thermal with storage, and behind-the-meter battery storage systems coordinated through smart-grid technology – will play an important role in ensuring that electricity supply is available when required.

Using grid-scale energy storage to respond to short-term fluctuations in demand is not new. Globally, the largest installed grid-scale storage technology is pumped hydro, which has been deployed in Japan and the United States primarily to balance relatively inflexible output from nuclear.

Bloomberg New Energy Finance reports that 90% of the 700 MW of utility-scale storage projects commissioned around the world in 2016 used lithium-ion batteries. The United Kingdom grid operator recently awarded 500 MW of energy storage contracts as part of its 2016 capacity auction, and California has mandated 1.3 GW of energy storage by 2020, with more than 400 MW already under contract. This month, the Victorian Government has called for expressions of interest to install 20 MW of grid-scale battery storage in western Victoria to strengthen the grid.

Australia's policy and regulatory regime for storage is still emerging but the CEFC is working with a number of proponents who are looking to bring storage projects to market.

Proposed rule changes such as aligning market dispatch and settlement intervals (known as five-minute settlement) would make fast-response technologies such as battery storage more economic, as well as increasing commercial opportunities for demand management.

2.7 BIOMASS CAN DELIVER BASELOAD RENEWABLE ENERGY USING ESTABLISHED TECHNOLOGY

With abundant land for agriculture and forestry, Australia is ideally placed to take advantage of biomass to generate baseload renewable energy for the National Electricity Market, particularly through increased generation using sugarcane waste or municipal and commercial waste biomass and by co-firing wood pellets in coal-fired power stations.

While **biomass from sugarcane waste** has been used for electricity generation in Australia for decades, the feedstock remains underutilised and there are material opportunities to boost biomass generation to make better use of available resources.

Combusting wood pellets in coal-fired power plants is increasingly common overseas. Since 2013, the Drax power station, the largest plant in the United Kingdom with nearly 4,000 MW of installed capacity, has converted three of its six units to run exclusively on biomass. Sustainable production of biomass for fuel combustion boosts employment in regional areas, and co-firing biomass at existing coal-fired plants can help to derive additional value from existing generation and connection assets. The CEFC has commissioned analysis of the economics of local wood pellet production and biomass conversion of Australian coal-fired power stations to be released later this year.

2.8 THE ELECTRICITY SYSTEM HAS LOWER-COST OPPORTUNITIES TO REDUCE EMISSIONS THAN OTHER SECTORS AND IS CAPABLE OF BEARING MORE THAN ITS PROPORTIONATE SHARE OF THE NATIONAL EMISSIONS REDUCTION BURDEN TO 2030

The electricity sector has fewer direct sources of emissions and has lower-cost and better-understood opportunities for reducing emissions than other sectors. Australia's electricity market – one of the most emissions-intensive electricity systems in the world – is also responsive to policy signals: official emissions data show that during the operation of a carbon price in 2013, electricity emissions were 9% below the 5-year average before the carbon price was introduced (187 Mt vs 205 Mt). By contrast, our experience as a clean energy investor has shown that emissions from transport and industry face a number of barriers including a lack of established or cost-effective technical solutions, a lack of policy support, behavioural impediments and diffuse sources of emissions.

Wind and solar farms are typically quick to construct (1-2 years after financial close) and the industry faces few supply constraints on materials and components. The recent increase in wind and solar construction indicates that renewables are capable of being rolled out rapidly.

For those reasons, the electricity system is capable of rapid transformation and is likely to bear a larger share of the national emissions reduction burden in the early years of Australia's shift to a low-carbon economy.

BARRIERS TO INVESTMENT

2.9 POLICIES TO DRIVE THE LONG-TERM TRANSITION MUST BE BANKABLE

While costs for renewable energy technologies are continuing to decline, there is still no market for investment in utility-scale low-carbon generation capacity without investment support mechanisms. Long-term investment support mechanisms backed by governments are still necessary to drive low carbon energy generation to meet carbon targets.

A range of policies can drive decarbonisation of the electricity sector, including pricing mechanisms such as carbon pricing or an emissions intensity target; 'technology-pull' policies such as a renewable energy target, a low-emissions target, or reverse auctions with contracts for difference; or regulatory interventions such as regulated closures or absolute baselines. Policies vary in terms of their impact on wholesale and retail electricity prices, generator profits, resource costs and the rate of construction of new generation capacity. Recent modelling reports (such as Jacobs CCA 2016 and Frontier Economics AEMC 2016) compare some or all of these policies.

Given the long-term nature of the transformation of the electricity system, a stable 'bankable' policy framework is necessary to promote investor confidence and capital availability and reduce risk, financing costs and the overall costs of the transition.

Renewable energy auctions are emerging as a dominant policy tool for electricity sector changes, with more than 90 renewable energy auctions in operation globally. Auctions use market competition and discipline to keep downward pressure on project costs, and long-term contracts with a government counterparty (typically power purchase agreements, feed-in tariffs or contracts for difference) provide certainty over revenues which in turn reduces financing costs. Reverse auctions have been used by the Australian Government – the Emissions Reduction Fund is an example of this structure.

A well-designed auction program ensures that project bids are designed to meet the needs of the electricity system. For example, an auction round could invite proposals that use energy storage to dispatch power during afternoon and evening daily peaks, or provide other system value services. Staging periodic auctions on a multi-year timetable ensures that contracts capture reductions in technology costs, attract new project developers to the market to increase competition and allow the procurement process to respond to changes in market needs over time.

State and territory governments in Australia are using auctions to support new renewable energy investment. The Australian Capital Territory and Queensland have conducted auctions; South Australia has a tender-based procurement for renewables underway; Victoria has called for expressions of interest for a battery storage tender, and Victoria, New South Wales and Queensland are expected to conduct renewables auctions in coming years. Contracts can be designed to share risk between investors, consumers and governments.

2.10 NEW FOSSIL-FUEL GENERATION IN AUSTRALIA WOULD BE UNLIKELY TO FIND PRIVATE SECTOR FINANCE AT AN ACCEPTABLE COST

Coal-fired generation capacity is being withdrawn from the National Electricity Market: since 2012, nine coal-fired power plants with a total capacity of more than 3,500 MW have closed. Further withdrawals are anticipated, with Hazelwood Power Station (1,600 MW) scheduled to close in 2017 and Liddell Power Station (2,000 MW) scheduled to close in 2022. The Australian Energy Market Operator's 2016 National Transmission Network Development Plan projects that up to 15.5 GW of coal-fired generation capacity may be withdrawn from service in the next 20 years under a neutral economic growth scenario. There is no new coal-fired capacity among current proposals registered with AEMO. Coal-fired generation tends to be relatively inflexible and not suited to a market with higher levels of renewable energy penetration and declines in daytime demand as a result of roof-top solar generation.

While the range of cost estimates for new coal-fired generation capacity are broadly comparable with new renewable energy capacity (excluding any cost for carbon emissions), negative investor perceptions mean that new investment in coal-fired capacity would be unlikely to be financed by

Australian or international capital markets. Investors perceive that new fossil-fuel generation capacity has carbon risk, which is the risk that a new asset would be stranded if a future government were to adopt tighter emissions constraints. Further, there is arguably no longer a social licence for new coal-fired power stations in Australia.

While there are several proposals in the market for new **gas-fired generators** in Australia, our observations indicate that it is challenging to find long-term domestic gas supply agreements to support new investment. Gas prices are expected to rise significantly further in real terms over the next 15 years as international demand increasingly determines Australian domestic gas prices through LNG exports. A recent study (EnergyQuest 2016) points to a structural tightening of Australia's gas markets and finds that under plausible assumptions, scenario analysis indicates a growing domestic gas supply gap in the southern states over the next decade. In addition, changing daily generation profiles are likely to reduce the market incentives for gas peaking generation as solar reduces daytime price peaks. Market risk premiums indicate that gas-fired generation is likely to have a shorter economic life under future carbon constraints.

Carbon capture and storage (CCS) is likely to be needed as part of the global mix of technologies to meet long-term emissions reduction goals, but is unlikely to play a significant role in reducing Australia's electricity sector emissions in time to meet our 2030 Paris Agreement commitments. According to the IEA (IEA 2016), CCS is operating at large scale in 15 plants globally, only one of which is a coal-fired power generation – the Boundary Dam Capture and Storage project in Saskatchewan, Canada, where CO_2 is captured and used for enhanced oil recovery at nearby oil fields. The Petra Nova project at a coal-fired power plant in Texas is due to begin operation in 2017. But the IEA notes that few CCS new projects are being developed, several have been cancelled and the current rate of progress is falling short of what is required to achieve climate goals. They say that CCS projects are complex integrated projects that require significant lead times – as long as a decade – to develop and commission, and that investment incentives such as mandates, subsidies, grants or feed-in tariffs are required to spur investment.

ABOUT THE CEFC

The Clean Energy Finance Corporation invests, applying commercial rigour, to increase the flow of finance into the clean energy sector. Our mission is to accelerate Australia's transformation towards a more competitive economy in a carbon constrained world, by acting as a catalyst to increase investment in emissions reduction. We do this through an investment strategy focused on cleaner power solutions, including large and small-scale solar, wind and bioenergy; and a better built environment, with investments to drive more energy efficient property, vehicles, infrastructure and industry. The CEFC also invests with co-financiers to develop new sources of capital for the clean energy sector, including climate bonds, equity funds, aggregation facilities and other financial solutions. The CEFC operates under the *Clean Energy Finance Corporation Act 2012*.