The Economics of the Future Energy System

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THE ECONOMICS OF THE FUTURE ENERGY SYSTEM

How can we provide a high degree of energy security in Australia at the lowest possible cost, while contributing our fair share to the global effort to contain the costs of climate change?

I take as my starting point Prime Minister Turnbull's admonition that we put ideology aside as we seek answers to this question.

Putting ideology aside also means putting aside old conceptions of what works best. It means recognising that we are dealing with complex issues that cannot be managed through simple slogans.

Putting ideology aside leads inevitably to the conclusion that the economics of Australia's energy future looks very different from the economics of Australia's energy past.

If we haven't been paying attention to recent technological and economic developments affecting the energy sector, and look again with clear eyes, we are surprised by how different the lowest cost solutions today are from what they were not long ago.

Six sets of changes have been especially important for Australian choices in the electricity sector. Four of these relate to changes in the cost of renewable energy and storage relative to coal- and gas-based electricity. Two relate to perceptions of the costs of climate change and the necessity of mitigating them.

FOUR CHANGES AFFECTING RELATIVE COSTS OF RENEWABLES

FIRST CHANGE: FALLING COSTS OF RENEWABLES AND STORAGE EQUIPMENT. There have been massive falls in the costs of producing equipment for generation of low emissions energy and for storing energy of all kinds. So far the cost reductions derive mainly from learning by doing in the course of large-scale production in the world's lowest-cost manufacturing centres. As the improvement in manufacturing efficiency reaches technical limits, costs will continue to fall for some time through application of new technologies. In the massive modelling effort on the Australian transition to a low carbon economy for the 2008 Garnaut Climate Change Review, we consulted widely and formed the view that costs of capital goods for PV solar generation would fall by a few percent per annum. In practice, costs have fallen by about five sixths since those views were embodied in the modelling nine years ago. Similarly large reductions have occurred in the cost of lithium ion batteries and related systems for storing energy and balancing grid instability. There have been less dramatic but substantial reductions in costs of equipment for electricity from wind, nuclear, hydro and solar-thermal sources, in co-generation of power from industrial processes, and for increasing energy efficiency. Learning by doing has also been important in reducing installation costs for wind and solar PV power generation in Australia.

SECOND CHANGE: IMPROVEMENTS IN THE GRID BALANCING CAPABILITIES OF NEW TECHNOLOGIES. There have been transformational improvements in the technology applied to the integration of the electricity grid with batteries for storing and balancing supply of intermittent energy. The improvements relate to decentralised deployment of renewable energy and storage, as well as grid level applications. These improvements are at once effect and cause of the early deployment of grid-level battery storage in the United States, Europe, Japan and Korea. Australian small business is contributing to innovation for decentralised energy systems.

THIRD CHANGE: DRAMATIC REDUCTIONS IN COSTS OF CAPITAL REDUCE COSTS OF RENEWABLES. Similarly transformational in its effects, there has been a dramatic reduction in the cost of capital. Real interest rates are by far the lowest in recorded history. Interest rates on long-term bonds issued by Governments are below zero in a majority of developed countries. Real interest rates on ten-year bonds are below or near zero in all developed countries including Australia. These exceptionally low costs of capital are driven by fundamental changes in underlying economic conditions and are with us for a long time. The huge fall in the cost of capital is important for energy sector choices because the costs of producing renewable energy and of storing and transporting energy are overwhelmingly capital costs, while the costs of producing energy from fossil fuels are mainly recurrent. Low capital yields reduce the costs of renewable energy and storage relative to the costs of thermal energy from fossil fuels. The large reductions in the cost of capital in recent years have greatly reduced the cost of renewable relative to fossil thermal energy.

FOURTH CHANGE: DRAMATIC INCREASE IN AUSTRALIAN COST OF GAS. A fourth change is specifically related to Australia. When I was working on the first climate change review in 2007 and 2008, Australia had the developed world's cheapest natural gas available for domestic use—about one third of United States prices. The first climate change review recognised a major role for gas-fired electricity as a transitional fuel and for balancing the intermittency of renewable energy. My 2011 review update continued that recognition but introduced a note of caution: the development of an LNG export industry in eastern Australia would lift domestic gas prices to export parity levels and increase the cost of gas-based electricity. Since then, the development of LNG export capacity in Queensland beyond current gas availability has led to gas shortages and lifted prices at times to well above export parity. Domestic gas prices are now about three times as high in Australia as in the United States—and during the period of high South Australian electricity prices in July 2016 were sometimes six times as high, and higher even than in Japan and other countries to which Australia was exporting gas. This is before the sixth and last of the LNG trains in Queensland comes into full production later this year. High and occasionally unstable gas prices are with us for the foreseeable future. That increases the cost and diminishes the economically rational role of gas in balancing the intermittency of solar and wind energy.

Let me illustrate the extent of change in costs of renewable energy and deployment of storage with two facts, one related to the cost of solar energy, the other related to deployment of grid-level battery storage in the United States.

Last month, the lowest tenders for supply of power from new large-scale solar storage facilities in the Middle East came in at about US3 cents per kilowatt hour—around half the cost of fuel alone for most gas thermal generation in Australia. Large-scale deployment of solar and wind at favourable locations now generates power at low cost. This is a powerful factor causing a rapid increase in intermittent energy supply in many countries.

Right now, the US has over 44 grid-connected batteries with greater than 10MW power capacity, with a total of over a Gigawatt. California has a mandated grid-connected storage target of 1.3 Gigawatt by 2020. Large-scale deployment of battery storage is now an established way of balancing intermittent energy supply.

TWO CHANGES IN THE ELECTRICITY SECTOR RELATED TO CLIMATE CHANGE

And then there are two changes in perceptions of the costs of climate change and the importance of containing them.

FIRST CHANGE FROM CLIMATE CHANGE: MORE INTENSE EXTREME WEATHER EVENTS. There is greater awareness of the risks from climate change to large scale infrastructure, and of the costs of building infrastructure to withstand the intensification of extreme weather events. In Australia, there have been recent examples of unusually strong heat waves, bushfires, winds and floods disrupting electricity transmission infrastructure. Adjustments in the design and construction of transmission systems can reduce the risks and extent of disruption: stronger and higher towers; placing cables underground. But greater resilience comes at considerable cost. For many years, the science has advised us that climate change would cause conventional infrastructure to be more vulnerable to damage from the intensification of extreme weather events, and higher costs of making infrastructure more resilient to reduce the costs of damage. The modelling for my 2008 review suggested that damage to or increased costs of infrastructure would be an important source of loss for Australia from failure of climate change mitigation. What has changed recently is that the actual experience of greater intensity of extreme weather events has made this risk tangible to Australians who had not been exposed to or persuaded by the scientific evidence. It is now more common to recognise the greater costs of building infrastructure to withstand extreme weather events, and the greater risks of failure of conventional infrastructure as a result of climate change.

SECOND CHANGE FROM CLIMATE CHANGE: GREATER AWARENESS OF NEED TO REDUCE EMISSIONS. There is now greater awareness that Australia has to do a great deal to reduce greenhouse gas emissions if it is to do its fair share in the climate change effort. The lead up to the December 2015 meeting of the United Nations Framework Convention on Climate Change and the agreement in Paris were decisive. The lead-up to Paris saw influential interventions in public discussion of climate change by Pope Francis, including in his encyclical letter Laudato Si; forceful United States diplomacy on climate change led by President Obama and Secretary for State Kerry, including at the time of the G20 meeting in Brisbane in 2014; acceptance of the need for developed countries to have zero net emissions from electricity generation soon after the middle of the century at the G7 meeting hosted by Chancellor Merkel in Berlin in July 2015; an agreement to cooperate on climate change mitigation between Presidents Obama of the United States and Xi of China in November 2015; forceful interventions in support of a strong outcome in Paris by the heads of government of the major European countries, Germany, France and the United Kingdom; and acceptance by the major developing countries, led by Brazil and India, that they would be part of a major global mitigation effort.

The Paris agreement, accepted by all major countries, seeks to hold human-induced increases in average temperatures to as far as possible below 2 degrees, and if possible to 1.5 degrees. The major countries have ratified the Paris agreement since last December—in the case of the United States, making Paris different from the Kyoto agreement that was signed by the Clinton-Gore Government but never officially ratified.

Achievement of the 2 degree objective requires developed countries to reduce net emissions from electricity generation to zero by the middle of the century. Keeping alive the possibility of 1.5 degrees would require zero net emissions from electricity in the developed countries well before mid-century.

Australia faces special challenges in meeting the Paris objectives, as the developed country with the highest emissions per person and by far the highest emissions per person from electricity generation. A slow start on reducing electricity emissions has to be followed by a fast finish. The current 2020 and 2030 targets represent a slow start. The rate of emissions reduction has to accelerate sharply at some time well before mid-century. Analysis by the Climate Change Authority and others shows that the total cost of eliminating emissions is likely to be lower the sooner an acceleration begins. This will be an important consideration in the proposed 2017 review of Australian targets prior to the formal review of progress within the United Nations Framework Convention in 2018.

RENEWABLES AND CLIMATE CHANGE IN THE AUSTRALIAN ENERGY SYSTEM

Solar PV and wind are now relatively low cost sources of electricity in environments suited to them—including most of southern Australia and parts of northern Australia. Nowhere in the developed world are solar and wind resources together so abundant as in the west-facing coasts and peninsulas of southern Australia. The South Australian resources are particularly rich. The Upper Eyre Peninsula and Spencer Gulf in particular reveal unique combinations of intense insolation and access to diverse and strong wind patterns.

The growth of wind and rooftop solar energy at the expense of coal played an important role in the reduction by about 8% in Australian electricity emissions from late 2010 to June 2014 (Charts 2 and 3). The other major source of reduction in emissions over this period was a shift from coal to gas). The period of carbon pricing from July 2012 to June 2014 saw strong expansion of the role of gas at the expense of coal, and of black coal at the expense of emissions-intensive brown coal.

Since the end of carbon pricing, electricity emissions have resumed their upward march. Solar and wind generation have continued to expand, after a pause in wind in response to uncertainty about the future of the Renewable Energy Target. The continued expansion is driven by falls in the costs of solar and wind equipment and by incentives within the Commonwealth's Renewable Energy Target. The expansion of solar is accelerating and has great momentum following major reductions in costs of larger systems. However, the reduction in emissions from increased wind and solar generation has been outweighed by changes within the mix of fossil fuels: the expansion of coal, especially brown coal, and contraction of gas. The changes in the fossil energy mix have been driven by higher gas prices and the end of carbon pricing.

South Australia has by far the highest proportion of solar and wind amongst Australian states. This has emerged through competitive processes, principally as a result of superior renewable resources being used to take advantage of similar Commonwealth incentives across the States. The high renewables share in South Australia is also assisted by lesser availability of low-cost coal resources than in Victoria, Queensland and New South Wales. These underlying conditions will remain, so that South Australia is likely to continue to be the Wind and Solar State. Only deliberate distortion of policy to promote location of renewable generation in other states at the expense of South Australia would avoid that outcome. The resulting high penetration of intermittent renewables mean that South Australia has to find the answers first to questions that will soon arise all over the country.

Australia is relatively well endowed with most other forms of renewable energy. The hydro-electric resource is not particularly rich, although the Tasmanian and Snowy Mountains systems are significant on a global scale and have potential for playing an important role in balancing intermittent solar and wind energy supply. There is increasing deployment of solar thermal technologies in other countries, which combine generation and storage, and Australian research is opening new avenues to reducing costs. Australian research and development on use of sea water in pumped hydro-electric generation is revealing opportunities for large pumped hydro storage at low cost by global standards to balance intermittent energy supply and provide grid stability services. Biomass from sugar processing is a particularly rich renewable energy resource, that could generate large amounts of electricity in Queensland at relatively low cost while balancing intermittency in a similar way to fossil thermal energy. Famous Australian economist Colin Clark's observed in 1942 in his classic book Conditions for Economic Progress that the Australian eucalypt was an unusually efficient machine for producing renewable energy. Algae with its preference for intense sunlight and line environments is even more efficient—and there is plenty of sun and salt in South Australia. Advances are being made in wave and tidal energy. The southern coast of Australia is as good as anywhere for wave, for much the same reasons that it has superior wind resources. The northern coasts of western Australia have exceptional potential for tidal power, that one day may justify the huge investments in transmission or local industrial infrastructure that would be necessary to give them value. The deep hot rocks of South Australia and adjacent parts of this ancient continent await the clever applied earth science and engineering that is necessary to unlock commercial value. Australia has the world's largest natural resource endowment of high grade uranium oxide, which will play an important role in global progress towards zero net emissions from electricity. However, current costs of nuclear relative to renewable energy alternatives suggest that it is unlikely that nuclear energy will be competitive in this country for the foreseeable future.

The Australian Government is wise to make resources available to test the alternative forms of zero emissions energy that have good prospects for eventual large-scale commercial deployment in Australia. This is a role for ARENA, substantial funding for which has been continued in the recent budget agreement. Nevertheless, from what we know now, the achievement at reasonable cost of current 2030 emissions reduction targets, and the stronger targets that are necessary for Australia to meet its Paris commitments, require rapidly increasing contributions from solar PV and wind. This means that all Australian States must come to grips with the intermittency of these forms of renewable energy.

BALANCING INTERMITTENT RENEWABLES.

High penetration of intermittent renewables introduces high variability in wholesale prices, and the potential for destabilising variation in systemic frequency and voltage. The maintenance of systemic stability requires countervailing variations in volumes of wholesale power supply, and new sources of frequency control and ancillary services (FCAS).

Let me focus at first on the wholesale power market.

High penetration of renewables leads to low wholesale power prices at times when renewable energy is able to meet local demand, and high prices when the market has to be balanced by gas peaking power. Charts 4,5 and 6 illustrate the point with data from three months in last financial year—months for which I had taken out data for other purposes, and not selected deliberately for this presentation. In July, December and February of last financial year, the times of lowest wholesale prices each day—typically the early hours of the morning—revealed substantially lower wholesale prices in South Australia than in the two states with the lowest cost thermal coal resources—Victoria and Queensland. These were times when wind, supported by solar power in daytime hours, largely met requirements. The times of highest wholesale prices each day—typically the morning and evening peaks when gas provided the incremental supply to meet higher demand—prices were highest in South Australia. Queensland had even higher high prices in February 2016, as demand was lifted by commissioning of new LNG capacity. In the intermediate hours, prices tended to be a bit lower in Victoria than the other States, but not wildly different.

The expansion of intermittent energy supply in South Australia will tend to increase the number of hours each day with very low prices. The challenge is how to reduce prices at times when demand is strong and intermittent energy supply weak. Price volatility is not a problem in itself. Volatility provides the incentive to reduce demand, or to invest in new sources of electricity generation that produce power when prices are highest, or for investment in storage. Volatility provides the signal that increased transmission capacity may be warranted and should be considered alongside other means of balancing intermittency. Large users of power have opportunities to hedge against price uncertainty, and retailers can hedge to insulate their customers from variable prices.

The main sources of countervailing variation are demand management, storage, gas peaking generation, long-distance transmission, and diversity in renewable energy supply. Each has its strengths and limitations. Each has an important role to play through the transition to a low carbon economy. Demand management, co-generation from industrial processes, storage, long distance transmission and renewables diversity all have important roles in the zero carbon economy of the future. Whether or not gas peaking has a role after the transition depends on the availability of commercially viable sequestration of carbon dioxide wastes from gas combustion.

The challenge of policy is to allow and to facilitate good use of all means of balancing intermittent energy, and to ensure that reliance is placed on the most cost-effective of them in particular circumstances. Exclusive emphasis on only one or two of them alone will greatly increase the cost of the balancing.

Efficiently operating markets embodying a carbon price in some form—perhaps the baseline and credit scheme favoured in the recent Climate Change Authority report—can sort out the economically efficient contributions of alternative forms of generation and storage in wholesale power supply.

The wholesale power market currently contains distortions that block efficient use of new storage technologies. The most damaging of these distortions is the averaging of settlement prices over 5 minute periods. Suppliers and users of wholesale power bid into the market each 5 minutes. However, contracts between buyers and sellers are settled by averaging prices over half hour periods. This dulls incentives to expand output in short periods of exceptionally low supply, and to reduce them in short periods of high supply. The importance of this distortion is demonstrated by experience through July 2016, when average South Australian prices were exceptionally high. A large part of the exceptionally high average prices came from less than 40 five minute periods when prices were at or close to the regulated maximum of $14,000 per MWH. Some of these high price episodes occurred within the same half hour as other 5 minute periods with negative prices down to the regulated limit of minus $1000. Battery systems, unlike thermal generators, respond fast enough to contribute to stabilisation by absorbing energy in one 5 minute period when prices are low and expanding wholesale supply in an adjacent 5 minute prices when prices are high. Averaging over 30 minute periods removes incentives for stabilising behaviour, and actually introduces incentives to destabilise the market.

ZEN Energy's partner company in grid level battery storage and grid stabilisation, Greensmith, has installed more than one third of the large and rapidly growing battery storage capacity in the United States. This morning I asked its senior officers what contribution a battery storage system would have made to easing the recent power problems of South Australia. Greensmith's assessment from reading public materials including the AEMO report is that the system-wide problem is likely to have derived from variations in frequency, which batteries are particularly well placed to manage. It is not clear from the published material what caused the wind turbine trips. If later analysis suggests that the cause was systemic variation in frequency, then batteries would have provided the most cost-effective remedy. If the problems derived from local voltage issues, batteries located with wind farms could have avoided the problem. Once the system had tripped, and the challenge was to bring gas generators back into service as quickly as possible, a battery would have provided reliable and quick-acting black start services. By contrast, both contracted black start providers failed to restart the South Australian system last week.

Other characteristics of Australian market regulation discourage use of decentralised battery storage that has the potential to contribute to evening out demand and supply of wholesale power, and also to reduce peak demand for network services.

While more efficient markets can help in the allocation of resources among types of power generation and storage, they cannot play this role in defining efficient allocation of resources between network expansion and new forms of generation and storage. Electricity distribution and transmission networks are natural monopolies that require planning decisions in the public interest. The Australian regulatory system is poorly designed for taking decisions on maintenance and expansion of the networks. Major reform is required. It is important to shift the initiative in putting forward proposals for investment in network maintenance and expansion in the hands of a public body charged with taking decisions in the national interest. That would remove the conflict of interest embedded in current arrangements. Such a body would be charged with assessments of whether investment in network maintenance and expansion is likely to yield higher returns than investment in decentralised generation and storage. To do its important job well, the energy planning agency would need to have deep professional capacities, and insulation from the day to day vicissitudes of partisan politics. The Australian Energy Market Operator could be strengthened to perform this planning role.

It is impossibly unlikely that such a planning process would have led to the $85 billion of investment in expansion of transmission and distribution capacity that Australia has seen over the past decade of mostly declining total demand for wholesale power through the network. At the same time, it may have led to greater investment in some forms of long distance transmission. Australia has made massive investment in its power networks over the past decade, which has been added with high margins to the bills of power users. Recent experience suggests that this massive expenditure has not purchased energy security.

Rational network design in contemporary circumstances would see evolution towards greater use of decentralised power, supported by a central transmission network designed to play a large role in balancing intermittent energy from different sources. It might not necessarily lead to reduced power flows through the grid. An efficient electricity system may see the electrification of transport gathering pace in the years ahead. An efficient system is more likely to see Australia's advantages as a low-cost producer of renewable energy reflected in expansion of energy-intensive industries as the whole world shifts to greater reliance on renewable energy. These developments would mean an expansion of total power demand as the proportion of supply through the networks declined.

The new technology and economics of energy suggest that judicious application of local renewable energy supply technologies such as solar and battery storage can greatly reduce peak demand for power through the networks and therefore the costs of providing network services. At the same time, it can reduce vulnerability to disruption of networks from extreme weather events. The lights that stayed on in South Australia through last week's blackout were in homes and businesses which had invested in local battery storage, and on Kangaroo Island where the anticipation of failure of the submarine cable had led to provision for decentralised back-up generation.

Judicious investment in solar and wind generation, co-generation from industrial processes supplemented by gas generation where adjacent pipelines make this feasible, demand management and battery storage, supported by efficient integration into established networks, can reduce power costs for users outside Adelaide below what is available from reliance on the grid alone. Decentralised provision of power also provides security against future disruption from extreme weather events.

There are gaps in current markets for Frequency Control Ancillary Services that have become more important and costly with the expansion of intermittent energy supply. Fast response stabilisation services are required. These are much more likely to be made available at low cost if thier supply is secured through introduction of new competitive markets, designed so that the new technologies can compete on a level playing field with incumbent thermal generators.

The costs and technological capability of battery storage has fallen to the point where it can contribute substantially to price stabilisation and grid stability alongside high and rising penetration of renewable energy. It can be introduced quickly. United States experience suggests the possibility of full deployment of grid level batteries within six months from commercial decisions to invest in them.

Pumped hydro-electric facilities have longer lead times. Recent commercial research and development suggests that this form of storage will be able to play a major role in low-cost balancing of intermittent electricity supply as eastern Australia moves towards much higher penetration of intermittent renewables.

Increased interconnection between South Australia and other States would not remove the requirement for investment in storage to stabilise wholesale prices and the grid. Long distance trade in renewable energy will reduce price volatility to some extent. However, the national expansion of renewable energy supply will make the balancing of intermittency as important to Australia as a whole as it is to South Australia now.

RENEWABLES AND THE SOUTH AUSTRALIAN ELECTRICITY CRISIS

We are here today because South Australia has been through an electricity crisis. Emergency workers are still out in the floods helping people in distress—a week after the troubles began. Through a massive effort from emergency workers, power has been restored to almost all homes and businesses. The electricity blackout occurred in an era in which households depend on electricity not only for their light and warmth and cooling and cooking, but for finding their way around the city, managing their appointments, paying their bills, doing every computation and keeping in touch with friends. For those with disabilities and illness, electricity plays a vital role in day to day living as well as the maintenance of life.

The electricity grid and the regulatory systems that guide its investment and operations are poorly suited for the challenges of contemporary Australian energy requirements, let alone for the transition to a low carbon economy. The regulatory arrangements are part of the cause for utilities having the worst productivity growth of all sectors through the past decade of miserable performance in the Australian economy as a whole. That has little to do with renewable energy. Network costs per connection in Australia have moved over the past decade from the better half of global performance, to close to the highest costs in the developed world.

While the growing role of renewables has not been anything like the main contributor to strongly negative productivity growth and the blow-out in costs in the electrical utilities, the prospect of a much larger role of intermittent renewable in the electricity sector in future is good reason for making the efficient integration of wind and solar one focus of thorough review of governance in the sector.

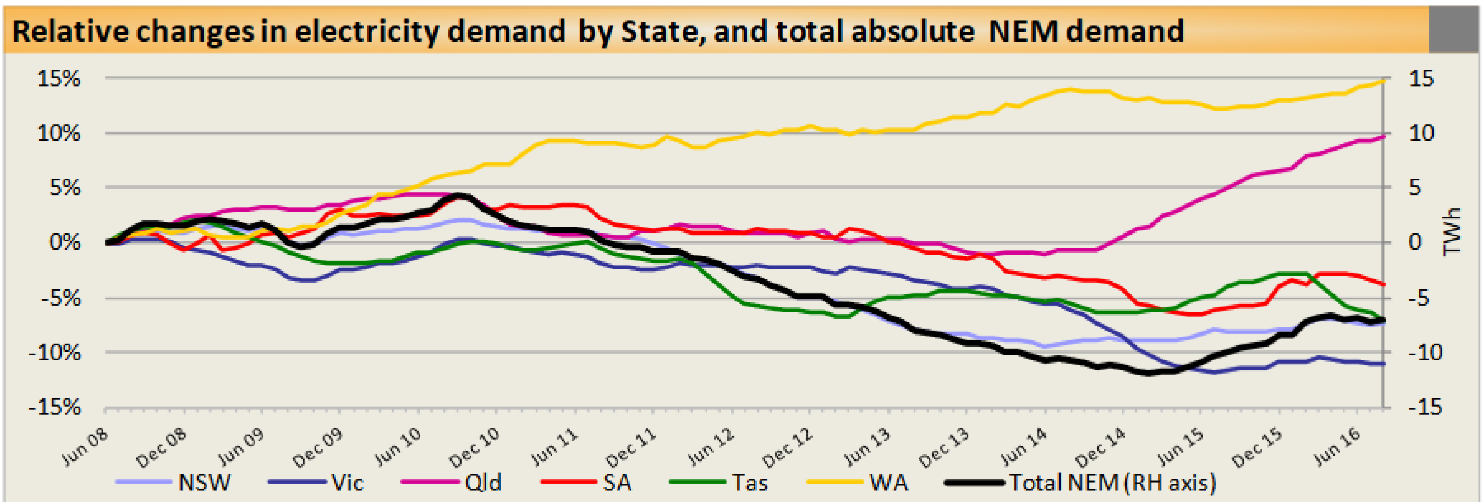
It is good that we now have a Federal Minister responsible for both Climate and Energy policy, with responsibility to reconcile the two. It is good that he has called a meeting of Ministers tomorrow to discuss the implications of the SA power crisis for both climate and energy policies.

It is important that the meeting tomorrow is guided by the Prime Minister's admonition to put ideology aside. It is important that the reconciliation of energy security with climate objectives and grid stability is seen as a complex challenge requiring a new look at our regulatory framework. That new look, in turn, will lead to recognition that the energy system that will perform well in the future will be very different from the energy system of the past. It will contain much more renewable energy. It will embody a different balance between centralised and decentralised power. It will draw security from decentralisation as well as from effective provision of network services.

Play our cards right, and Australia's exceptionally rich endowment per person in renewable energy resources makes us a low cost location for energy supply in a low carbon world economy. That would make us the economically rational location within the developed world of a high proportion of energy-intensive processing and manufacturing activity. Play our cards right, and Australia is a superpower of the low carbon world economy.

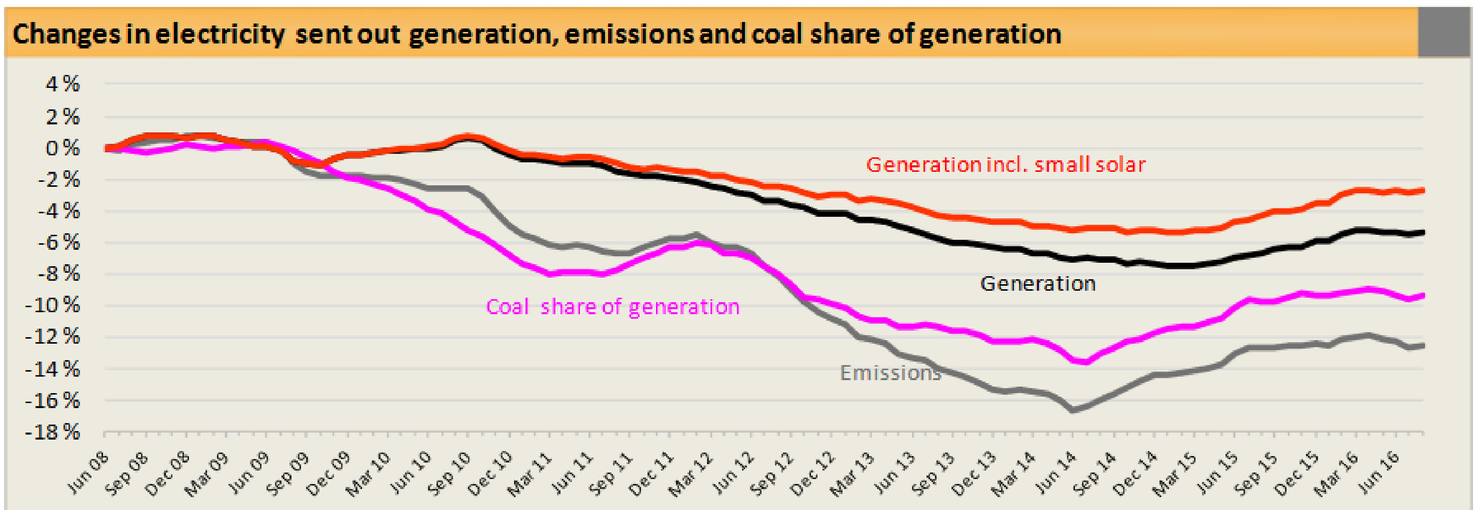
As we work through the challenges in the aftermath of South Australia's electricity blackout, lets make sure that our responses enhance rather than truncate Australia's and South Australia's opportunities.

Demand is receding:



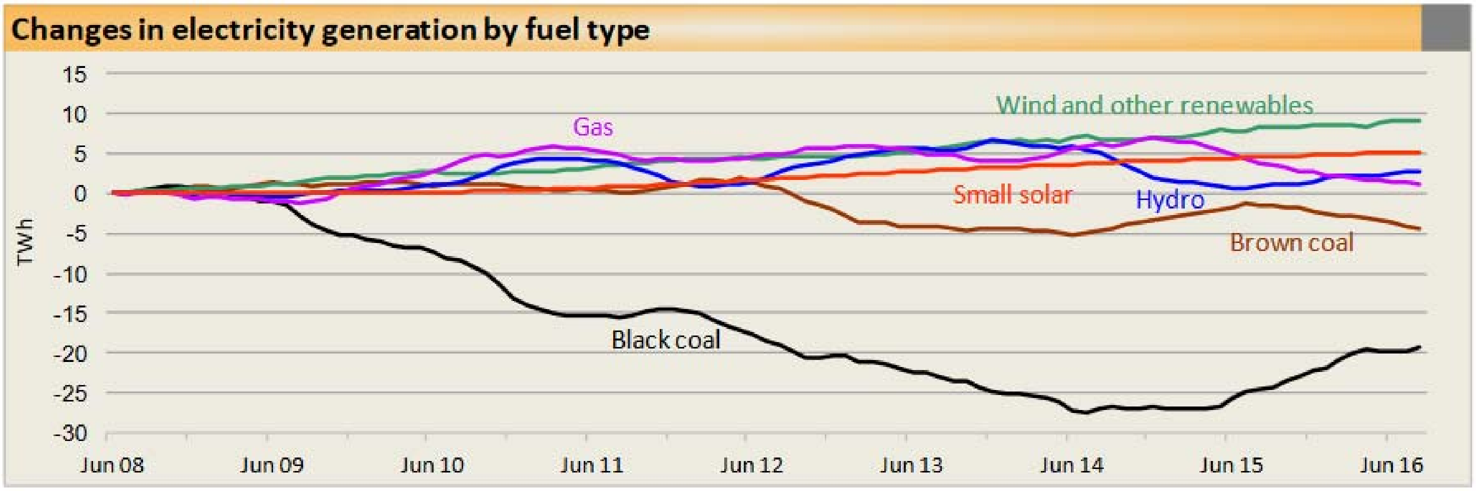
Source: CEDEX September 2016, *Pitt&Sherry*

Carbon emissions have risen with increased coal generation



Source: CEDEX September 2016, *Pitt&Sherry*

Gas fired electricity is being replaced by coal



Source: CEDEX September 2016, *Pitt&Sherry*

SA prices more variable: higher in high times, lower in low times

July 2015	**QLD**	**VIC**	**SA**
Average RRP	46.7	34.8	73.5
Bottom 10%	20.7	14.7	8.1
Middle 80%	34.7	33.0	49.3
Top 10%	168.2	68.6	332.3

Source: Aggregated price and demand data, *AEMO*

SA prices more variable: higher in high times, lower in low times

December 2015	QLD	VIC	SA
Average RRP	43.1	48.0	66.8
Bottom 10%	23.0	12.1	9.9
Middle 80%	40.8	41.4	49.3
Top 10%	81.4	136.7	263.9

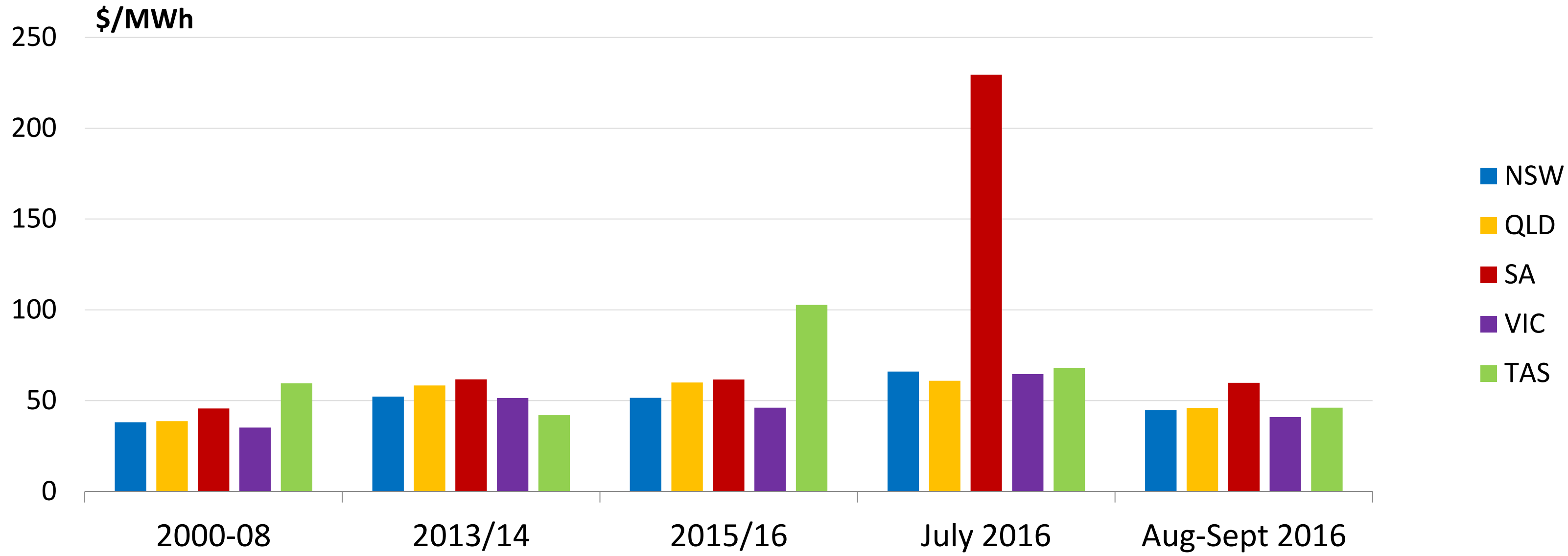
Source: Aggregated price and demand data, *AEMO*

SA prices more variable: higher in high times, lower in low times

February 2016	QLD	VIC	SA
Average RRP	91.8	30.9	34.7
Bottom 10%	26.0	14.3	7.9
Middle 80%	49.5	29.9	33.0
Top 10%	494.9	55.2	75.2

Source: Aggregated price and demand data, *AEMO*

NEM state average power price comparison



Source: Aggregated price and demand data, *AEMO*