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Leslie Guy
Secretary to the Committee
Select Committee inquiring into
State-wide electricity blackout
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24 February 2017

Dear Ms Guy

Many thanks for allowing additional time for us to provide comment on this important inquiry.

The Conservation Council of South Australia is SA's peak environment group, representing around 60 environment and conservation organisations. We have a keen interest in energy policy and practice, and support a smooth transition from fossil fuels to renewable energy in South Australia.

This transition is inevitable, and it is already well underway. It's no longer being led by Governments and Government policy, but by individual households and businesses making rational investment decisions. This means the increase in the percentage of renewable energy in the SA grid (approaching 50%) will continue (and accelerate as renewable technology continues to move lower on the cost curve) whether the SA Parliament likes it or not.

The CSIRO, along with many other credible energy researchers and commentators have emphasized that a grid powered from 100% renewable energy in Australia is possible and achievable. In SA this could happen as early as 2030. The key question is what measures we need to put in place to ensure the pathway from 50% to 100% is as smooth as possible.

It is clear from the recent experience in South Australia that inadequate planning for the transition is affecting the price, reliability and security of our electricity supply.

A smooth (rather than chaotic) transition requires a good understanding of the technical issues involved in higher penetrations of variable renewable energy and commitment by electricity market participants to implement the solutions that will address them.

Context of the blackout

The SA blackout needs to be understood in the context of a National Electricity Market (NEM) that has not embraced the shift from fossil fuels to renewables that we know is necessary to combat climate change, meet Australia's international commitments and prevent high power prices and stranded assets in the future.

The National Electricity Objective underpins the NEM and the rules that govern it. The Objective is:

> to promote efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers of electricity with respect to – price,

quality, safety, reliability, and security of supply of electricity; and the reliability, safety and security of the national electricity system.

The Objective contains no language that acknowledges the need to transition Australia's electricity system away from fossil fuels. It does not explicitly require the NEM to prepare for the transition that is already taking place, and will only accelerate.

The wording of the Objective means there is no legislative driver for the technical solutions and operational changes needed for a smoother transition. Instead, these measures are at the mercy of political will. Unfortunately, there are many examples of those with a vested interest in preserving our current ageing and expensive energy framework exerting undue influence on climate and energy policy and also the rules that govern the electricity market.

Causes of the blackout

The blackout was the product of extreme weather combining with several mainly preventable failures:

1. The Australian Electricity Market Operator (AEMO) was aware that severe weather was forecast but made the judgement not to treat this as a 'credible contingency event', which would have required backup measures in the event of power system failures.
   Comment: This decision has been questioned by a range of energy analysts and is likely to be the subject of further investigation by the Australian Energy Regulator.

2. Tornadoes and lightning strikes caused severe damage to transmission towers and caused faults and voltage dips to three transmission lines.
   Comment: SA's electricity infrastructure is clearly not able to withstand extreme weather events, however this is not something that could have been addressed in the short timeframes leading up to the storm. Investment to 'storm-proof' infrastructure would likely flow through to consumers so would need a thorough cost-benefit analysis.

3. AEMO was unaware of the 'ride-through' settings of SA wind farms (which meant that after a specified number of faults or voltage changes, wind farms would automatically shut down).
   Comment: Similar issues were experienced in Europe a decade ago and successfully resolved. Changing the ride-through settings is simple and AEMO's chairman recently announced that this has now been done, meaning this will not happen again in future. It could be argued that AEMO could and should have been aware of these settings. Knowing this may have enabled adequate backup systems to be put in place - although some energy commentators have questioned whether any technology could have coped with the sudden loss of voltage caused by damage to transmission infrastructure.

4. The sudden loss of power from wind farms required a sudden and dramatic increase in power from the Heywood interconnector, which was already operating close to full capacity and therefore overloaded and disconnected. This caused the shutdown of all power to the state.

Comment: If AEMO had treated the severe weather as a credible contingency event, limiting supply from Heywood would have been an appropriate backup measure.

5. Restarting of the system was delayed by the failure of the two generators contracted by AEMO to provide 'system restart ancillary services' (startup without power in the event of a complete blackout).
   Comment: The cause of these failures is still being investigated by AEMO.

While there has been considerable commentary that this issue was caused by SA's high penetration of variable renewable energy, particularly wind, it is clear from the above (and has been acknowledged by AEMO) that the blackout of 28 September was not related to variable energy supply or an inability for wind farms to cope with high wind speeds.

Indeed, there has been considerable analysis of similar potential blackouts in other states, including NSW that highlights the failure of reliability in gas and coal energy sources as a critical factor.

8th February 2017 load shedding event in SA

While it is not the subject of this inquiry, it is worth discussing the statewide blackout in the context of other, more recent power outages in the state, for example the 8th February load shedding event, as there are some common underlying factors.

While analysis of this event is continuing, it appears that likely causes were a combination of:

- poor forecasting of supply and demand by AEMO, whose wind and temperature forecasts were quite inaccurate
- loss of 273MW of gas supply from various generators in the leadup to the peak demand event (some caused by the high temperatures)
- an unwillingness for the Pelican Point gas generator to voluntarily turn on capacity to meet additional demand, possibly because increasing supply would have reduced wholesale electricity prices.

Additionally, a software fault caused SA Power Networks to shed 300MW instead of the 100MW that was requested by AEMO, magnifying the impact of the event.

It is worth noting that South Australia's rooftop solar contributed significantly to meeting demand throughout the high temperatures leading to the peak. It also reduced and delayed the "underlying" peak demand of 3317MW to an "operational" peak of 3085MW.

What can be learnt from these events

Common factors in both events include:

- poor planning and preparation for extreme weather events by AEMO
- technical failures of gas generators in times of need
- an electricity system that is not 'smart' enough to shed load in ways that are not harmful to energy consumers.

An issue that was not related to the statewide blackout, but which likely played a role on 8 February and which directly caused the SA price spike events of August and September

2016 was the apparent gaming of the electricity market by gas generators for their own financial gain. This certainly has implications for the future security and stability of SA's power supply, and so is highly relevant to this inquiry.

The importance of a smooth transition

South Australia is a world leader in the shift from dirty to clear energy sources. We should be incredibly proud of this. But it is essential that we manage the transition properly, and minimise disruption and costs to consumers.

In response to the blackout, some have called for a return to larger, inflexible forms of energy generation such as coal or nuclear. As well as having a range of negative environmental impacts, these technologies will not reduce electricity costs, and they integrate poorly with high SA's high proportion of renewable energy. What we need are flexible (dispatchable) forms of energy that can quickly turn on to fill in gaps between variable energy supply and consumer demand.

The technological solutions to do this are actually fairly simple. The enabling culture and regulatory environment is what we need to cultivate.

Technological solutions for a smooth transition

Technologies that can support a smooth transition include:

- forms of synchronous renewable energy that can be stored (eg solar thermal)
- provision of frequency control ancillary services from non-traditional sources (the Finkel Review paper suggested wind turbines fitted with synthetic inertia controllers, batteries with power conversion electronics, or spinning motors known as synchronous condensers
- grid scale storage (eg pumped hydro and large scale batteries)
- micro grids
- community energy schemes
- domestic scale batteries
- electric vehicles
- energy efficiency
- demand management.

Electricity Market Reform

Many of these solutions have been discussed for years, but the Australian Electricity Market Commission has been slow to implement rule changes that would facilitate them due to strong resistance from entrenched interests. As a result, there has been unnecessary investment in electricity infrastructure upgrades, which have increased electricity costs for consumers.

The current electricity market rules have been subject to undue influence and manipulation by fossil fuel generators to the detriment of consumers. There is a strong case for reform of the electricity market.

Learning for Texas

In September last year, Nick Miller, Senior Technical Director for GE Energy Consulting, was in Australia consulting to AEMO when the SA blackout took place.

Shortly afterwards he outlined the experience of Texas in responding to some of the challenges SA is facing today.

He believes there are 6 key ideas we need to embrace (see: http://www.gereports.com/experts-6-bright-ideas-golden-age-renewable-energy/)

1. Revolutions like this don't happen without missteps
I've spent the past 15 years leading research projects and wrestling with the inevitability that my world, the world of the power system, is changing at a disorientatingly fast rate. We don't get every piece right. And yet we get a setback and people say, "Well, obviously we shouldn't be doing this." No, that's not the answer. The answer is, what can you learn from a mistake like this?

2. The important things for running a power system with lots of wind or solar power are: No.1, flexibility; No. 2, flexibility; and No. 3, flexibility
The fact that there's uncertainty of demand (higher demand from consumers at different times of day) and uncertainty of supply (somewhat unpredictable variations in when the wind blows and when the sun shines) means that everything else in the power system needs to be more agile. The term we use in the industry is flexibility.

Take the other forms of generation contributing to the grid—say it's gas turbines. Compared to previous turbines, they need to be able to start, not an hour from now, but 10 minutes from now, and they need to be able to ramp up to power faster than they ever used to be able to. And they need to be able to turn way back, and to sit there producing relatively small amounts of electricity in anticipation of the need to ramp up. And likewise in anticipation of the need to be able to go down quickly when the wind picks up or the sun comes out from behind a cloud. So that's operational flexibility and GE has done very well in that space—the new stuff is dazzling!

Another piece of the puzzle is flexibility of institutions, politics, business.

3. Australia is an energy country, just like Texas is an energy "country"
Texas has one of the largest electrical systems in the US and it runs its grid accordingly. It is about the size of Australia, in terms of people and power. Texas has 15,000 megawatts (MW) of wind generation. And it regularly gets to operating conditions of 50% of instantaneous renewable penetration. That is, one out of two watts, at a time of day, are coming from wind. Texas does it reliably and they've kept the rates down.

Australia, like Texas, is an energy country. You've got great wind, you've got great solar, you've got a whole bunch of different fossil fuels. So has Texas. Texas looked at wind power and said, "Oh! This is energy; we do energy. Let's do wind." And they gave it more than just lip service. They changed the rules. They made investments in the grid. They watched the shop and tightened up the screws on every participant. So they have demands on the quality of the resource and the quality of performance from the wind plants that are the highest in the industry.

Texas has the best wind forecast. They've invested in their operations. They've invested in the transmission. They've changed the rules. They're constantly adjusting the market rules to the reality that the system doesn't look the way it always did.

4. People don't like to live where it's super windy

In places where you have a great wind resource, you generally don't have good transmission infrastructure or easy access to the grid. Texas recognised that and they sought a whole bunch of public comment and did a whole bunch of slicing and dicing of the figures and said, "OK, here are some areas where there's great wind resource and we've done enough homework to believe that those areas will be developed."

They went ahead and found public money, and did all the pain of routing and permitting, and built transmission lines into these wind-rich areas. A field of dreams. Then the wind plants came along and subscribed to those lines. They covered the risk that the ratepayers had paid forward. They're fully subscribed. It was wildly successful. That's one of the ways Texas got to 15 gigawatts of renewable generation.

5. The most economical thing you can do for everybody is to revisit the stuff you already have and use it better

I have an industry "war story" that I hold up as an example of good industry practice. The government of the state of Hawaii has said it's never going to build another fossil-fired power plant. All plants going forward are going to be renewable energy. HECO [Hawaiian Electric Company], the host utility, has this old fossil fleet, but we worked with them and they recognised up front that the operating profile of the fossil fleet is going to change significantly—more ramping, deep turnback, etc— as they have more and more wind and solar.

Ramping is hard on the equipment, but you have to have enough ramping to cover the system as the sun sets and the wind drops out—to ramp up and ramp down. So, they went through their fleet, which is not huge, but more than a dozen fossil plants, some of which were 60 years old, and for every single plant, they said, "Right, what limits turnback—the minimum power? What limits the up ramp and the down ramp and the start times?"

They went through, the pathology, the tests and said, "OK, we should spend $20 million toward the improvements that are the low-hanging fruit." And they went to the regulator and they said, "Look, if you want us to do all this wind and solar and reduce our carbon footprint in the state, we need to have agility from these plants." And the state took that argument and said, "You're right. Go forth. Put that investment in the rate base and make that improvement."

They increased their ramping capability on Oahu by a factor of five. Five times the megawatts per minute. It's a really cool story. So there are things you can do, but they don't happen on their own. It takes some institutional nudging. They could just as easily have said we need five times the ramping rate, so we're going to go and drop $200 million on a battery. You need this meeting of technology needs with people who are watching the money.

6. You have to ask the tough, "Where's the beef?" questions

My view on energy-storage opportunities is positive but cautious. What the grid needs is flexibility. When energy storage is the most economical way to get the flexibility in there, it's the right technology.

Energy storage makes more sense as the penetration of wind and solar increases. It makes more sense as you exhaust all the traditional thermal generation that's already on the ground. When you've squeezed every last morsel of performance out of what you've already built, then it makes more sense. And, the per-unit cost of energy storage is coming down.

But there's a fundamental truth that needs to temper our enthusiasm: Energy storage doesn't create a single megawatt hour. It's megawatt hours that make your economy run. Storage evens out your troughs and peaks, it does a whole bunch of good stuff, but all of that good stuff has to pay the rent.

In crude vernacular, Texas runs its grid really tightly, and they demand, without exception, a high level of performance, including from all the wind plants.

For example, the Electrical Reliability Council of Texas (ERCOT) has put in place a retroactive requirement on all wind plants to add the capability to provide primary frequency response. That means the ability to change their output locally, autonomously, in response to a deviation in system frequency. That's not standard practice, but ERCOT said: We need this. There are going to be operating conditions when we need that capability from the wind plants. We're putting it in place. Some of the market participants were not necessarily pleased with the changes initially. In the end, though, it's a relatively small cost, and it's worked really well.

We would welcome the opportunity to appear before the Committee to elaborate on these issues.

Yours sincerely,

Craig Wilkins
Chief Executive