SACOSS
South Australian Council of Social Service

Looking Around the Corner

A discussion on Current South Australian Power System Risks

SACOSS Report
February 2016

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Executive Summary

The South Australian Council of Social Service (SACOSS) has been active in South Australian energy market matters for some time, especially in relation to consumer protection, retail pricing and network determinations, but has not generally commented on issues associated with NEM (National Energy Market) wholesale markets … until now.

SACOSS commissioned an initial work piece to provide analysis and comment on the impact of recent wholesale market activities and decisions by NEM participants on future power station operating regimes, and to discuss the likely impact on the South Australian power system.

The objectives of the project were to:

- Develop SACOSS' understanding of the fundamental wholesale market design, configuration, physical characteristics and risks associated with the South Australian elements of the NEM;
- Explain the reasons behind recent market pricing outcomes; and
- Comment on the likely impacts of the impending shutdown of Alinta's Northern Power Station.

SACOSS note there are still of number of key issues that require further work:

- Northern Power Station will be shutting down around the end of March 2016 and although the SA power system has 'survived' in the past with both Northern units out of service for up to 3 months, the more enduring and consequential effects of this are not clear.
- Potential changes in operating regimes have been announced for two significant SA power stations:
    - AGL's Torrens A Power Station will potentially be mothballed by mid-2017;
    - Engie (formerly GDF Suez) have declared to the Australian Energy Market Operator potential changes in its running regime at Pelican Point across winter 2016.
- Even with Northern Power Station operating in recent months, there continues to be a high degree of ramp-rate limited and constrained plant in SA, thereby allowing the strategic rebids of any participant to be extremely sensitive to increasing wholesale market prices, for as little as 5 minutes, in South Australia.

Of particular concern, we note that South Australian volume weighted average spot prices for 2015/2016 year-to-date, is currently tracking to levels seen when the carbon price was in place for the 2 year period from July 2012 to June 2014, as highlighted below in the Table 1.

Period	$/MWh
2011-12	32
2012-13	74
2013-14	68
2014-15	42
2015-16 (YTD to 1-Jan-2016)	64

Table 1: SA Annual volume weighted average spot prices
Source: AER data

Similarly, we noted recent increases in the SA contract price for Calendar Year 2016, a fact many business and industrial users have made clear to us. SACOSS will continue to monitor wholesale market pricing outcomes in conjunction with the regular analysis by AEMO and especially the AER.

The load shedding arrangements noted in this report to manage power system frequency have an immediate and consequential impact on SA consumers. In the event more load shedding events are required (or the size of events increases) in the future, SACOSS wanted to understand the impacts of more significant load shedding events – state-wide blackouts.

If the likelihood of an event was say 1 in 30 years, the economic impacts of a state-wide blackout would be somewhere between $6m and $28m annually using the data detailed in this report (see table 2 and 3). The Australian Energy Market Operator is currently procuring System Restart Ancillary Services (SRAS) in SA worth $2.3m annually (which still includes Northern Power Station), which effectively implies a probability of an approx. 1 in 90 year event using Table 2's SA Res/Bus Value of Customer Reliability impact assessment: SACOSS strongly believes that this appears to be far too low a probability.

Recommendation:
SACOSS requests an independent investigation by the SA government into the events on 1 Nov 2015 when SA separated from the eastern states, including load flow 'what-if' analysis had Torrens A4 and Northern 2 not returned to service earlier in the day.

SACOSS will monitor events over summer 2015/16 and assess its response and actions in April 2016, as the impacts of the Northern Power Station shut down take effect, in order to respond constructively on behalf of South Australian consumers who are arguably at the forefront of a paradigm shift in power system operation; certainly within Australia, if not the world.

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About SACOSS

The South Australian Council of Social Service is the peak non-government representative body for health and community services in South Australia, and has a vision of Justice, Opportunity and Shared Wealth for all South Australians.

SACOSS does not accept poverty, inequity or injustice. Our mission is to be a powerful and representative voice that leads and supports our community to take actions that achieve our vision, and to hold to account governments, business, and communities for actions that disadvantage vulnerable South Australians.

SACOSS has a long-standing interest in the delivery of essential services. Our research shows that the cost of basic necessities like electricity impacts greatly and disproportionately on vulnerable and disadvantaged people.

SACOSS' purpose is to influence public policy in a way that promotes fair and just access to the goods and services required to live a decent life. We undertake policy and advocacy work in areas that specifically affect disadvantaged and low income consumers in South Australia.

SACOSS has a strong membership base of around 300 people and organisations from a broad cross-section of the social services arena. Members of our organisation span both small and large agencies, peak bodies, service providers, individuals, and some government departments.

SACOSS is part of a national network, consisting of ACOSS and other State and Territory Councils of Social Service.

Project Overview

The South Australian Council of Social Service (SACOSS) has been active in South Australian energy market matters for some time, especially in relation to consumer protection, retail pricing and distribution tariff reviews, but has not generally commented on issues associated with NEM (National Energy Market) wholesale markets … until now.

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The project explored the current and future landscape of South Australia from a wholesale market perspective in order for SACOSS to better understand potential impacts to residential, commercial and industrial consumers in SA for the coming years.

The project analysed some of the excellent work undertaken by the Australian Energy Market Operator (AEMO), ElectraNet (the South Australian Transmission Network Service Provider) and Australian Energy Market Commission (AEMC). We commend these organisations on their work to date and agree that there is a considerable amount yet to be completed. SACOSS commits to being involved as much as practicable.

SACOSS note there are still of number of key issues that require further work:

- Northern Power Station will be shutting down around the end of March 2016 and although the SA power system has 'survived' in the past with both Northern units out of service for up to 3 months, the more enduring and consequential effects of this are not clear.
- Potential changes in operating regimes have been announced for two significant SA power stations:
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Of particular concern, we note that South Australian volume weighted average spot prices for 2015/2016 year-to-date, is currently tracking to levels seen when the carbon price was in place for the 2 year period from July 2012 to June 2014, as highlighted below in the Table 1.

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Continued Focus

SACOSS agree with a number of statements made by AEMO in recent time regarding SA power system challenges, and while SACOSS accepts that under normal conditions, system inertia is not an issue, we do regard a number of critical issues still require further risk mitigation:

- The lack of underlying inertia in the SA power system and frequency response capability when separated from Victoria, resulting in increased reliance on the Vic-SA interconnector, and the dependence of SA on frequency emergency management schemes.
- A number of additional market and system changes are likely to be required (and paid for by someone, possibly consumers!) in the foreseeable future to accommodate the rapidly changing wholesale market environment.

Inertia

Inertia refers to the rotational momentum of the synchronous generators connected to the power system and defines the degree to which the generating unit will resist the frequency change. The 'heavier' the physical generating unit, the larger the momentum it will have when in operation, and the more difficult it is to slow down.

Under normal conditions, when SA is connected to the NEM via Vic-SA, the frequency in SA will be the same as the frequency in the other eastern states and NEM inertia will slow down the frequency decay that may occur from a plant trip in the SA region. However, if SA is disconnected from Victoria (Murraylink can inject power but not presently regulate frequency), it is the inertia of the SA generators and network elements alone that will support frequency in SA.

Of particular interest has been SACOSS's own analysis on Inertia[1]. Although not an expert in this field, it is clear to us that the initial investigations conducted by AEMO in 2013[2] (Figure 2) and recently re-examined in AEMO's Electricity Statement of Opportunities in October 2015, highlight a fundamental challenge with power system inertia in SA if/when the interconnector to Victoria is undergoing maintenance, partially available or trips.

[1] Inertia refers to the rotational momentum of the generators connected to the power system and defines the degree to which the generating unit will resist any power system frequency changes

[2] AEMO, Integrating Renewable Energy – Wind Integration Studies Report 2013, Figure 3.4

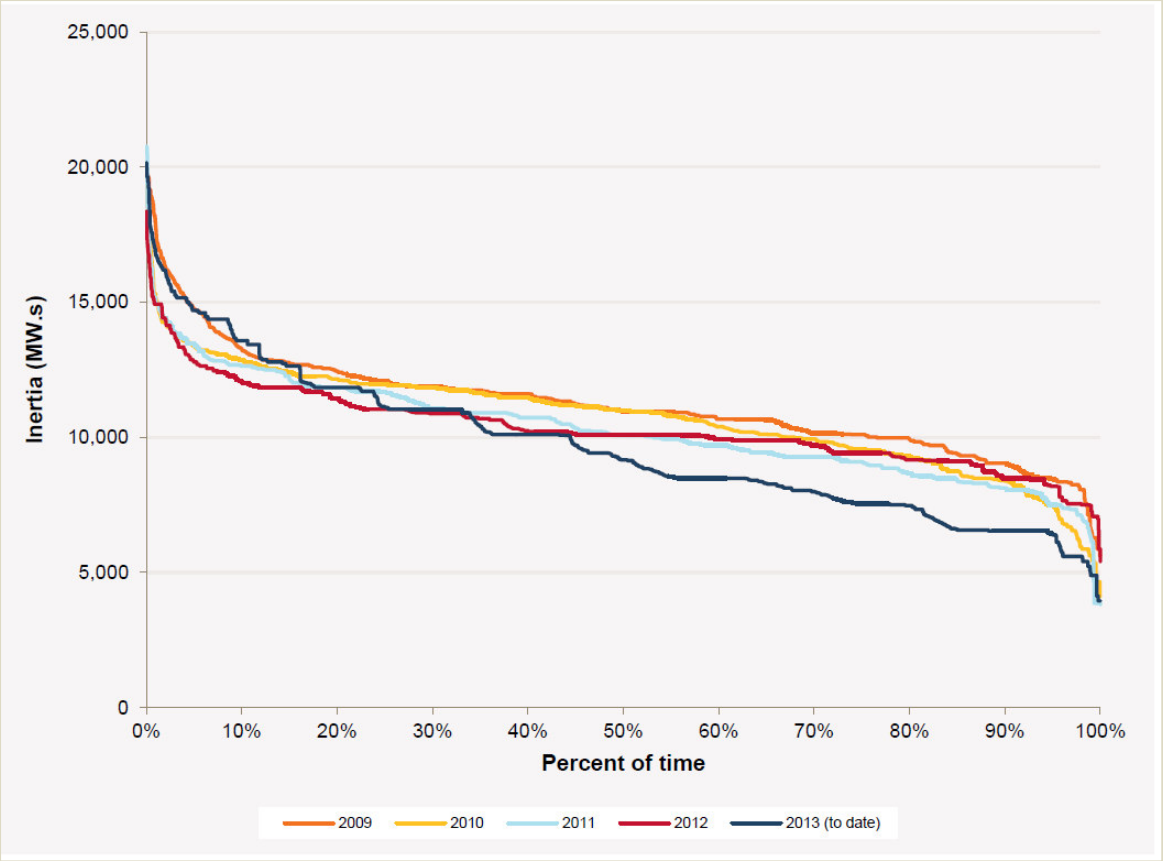

Figure 2: AEMO Chart (Figure 3.4) of SA System Inertia, 2013
Source: AEMO

SACOSS' consultants were able to create a proxy for AEMO's inertial calculations for SA using publically available 5-minute generation data and static inertia figures from constraint equations[3]. The proxy, although extremely simplistic and not indicative of TNSP plant in service, showed generally similar trends for historical periods. When the 2015 actual data was modified to show the potential effects of both Northern units shutting down for 2016, from a percentage change point of view, the inertia impacts of Northern Power Station shutting down were clear (Figure 3).

[3] It is only a proxy for inertia as it is missing key inertia data for ElectraNet assets that are not publically available.

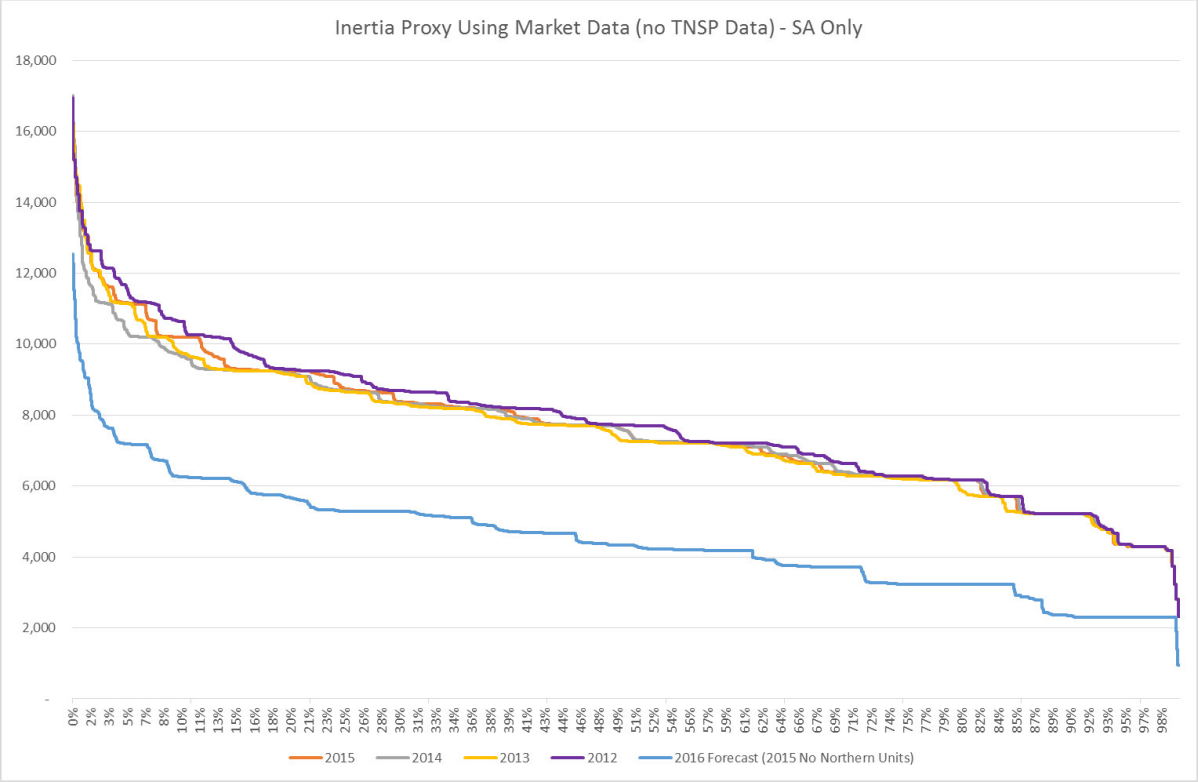

Figure 3: Inertia Proxy using Market Data (no TNSP Data) – SA Only

It should be noted that the shutdown of the Northern units is likely to see a response from other market participants and possibly network assets, which should see inertia levels increase for an SA islanded system, although this would only occur if the responding generators contribute inertia to the system (which does not currently occur with most wind and solar assets). SACOSS will work with relevant groups to improve the accuracy of this Inertia proxy in 2016 to ensure adequate public transparency on this complex, but very important issue for SA.

The consequence of low inertia for a separated SA power system is the heavy reliance on under-frequency load shedding (or generation tripping in the case of over over-frequency events), an outcome that is detrimental to SA consumers in many ways. The experiences of Victoria in 2007 when 2200MW of load shedding occurred, costing the Victorian economy an estimated $600m (in 2015 dollars) have been used as a point-of-reference to understand the importance of solving some of these challenges correctly[4]. The events of 1 November 2015 in South Australia serve as a similar warning to ensure appropriate risk controls are in place for the benefit of SA consumers.

[4] Victorian Government, Major Incident Report 16 Jan 2007 http://www.energyandresources.vic.gov.au/energy/safety-and-emergencies/energy-supply-emergencies/january-supply-interruptions-executive-summary [Accessed 20 November 2015].

Economic Impacts of State-wide Blackout

The load shedding arrangements noted above to manage power system frequency have an immediate and consequential impact on SA consumers. In the event more load shedding events are required (or the size of events increases) in the future, SACOSS wanted to understand the impacts of more significant load shedding events – state-wide blackouts.

SACOSS has considered two methods for assessment: Value of Customer Reliability (VCR) and a recent example from Victoria that resulted in load shedding levels that were approximately the same size as typical SA demand profiles.

VCR represents, in dollar terms, the willingness of customers to pay for the reliable supply of electricity. The values produced are used as a proxy and can be applied for use in revenue regulation, planning and operational purposes in the NEM. SACOSS has been an active supporter of this method. It is important the VCR figures accurately reflect the value of reliability across a range of customers, with the assessment below capturing the benefit for both business and residential customers[5].

The next method for assessment came from assessment made in Victoria from a January 2007[6] major electricity supply interruption. In that case, consultants were able to assess the direct AND indirect economic impacts at a value of $600m in today's dollars for a partial impact to the Victorian system (herein referred to as the 'Vic Event').

For the purposes of this assessment, we have used the following assumptions:

- Median SA Operational demand[7] for the last 4 years is approx. 1500MW;
- Northern Power Station is not available for generation or SRAS (as will be the case from April 2016);
- Torrens Island has 3 B units and 1 A unit that are warm enough for immediate generation;
- Pelican Point is only capable of half-load as indicated through recent running profiles and in recent AEMO announcements[8];
- System Restart Ancillary Services (SRAS) sources (Dry Creek and Quarantine[9]) work as expected and all SA synchronous generation (except Snuggery, Port Lincoln and

[5] AEMO VCR Review, Nov 2015, [Accessed 10 December 2014]

http://www.aemo.com.au/Electricity/Planning/Value-of-Customer-Reliability-review

[6] In this event, 2300MW was shed (2200 initially and 100MW of smelter load shortly thereafter) and was not fully restored until over 4 hours later (unserved energy was 7100MWh), with the economic effect estimated at approx. $500m ($600m in today's terms) with indirect costs as much as the direct costs http://www.energyandresources.vic.gov.au/energy/safety-and-emergencies/energy-supply-emergencies/january-supply-interruptions-executive-summary

[7] Operational Demand is used (as opposed to total demand) as AEMO has stated it will not allow wind generation to be used until the system rebuild is greater than approx. 40% or the Heywood interconnector is available.

[8] AEMO ESSO Update, October 2015.

[9] The 2015 Independent Review of SRAS Process Improvements by DGA Consulting identified Quarantine and Northern Power Station as the 2015/16 SRAS sources (p 27). It is assumed when Northern Power Station shuts down in April 2016, Dry Creek units will be enabled for SRAS but this is yet to be confirmed.

Ladbroke Grove – all due to remote location) are supplied power for safe shut-down, auxiliary loads (approx. 100MW) and commenced export of energy within 4 hours with 600MW of load restored; and,

- All demand is restored within 8 hours[10] at an eventual rate of 200MW/hr given the load blocks that would be able to be handled by the smaller sized generating units in SA.

Table 2 shows the possible economic impacts using both methodologies with the length of the event shown at various points.

Time (in hrs)	Demand (MW)	Unserved Energy (MWh)	Accumulated Impact to SA Economy ($m)	
			SA Residential/ Business VCR: $35.8k/MWh	Vic Event: $84.5k/MWh
Just prior to event	1500	0	0	0
End 1st Hour	0	1,500	53.7	126.8
End 2nd Hour	250	2,750	98.5	232.4
End 4th Hour	700	4,550	162.9	384.5
End 6th Hour	1100	5,550	198.7	469.0
End 8th Hour	1500	5,750	205.9	485.9

Table 2: Economic Impact to SA using a Desired Scenario

If the above scenario is delayed by just 4 hours with a slower than expected restoration rate, the impacts are even more significant.

Time (in hrs)	Demand (MW)	Unserved Energy (MWh)	Accumulated Impact to SA Economy ($m)	
			SA Residential/ Business VCR: $35.8k/MWh	Vic Event: $84.5k/MWh
Just prior to event	1500	0	0	0
End 1st Hour	0	1,500	53.7	126.8
End 2nd Hour	50	2,950	105.6	249.3
End 4th Hour	250	5,550	198.7	469.0
End 6th Hour	450	7,750	277.5	654.9
End 8th Hour	850	9,250	331.2	781.6
End 10th Hour	1250	9,950	356.2	840.8
End 12th Hour	1500	10,000	358.0	845.0

Table 3: Economic Impact to SA using a 4-hour Delay Scenario

If the likelihood of an event was say 1 in 30 years, the economic impacts of a state-wide blackout would be somewhere between $6m and $28m annually using the above two table's outcomes. AEMO is currently procuring SRAS in SA worth $2.3m annually (which still includes Northern Power Station), which effectively implies a probability of an approx. 1 in 90 year event using Table 2's SA Res/Bus VCR impact assessment: this appears too low a probability!

[10] Most demand in the March 2015 blackout in Turkey was able to be restored within 8-10 hours although Turkey have a high level of hydro generation capability (which had effectively pushed thermal-gas generation offline) during high running periods.

Moving Forward

SACOSS has taken on board a number of matters for further consideration and involvement with the relevant State and National bodies, including:

1. Maintaining a 'Watching Brief' on a number key items over the next 2-6 months.
2. Ensure SACOSS' involvement in the following key market issues, reviews and consultations:
    - The imminent release by AEMO/ ElectraNet Report on SA Power System issues, ensuring involvement in possible working groups and forums to better represent the needs of SA consumers;
    - Formation of a working party to bring AEMO/ElectraNet/SA State Government and interested participants together on SA power system implications BEFORE potential system incidents occur.
    - Follow the potential developments of an inertia market through 2016 given recent AEMO comments and internal SACOSS analysis.
3. SACOSS requests an independent investigation by the SA government into the events on 1 Nov 2015 when SA separated from the eastern states, including load flow 'what-if' analysis had Torrens A4 and Northern 2 not returned to service earlier in the day.

Given the amount of focus and interest on the South Australian power system, as well as the expert advice indicating particular challenges in SA, this project has highlighted the need for SACOSS to continue to be involved in wholesale market matters. SACOSS will monitor events over summer 2015/16 and assess its response and actions in April 2016, as the impacts of the Northern Power Station shut down take effect, in order to respond constructively on behalf of South Australian consumers who are arguably at the forefront of a paradigm shift in power system operation; certainly within Australia, if not the world.