ElectraNet

ADDRESSING THE SYSTEM STRENGTH GAP IN SA

Economic Evaluation Report

18 FEBRUARY 2019

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Executive Summary

ElectraNet has investigated options for most efficiently meeting the ongoing need for system strength to ensure the secure and reliable operation of the power system in South Australia under foreseeable operating conditions.

This report presents the results of our economic evaluation of potential solutions to meet this need, including generator contracting and the installation of synchronous condensers on the transmission network. These options are compared with the current operational practice of generator direction by the Australian Energy Market Operator (AEMO) to manage system strength in South Australia.

Overview

Our analysis of system strength solutions has identified that in the interests of customers:

- Contracts with existing gas-fired generators would not be an economically viable solution based on the market costs of this option
- Installing synchronous condensers on the transmission network is the most efficient and least cost solution in the short to medium term
- The costs of the current generator direction process continue to grow, reinforcing the need for installation of synchronous condensers as soon as possible, which will bring forward generator direction cost savings for customers
- Installing synchronous condensers remains a no regrets measure to meet the minimum need for system strength in the absence of any other available solutions in the immediate term, noting that any future sources of system strength that emerge will help address wider constraints on the power system
- This system strength solution is also expected to efficiently meet the minimum threshold level of inertia in South Australia through the installation of high inertia machines, at minimal additional cost.

The avoided cost impacts of the generator direction and compensation process through this investment in synchronous condenser capability results in an estimated net cost saving equivalent to $3 to $5 per year off a typical South Australian residential electricity bill.

Declaration of a system strength gap in South Australia

On 13 October 2017, AEMO declared a Network Support and Control Ancillary Service (NSCAS) gap for system strength in South Australia.

AEMO's notice identified a system strength gap at the Davenport 275 kV transmission connection point of 620 MVA each year for the remainder of the current five-year NSCAS planning horizon and beyond. AEMO specified that system strength services were required on an ongoing basis from 30 March 2018, with the proposed solution to be verified through detailed system studies.

ElectraNet elected to meet this NSCAS gap as a fault level shortfall under the new system strength framework introduced by the Australian Energy Market Commission (AEMC) in September 2017.

To address this gap in the interim, AEMO continues to direct synchronous generators to operate when required through its powers of market direction, until an ongoing solution can be deployed. As at 23 September 2018, AEMO has issued over 140 directions to South Australian generators in order to maintain sufficient system strength. However, the ongoing use of generator directions beyond the short-term is not sustainable and leads to distortions in the market, significant costs to customers and operating difficulties.

Immediate steps taken to address the system strength gap

We examined the most cost effective options to address the ongoing system strength gap, including contracting existing generation to operate when needed as the only potential solution to meet the 30 March 2018 date specified by AEMO.

The results of our generator tendering process demonstrated clearly that a contracting solution would not be economically viable given that the costs of the contracts required would far outweigh the cost of generator direction currently being incurred in the market.

In parallel with this work, ElectraNet has continued to assess the most cost effective solutions to address the ongoing system strength requirement as soon as practicable.

Options considered to address the ongoing system strength gap

The credible options identified for the ongoing management of power system strength and key assumptions that we have considered as part of this assessment are summarised in Table E.1 below. We have also worked with AEMO to validate the technical capability of proposed system strength solutions to ensure power system security is maintained.

Table E.1 – Summary of the credible options assessed

Option	Description
Base case	AEMO continues to source system strength services under the generator directions framework. Ongoing direction compensation costs are estimated to be approximately $34m per annum over the assessment period based on current annualised costs. There is also considerable risk and uncertainty as to how long this operational solution will remain viable from a practical perspective.
Option 1	ElectraNet sources system strength services from existing synchronous generators in South Australia. Ongoing annual generator contract costs are estimated to be $85m over the assessment period based on tender pricing.
Option 2	ElectraNet installs a number of synchronous condenser units at suitable network sites in South Australia at an indicative capital cost of $140m to $180m by end 2020.

AEMO's inaugural Integrated System Plan (ISP) published in July 2018 also recommends that immediate investment in transmission should be undertaken to remedy system strength in South Australia and identifies the need for synchronous condensers in South Australia to supply both system strength and inertia as a Group 1 investment to be pursued as an immediate priority.[1]

These requirements informed the development of the credible options we have assessed and are being taken into account in the detailed design of the proposed solution. AEMO is also required to approve the final technical specification, performance standards and operational requirements of the system strength service.

1 AEMO, *Integrated System Plan*, 17 July 2018. Available at https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/Integrated-System-Plan.

Installing synchronous condensers is the most efficient and least cost solution

Installing synchronous condensers on the transmission network was identified as the most efficient and least cost solution in the short to medium term. As shown in Table E.2 below, the installation of synchronous condensers (Option 2) provides the greatest net economic benefit of the options assessed, relative to the current practice of generator direction.

Table E.2 – Estimated net market benefit for each option

Option	NPV ($m 2018-19)	Rank
Option 1 – Contracting existing synchronous generators	(428)	2
Option 2 – Installing synchronous condensers	38	1

The cost and risks of the current generator direction process continue to grow, reinforcing the need for the timely installation of synchronous condensers, which will deliver generator direction cost savings for customers.

We estimate that commissioning of the required synchronous condensers would occur by end 2020. Based on the annualised costs incurred in 2018-19 to mid-September, implementation of a synchronous condenser solution would avoid ongoing direction costs in the order of $2m a month.

Accelerating the installation of a synchronous condenser solution through the early implementation of an initial number of units would bring forward some of these benefits, and result in a net saving to customers of around $3m per annum.

The net result of the implementation of a full synchronous condenser solution is an estimated cost saving equivalent to $3 to $5 per year off a typical South Australian residential electricity bill.

Installing synchronous condensers provides a no regrets measure to meet the minimum system strength requirement in the absence of any other available solutions in the immediate term, noting also that any future sources of system strength that emerge will help address wider constraints on the power system.

Implementation of this system strength solution through the installation of high inertia machines is also expected to efficiently meet the minimum threshold level of inertia in South Australia, at minimal additional cost.

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Glossary of Terms

Term	Description
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
CAP	Consumer Advisory Panel
DER	Distributed Energy Resources
ISP	Integrated System Plan
MVA	Megavolt-amperes
MW	Megawatts
MWs	Megawatt seconds
NEG	National Energy Guarantee
NEM	National Electricity Market
NER, Rules	National Electricity Rules
NPV	Net Present Value
NSCAS	Network Support and Control Ancillary Services
NTNDP	National Transmission Network Development Plan
PV	Photovoltaic
RIT-T	Regulatory Investment Test for Transmission
TAPR	Transmission Annual Planning Report
TNSP	Transmission Network Service Provider

1. Introduction

This report presents the results of our economic evaluation of potential options for the ongoing management of system strength on the power system in South Australia, including generator contracting and the installation of synchronous condensers on the transmission network.

These options are compared with the current operational practice of synchronous generator direction by AEMO to manage system strength in South Australia.

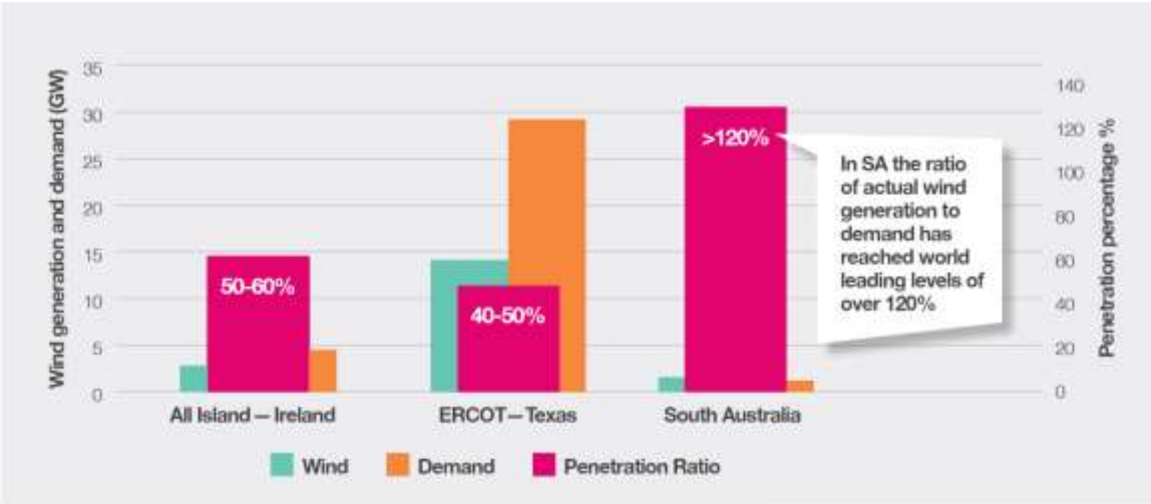
1.1 The challenges of a changing supply mix

South Australia is a world leader in renewable energy generation.

As more renewable energy generation such as wind and solar has come online, traditional synchronous generation sources such as gas-fired units now operate less often. This creates challenges in managing the security of the power system.

Figure 1 shows the extent of non-synchronous generation penetration in South Australia, compared to other power systems with high levels of renewable generation.

Figure 1 – Penetration of non-synchronous generation in selected power systems



Source: AEMO, South Australian System Strength Assessment, September 2017.

A secure power system needs adequate levels of both system strength and inertia.

Synchronous generators have traditionally been the predominant source of both of these requirements in the National Electricity Market (NEM). Existing intermittent renewable generators are generally asynchronous and do not materially contribute to providing system strength or inertia.

What is system strength?

System strength relates to the ability of a power system to withstand changes in generation output and load levels while maintaining stable voltage levels.

When system strength is high, voltage changes less for a change in load or generation than it would if system strength is low. System strength is generally measured by the three-phase fault level, expressed in megavolt-amperes (MVA).

In a system with low system strength:

- generators may be unable to remain connected during disturbances on the power system
- control of system voltage becomes more difficult
- protection systems which control the safe operation of the network may not operate correctly.

This impacts on system security and increases the risk of system instability and supply interruptions to customers. System strength is provided locally by sources such as traditional synchronous generators, transmission network lines and transformers, voltage control equipment and synchronous condensers.

What is Inertia?

Inertia relates to the ability of a power system to withstand changes in generation output and load levels while maintaining stable system frequency.

Inertia is generally measured in megawatt seconds (MWs). In a system with high levels of inertia, frequency changes less rapidly for a change in load or generation than in a system with low levels of inertia.

In a system with low levels of inertia:

- generators may be unable to remain connected during disturbances on the power system
- limits (constraints) may be applied to ensure stable operation of the power system, for example reduced power flows between regions.

Inertia is generally provided by large rotating electrical machines that are synchronised to the frequency of the power system, including traditional synchronous generators, motors and synchronous condensers.

Inertia can also be partly substituted, but not replaced, by fast acting frequency control services.

With increasing levels of asynchronous renewable generation, decreasing system demand and the progressive withdrawal of conventional synchronous generation, there is an increasing risk in South Australia that, without intervention, there will be insufficient online synchronous generation to maintain system security.

While inertia can be shared across regions when interconnected, system strength is a more local characteristic of the power system. Some system strength can be shared across regions via interconnectors as fault contribution into the local area. However, this depends on the distance (impedance of the network) from the point of interest. For example, the Heywood Interconnector provides a portion of the fault level at any particular location, but this diminishes with distance from the interconnector.

Improving system strength in South Australia will improve power system stability and resilience and enable non-synchronous generation sources (like wind and solar) to be more efficiently dispatched, reducing market costs in South Australia.

1.2 Structure of this document

The remainder of this document is structured as follows:

- Section 2 outlines the system strength requirements for South Australia under the National Electricity Rules (Rules), including associated inertia requirements.
- Section 3 describes the actions we have taken in the short-term in applying reasonable endeavours to address the ongoing system strength obligation, and the consultation we have undertaken to date.
- Section 4 provides the options we considered in order to address our system strength obligations.
- Section 5 outlines the methodologies and assumptions applied and the key categories of market benefit for our economic assessment.
- Section 6 provides the results of the economic assessment undertaken, including key sensitivities for varied input assumptions.
- Section 7 identifies the option which maximises net market benefits and provides indicative customer bill impacts.
- Section 8 sets out our next steps.

2. System strength requirements for South Australia

2.1 Declaration of a system strength gap in South Australia

On 13 October 2017, AEMO published a second update to its 2016 National Transmission Network Development Plan (NTNDP) and declared an NSCAS gap for system strength in South Australia.[2]

AEMO's notice identified a system strength gap at the Davenport 275 kV transmission connection point of 620 MVA each year for the remainder of the current five-year NSCAS planning horizon and beyond. AEMO specified that system strength services were required on an ongoing basis from 30 March 2018, and that the proposed solution would need to be verified through detailed system studies. This represents the minimum need that must be met in order to address the NSCAS gap declared by AEMO.

AEMO has subsequently published methodologies and assessments relating to minimum fault level requirements and shortfalls at specific fault level nodes.[3]

AEMO also currently applies a regional constraint to limit the aggregate level of non-synchronous semi-scheduled generation output in South Australia to levels typically between 1,295 MW and 1,460 MW unless a minimum level of synchronous generation is dispatched.[4] A higher limit of 1,870 MW of non-synchronous generation also applies (on a dynamic basis) once a higher level of synchronous generation is dispatched.

These constraints remain in place until further sources of system strength are made available in South Australia. Additional sources of system strength above that required to address the minimum need representing the declared NSCAS gap could alleviate these constraints, but these are excluded from the scope of this economic assessment.[5]

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2 AEMO, *Second update to the 2016 National Transmission Network Development Plan,* 13 October 2017, p.5. Available at http://www.aemo.com.au/-/media/Files/Electricity/NEM/Planning_and_Forecasting/NTNDP/2017/Second_Update_to_the_2016_NTNDP.pdf. This followed AEMO's declaration of a NSCAS gap for system strength in South Australia in its 2016 NTNDP published in December 2016.

3 AEMO, *System Strength Requirements Methodology, System Strength Requirements & Fault Level Shortfalls*, 29 June 2018, available at: http://aemo.com.au/Electricity/National-Electricity-Market-NEM/Security-and-reliability/System-Security-Market-Frameworks-Review.

4 AEMO's 2016 NTNDP and subsequent updates identified various combinations of synchronous generators which are required to be online in South Australia to ensure the power system is in a secure operating state. AEMO also published and has continued to update transfer limit advice to provide information about the levels of system strength required to securely operate the South Australian region of the NEM with high levels of non-synchronous generation (see AEMO, *Transfer Limit Advice – South Australia System Strength*, Version 19, 5 December 2018: available at https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Security-and-reliability/Congestion-information/Limits-advice).

5 However, this assessment is limited to the consideration of options that address the minimum need that must be met to address the NSCAS gap declared by AEMO, consistent with clause 5.20C.3(d) of the Rules that requires we make available the least cost option or combination of options to satisfy the system strength services requirement in the timeframe required.

ElectraNet elected to meet the declared NSCAS gap as a fault level shortfall under the new system strength framework.[6] This framework requires ElectraNet to use its reasonable endeavours to address the fault level shortfall by having system strength services available by the target date specified by AEMO.[7]

Before progressing a solution, AEMO must approve the technical specifications, performance standards and arrangements for enabling that system strength service under the Rules.[8]

2.2 Exemption from Regulatory Investment Test for Transmission

Transmission Network Service Providers (TNSPs) are not required to apply the Regulatory Investment Test for Transmission (RIT-T) to a proposed network investment in the specific circumstances where:

- AEMO provides a notice to a TNSP declaring a fault level shortfall in a region under the new system strength framework;
- prior to the declaration, the TNSP is not under an obligation to provide system strength services; and
- the time for making the system strength services available is less than 18 months after the notice is given by AEMO.[9]

As AEMO issued a notice on 13 October 2017 that declared a system strength gap in South Australia to be addressed on an ongoing basis from 30 March 2018, with no prior obligation to provide system strength services in place, ElectraNet is not required to apply the RIT-T in relation to this system strength requirement.

Given the urgency of the system strength requirement in South Australia, this exemption enables a solution to be delivered to provide these services in a timelier manner.

However, this document sets out an equivalent economic evaluation undertaken by ElectraNet to assess credible options and identify the most efficient solution to meet this identified need.

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6 On 19 September 2017, the Managing power system fault levels Rule was introduced by the AEMC to provide a new framework for the provision of system strength services in the NEM. The new obligations stemming from this framework for transmission network service providers to maintain required levels of system strength came into effect on 1 July 2018. However, transitional arrangements enabled the responsible TNSP to treat a system strength NSCAS gap that is declared by AEMO with less than 12 months' lead time during the transitional period to 1 July 2018 as a fault level shortfall for the purposes of the new system strength framework (in accordance with the transitional provisions under clause 11.101.6(a) of the Rules).

7 Clause 5.20C.3(c)(1) of the Rules.

8 Clause 5.20C.4(e) of the Rules.

9 Clause 5.16.3(a)(11) of the Rules.

2.3 Integrated System Plan and associated inertia requirements

On 17 July 2018, AEMO published its inaugural ISP which forecasts transmission system requirements for the NEM over the next 20 years.[10] The ISP recommends that immediate investment in transmission should be undertaken with completion as soon as practicable to remedy system strength in South Australia as a Group 1 priority and states:

> *"…the ISP identifies the need for synchronous condensers in South Australia to supply both system strength and inertia. This is essential now, and will continue to be needed after the RiverLink interconnector (the new South Australia to New South Wales interconnector)… is developed to allow the most cost-effective use of South Australia's local generation."*[11]

System strength and inertia are closely related and can both be provided by dispatching synchronous machines. Both are important to ensure secure supply for customers. If there is not enough of these services within the power system, there is an increased risk of system instability and supply interruptions.

AEMO's 2018 Inertia Requirements and Shortfall review confirms this relationship[12], and the ISP summarises inertia requirements for South Australia as follows:

> *"AEMO has identified minimum inertia requirements to operate the power system under rare conditions where the risk of regional network separation is heightened. A minimum inertia requirement has been identified for South Australia, flagging an opportunity to optimise this service with synchronous condensers currently being designed for system strength."*[13]

In its final determination for the Managing power system fault levels Rule, the AEMC also recognised that:

> *"Meeting the required levels of inertia and minimum required levels of system strength in a coordinated manner should be an inherent part of the TNSP's planning process."*[14]

The above requirements of the ISP are being taken into account in the detailed design of the proposed solution. AEMO is also required to approve the final technical specification, performance standards and operational requirements of the system strength service[15].

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[10] The ISP was recommended by the Independent Review into the Future Security of the NEM (Finkel Review).

[11] AEMO, *Integrated System Plan*, 17 July 2018, p.81.

[12] AEMO, *Inertia Requirements and Shortfalls*, 1 July 2018, p.10.

[13] AEMO, *Integrated System Plan*, 17 July 2018, p.62.

[14] AEMC, *National Electricity Amendment (Managing power system fault levels) Rule 2017*, 19 September 2017, p.52.

[15] In accordance with clause 5.20C.4(e) of the Rules.

2.4 Declaration of an inertia shortfall in South Australia

On 21 December 2018, AEMO published its 2018 NTNDP[16] and declared an inertia shortfall in the South Australia inertia sub-network.[17]

AEMO's Inertia Requirement and Shortfalls report[18] published in June 2018 specifies that the "minimum threshold level of inertia"[19] is 4,400 MWs and the "secure operating level of inertia"[20] is 6,000 MWs in South Australia. Consequently, AEMO has declared an inertia shortfall in South Australia and provided formal notice to ElectraNet requiring that it use reasonable endeavours to meet the inertia shortfall by 31 May 2020 through:

- procuring at least 4,400 MWs of synchronous inertia services (e.g. through the installation of synchronous condensers or contracting with synchronous generation) to meet the minimum threshold level of inertia; and
- considering generation contracting, batteries and other equipment capable of fast frequency response to provide inertia support activities beyond the minimum threshold up to the secure operating level of 6,000 MWs.

Within its inertia shortfall declaration, AEMO notes that the inertia requirements for South Australia are currently being met by AEMO's direction of synchronous generation to maintain sufficient system strength. However, once ElectraNet has addressed this fault level shortfall by installing synchronous condensers (being the preferred option identified in this report), AEMO projects that an inertia shortfall will arise as directions cease. The timeframe to meet the inertia shortfall therefore coincides with the indicative timeframe for delivery of a system strength solution.

AEMO's inertia shortfall notice further notes that equipping the proposed synchronous condenser units with flywheels may be an efficient means of both meeting system strength requirements and providing the additional inertia needed to maintain a secure operating state. This is reinforced in the 2018 NTNDP which states:

> *"To avoid ongoing market intervention, and to provide benefits to consumers, high-inertia synchronous condensers (e.g. synchronous condensers with flywheels) are urgently required in South Australia."*

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16 AEMO, *2018 National Transmission Network Development Plan*, 21 December 2018, available at http://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/National-Transmission-Network-Development-Plan.

17 Notice issued by AEMO under clause 5.20B.3(c) of the Rules.

18 AEMO, I*nertia Requirements Methodology: Inertia Requirements & Shortfalls*, 29 June 2018, available at http://www.aemo.com.au/-/media/Files/Electricity/NEM/Security_and_Reliability/System-Security-Market-Frameworks-Review/2018/Inertia_Requirements_Methodology_PUBLISHED.pdf

19 The "minimum threshold level of inertia" is determined by AEMO, and is the minimum level of inertia required to operate the inertia sub-network in a satisfactory operating state when the inertia sub-network is islanded.

20 The "secure operating level of inertia" is determined by AEMO, and is the minimum level of inertia required to operate the inertia sub-network in a secure operating state when the inertia sub-network is islanded.

2.5 Main Grid System Strength Contingent Project

The potential need for a transmission solution to meet the system strength requirement was identified in the Final Decision of ElectraNet's Transmission Determination for the 2018 to 2023 regulatory period issued by the Australian Energy Regulator (AER) in April 2018.[21]

This decision accepted the Main Grid System Strength project as a contingent project, noting the high level of certainty on the need for expenditure by ElectraNet to address the gap in system services declared by AEMO on 13 October 2017, but noting the uncertainty regarding the costs associated with addressing this need at that time.[22]

Should this project proceed, the associated revenue allowance for the contingent project will be determined by the AER through a separate assessment process in consultation with stakeholders, following the completion of the applicable trigger events for the project specified by the AER[23]. The status of these trigger events is outlined in Table 1 below.

Table 1 – Status of main grid system strength contingent project trigger events

Trigger event	Status
1. Confirmation by AEMO of the existence of a NSCAS gap relating to system strength, or other requirement for ElectraNet to address a system strength requirement, in the South Australian region.	**Complete.** This trigger event occurred when AEMO declared a system strength gap in South Australia on 13 October 2017.
2. Successful completion of the RIT-T (or equivalent economic evaluation) including an assessment of credible options showing a transmission investment is justified.	**Complete.** This trigger event is satisfied by this Economic Evaluation Report, which presents an equivalent economic evaluation to a RIT-T assessment.
3. Determination by the AER that the proposed investment satisfies the RIT-T (or equivalent economic evaluation).	**Pending.** A determination has been sought from the AER on the basis of this Economic Evaluation Report.
4. ElectraNet Board commitment to proceed with the project subject to the AER amending the revenue determination pursuant to the Rules.	**Part Complete.** The ElectraNet Board has made an initial commitment to the project, approving the procurement and installation of two initial synchronous condensers. Commitment to the full project will be sought on finalisation of the complete solution to meet the system strength gap, subject to the AER awarding incremental revenue commensurate with the capital and operating costs of the project, in accordance with the Rules.

21 Available at https://www.aer.gov.au/networks-pipelines/determinations-access-arrangements/electranet-determination-2018-23/final-decision.

22 AER, *Final Decision: ElectraNet transmission determination 2018 to 2023, Attachment 6 – Capital expenditure*, April 2018, p.16.

23 AER, *Final Decision: ElectraNet transmission determination 2018 to 2023, Attachment 6 – Capital expenditure*, April 2018, p.20.

3. What we are doing to address system strength requirements

3.1 Steps taken to address the system strength gap in the short-term

Since first identifying a system strength gap in South Australia in December 2016, AEMO has issued numerous generator directions in accordance with its operating requirement that a specific combination of large synchronous generating units be online in order to ensure a secure operating state.[24]

AEMO's 2018 South Australian Electricity Report indicates that, as at 23 September 2018, AEMO has issued over 140 directions to South Australian generators in order to maintain sufficient system strength.[25] AEMO will continue to issue directions to the market until such time as an ongoing solution is delivered.

We have assessed the most cost effective options to address the ongoing requirement to address the system strength gap, including contracting existing generation to operate when needed as the only potential solution in the short-term. Other potential solutions, such as the installation of synchronous condensers on the transmission network, require more time to be delivered.

In applying reasonable endeavours to satisfy the system strength requirement from the specified date of 30 March 2018, we took the following steps:

- worked closely with the relevant AEMO staff to confirm the level of system strength services required in South Australia[26];
- appointed an independent consultant to assist in the procurement of the required system strength services;
- met individually with the potential system strength service providers in South Australia identified by AEMO to gather information on their potential to provide these services;
- worked with the consultant and AEMO to develop and issue a Request for Pricing to the identified system strength service providers on 19 December 2017;
- received submissions from all parties by 24 January 2017; and
- worked with the consultant in the tender evaluation of these responses, including clarification from the tenderers where required, and seeking detailed information from AEMO on the frequency, duration and costs incurred in the directions issued to generators to date to satisfy the system strength requirement in South Australia.

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[24] Information on these directions is available on AEMO's website: https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Settlements-and-payments/Prudentials-and-payments/Settlement-Calendars/Intervention-Settlement-Timetables.

[25] AEMO, *South Australian Electricity Report,* November 2018, p.53. The report further states: "These were security directions, for the provision of fault current, not for energy. Where AEMO issues a direction for energy, this is a reliability direction. Apart from two directions in 2017, which were for reliability/shortfall reasons, all South Australian directions have been for system strength reasons." Available at: http://www.aemo.com.au/-/media/Files/Electricity/NEM/Planning_and_Forecasting/SA_Advisory/2018/2018-South-Australian-Electricity-Report.pdf.

[26] Noting that system strength requirements remain subject to ongoing assessment by AEMO in consultation with TNSPs, with updates to its transfer limit advice for system strength in South Australia issued by AEMO on 5 December 2018.

3.2 Outcomes of steps taken in the short-term

The results of the tendering process demonstrated clearly that a generator contracting solution would not be economically viable. The level and costs of the contracts required would far outweigh the cost of generator direction currently being incurred in the market, as shown in section 6.1.

The new framework for the provision of system strength services in the NEM requires us to make available the least cost option or combination of options to satisfy the system strength services requirement in the time required.[27]

The Rules also require that TNSPs use reasonable endeavours to make system strength services available by the date specified by AEMO.[28] The AEMC explained the rationale for this further requirement in its final determination for the Managing Power System Fault Levels Rule as follows:

> *"The Commission considers that an absolute obligation on TNSPs to guarantee the availability of the required fault levels at fault level nodes at all times is not practical. It may lead to excessive costs being imposed depending on the extent to which the TNSP needs to contract with a large number of providers of fault level in order to confidently meet the obligation at all times."*[29]

The AEMC's final rule determination further recognised that:

> *"…limiting the options available to TNSPs to third-party contracting could preclude potentially efficient investment options. Further, the Commission recognises that, under some circumstances, there may be a lack of competitive provision of the required services, and that it would not be in the interests of consumers for contracts to be entered into at any cost."*[30]

In light of these obligations it was concluded from tender pricing that a reliance on ongoing generator contracting would not be in the interests of South Australian electricity customers, nor would it be consistent with our obligation to make the least cost option available to satisfy the system strength requirements specified by AEMO. As above, the AEMC specifically recognised the potential for this circumstance to arise by providing for system strength procurement by a TNSP to occur on a reasonable endeavours basis.

ElectraNet has therefore taken all reasonable steps to address the declared system strength gap by the date specified by AEMO by thoroughly investigating generator contracting as the only potential solution in the specified timeframe.

However, both AEMO and ElectraNet recognise that ongoing use of generator directions beyond the short-term is not a sustainable outcome and leads to distortions in the market, significant costs to consumers and operating difficulties. Therefore, we remain committed to delivering the most timely and efficient solution possible.

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27 Clause 5.20C.3(d) of the Rules.

28 Clause 5.20C.3(c)(1) of the Rules.

29 AEMC, *National Electricity Amendment (Managing power system fault levels) Rule 2017*, 19 September 2017, p.47.

30 Ibid, p.51.

3.3 Consultation with stakeholders

Following the generator tendering process above, ElectraNet has continued to assess and consult on broader options to meet the ongoing system strength requirement in South Australia to identify the most efficient and timely solution.

This work has been closely coordinated with AEMO, the AER and South Australian Government, which have each supported the implementation of an efficient and timely solution to meet the fault level shortfall.

Information and updates have also been released to stakeholders as this work has progressed. This has included:

- an update on our response to the system strength gap to the ElectraNet Consumer Advisory Panel (CAP) in January 2018, including representatives of the Consumer Challenge Panel and AER;[31]
- an information sheet published in May 2018 on ElectraNet's website and distributed to stakeholders;[32]
- an update provided to the CAP on the project in June 2018, including the basis for the rapid implementation of a solution[33];
- information contained in our Transmission Annual Planning Report (TAPR) published on 30 June 2018 setting out the timing, purpose and total cost of the proposed network investment and the indicative total cost of non-network options considered;[34] and
- a further update to the CAP in October 2018 on progress in developing and implementing a solution[35].

We also continue to provide ongoing reporting on progress on the implementation of this project as a Group 1 priority transmission development identified by AEMO in its ISP.

We will continue to provide information and updates to stakeholders as the implementation of the project progresses.

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31 Refer to major projects update to Consumer Advisory Panel Meeting 11 available at: https://www.electranet.com.au/our-approach/community/consumer-advisory-panel/.

32 ElectraNet, *Power System Strength*. Available at: https://www.electranet.com.au/what-we-do/projects/power-system-strength/.

33 Refer to major projects update to Consumer Advisory Panel Meeting 12 available at: https://www.electranet.com.au/wp-content/uploads/2018/11/CAP-Meeting-12-June-2018-Major-Projects-Update-Presentation-FINAL-1.pdf.

34 ElectraNet, *South Australian Transmission Annual Planning Report*, 29 June 2018 (ElectraNet, 2018 TAPR, June 2018), pp. 86-9: see https://www.electranet.com.au/wp-content/uploads/2018/06/SA-Transmission-Annual-Planning-Report-2018.pdf.

35 Refer to major projects update to Consumer Advisory Panel Meeting 13 available at: https://www.electranet.com.au/wp-content/uploads/2018/11/181016-Consumer-Advisory-Panel-meeting-13-Major-Project-Update.pdf.

4. Options we considered to address the system strength gap

We have identified two credible options as part of this economic assessment to address the system strength gap in South Australia to provide customers with a reliable and secure power system, while also minimising costs. We have also worked with AEMO to validate the technical capability of our proposed solutions to ensure power system security. These options are summarised in Table 2, including the base case 'do nothing' option.

Table 2 – Summary of the credible options assessed

Option	Description
Base case	AEMO continues to source system strength services under the generator directions framework. Ongoing direction compensation costs are estimated to be approximately $34m per annum over the assessment period based on current annualised costs. There is also considerable risk and uncertainty as to how long this operational solution will remain viable from a practical perspective.
Option 1	ElectraNet sources system strength services from existing synchronous generators in South Australia. Ongoing annual generator contract costs are estimated to be $85m over the assessment period based on tender pricing.[36]
Option 2	ElectraNet installs a number of synchronous condenser units at suitable network sites in South Australia at an indicative capital cost of $140m to $180m by end 2020.

4.1 Base case – AEMO direction of synchronous generators

Each option is compared against a base case 'do nothing' option. In order to maintain sufficient system strength in South Australia and a secure operating state, AEMO currently directs synchronous generators in South Australia to operate as and when required under its powers of market direction.[37]

However, this is a costly process considering the compensation requirements for directed generators and associated impacts on the wholesale electricity market.[38]

We have sought detailed information from AEMO on the frequency, duration and costs incurred in the directions issued to synchronous generators to date to satisfy the system strength requirement in South Australia. Based on annualised historical costs, ongoing direction compensation costs are currently estimated to be approximately $34m per annum in net terms (equivalent to around $3m per month).

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36 Under this option, there would also remain a potential need for generator direction with its associated costs once the volumes and unit combinations offered by tenderers had been exhausted, and a potential for negative pool price exposure, both of which would add further costs to this option. These additional costs have not been included in this assessment.

37 Clause 4.8.9 of the Rules provide AEMO with the discretion to require a Registered Participant to do any act or thing if AEMO is satisfied that it is necessary to maintain, or re-establish the power system to, a secure operating state, a satisfactory operating state, or a reliable operating state.

38 Compensation may be payable to one or more participants as a result of a market direction. Clause 3.15.8(g) of the Rules requires that compensation determined for directions other than energy and ancillary service directions, such as directions to maintain system security, must be recovered from Market Customers, Market Generators and Market Small Generation Aggregators in proportion to the customer energy, generator energy and small generation aggregator energy respectively: https://www.aemo.com.au/-/media/Files/PDF/Direction-Recovery-Reconciliation-File-v13.pdf.

This excludes the broader impact of intervention pricing[39] on wholesale market prices through AEMO's direction process, which represents an additional cost ultimately borne by customers. AEMO estimates the cost impact of intervention pricing on wholesale market outcomes as a result of issuing directions for system strength as at September 2018 exceeds $270m. This is additional to the impacts of constraining wind generation.

In addition to compensation costs, given the operational difficulty of frequently issuing directions and the complexities of intervention pricing and the compensation process, there is also considerable uncertainty over how long ongoing direction of synchronous generation for system strength purposes will remain viable in South Australia. For this reason, both AEMO and ElectraNet recognise that generator direction is an interim operational measure only, and is unlikely to be sustainable.

4.2 Option 1 – Contracting existing synchronous generators

Option 1 would involve ElectraNet sourcing system strength services from the existing gas-fired synchronous generators in South Australia. Based on the results of the tender process with these potential system strength service providers (as described in section 3.1) ongoing generator contracting costs are estimated to be $85m per annum over the assessment period.

Under this option, there is also a risk that generator direction is still required once the volumes and unit combinations offered by tenderers are exhausted, and an additional risk of negative pool price exposure, both of which would increase the costs associated with this option. These additional costs are not included in this assessment.

4.3 Option 2 – Installing synchronous condensers

Option 2 would involve ElectraNet installing a number of synchronous condensers at suitable network sites in South Australia to provide system strength.

A synchronous condenser operates in a similar way to large electric motors and generators. It contains a synchronous motor with a shaft that is not directly connected to a prime mover, but is synchronised to the system frequency and spins freely to contribute to system strength within the power system.

While the final number and specification of synchronous condenser units to meet the system strength requirement remains subject to confirmation by AEMO, following detailed system studies ElectraNet has recommended that four synchronous condenser units providing a base level of inertia will be required to meet the system strength requirement as the full solution.

The indicative capital cost of this option is estimated to be approximately $140-180m, subject to the final number and specification of synchronous condenser units required.

It is estimated that commissioning of these synchronous condensers would occur by end 2020. Annual operating costs are indicatively estimated to be up to 1% of the total capital cost for the purposes of this assessment.

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[39] Where a direction has been issued, AEMO will apply intervention pricing in accordance with its Intervention Pricing Methodology: see https://www.aemo.com.au/-/media/Files/PDF/Intervention-Pricing-Methodology-October-2014.pdf.

We have also considered the installation of synchronous condensers fitted with larger high inertia flywheels to provide sufficient inertia capability to meet the 4,400 MWs minimum threshold level of inertia declared in AEMO's inertia shortfall notice on the basis of four units being required, to determine whether this provides an efficient means of delivering required inertia capability[40]. Our assessment of the incremental costs and benefits of making the units high inertia machines is set out in section 6.3.

Figure 2 below shows the most likely installation sites of synchronous condensers, as reported in our 2018 Transmission Annual Planning Report[41], are focused on the 275 kV network at Davenport and Robertstown.

Figure 2 – Likely sites of synchronous condensers

4.4 Options considered but not progressed

We also considered whether there are other credible options that may address the system strength requirement, and undertook a qualitative assessment in consultation with AEMO to identify any other technically and economically feasible solutions. A summary of these options is outlined below.

Based on our assessment, there is currently an insufficient degree of certainty surrounding these options for any of these to be considered as technically and/or economically feasible options for the purposes of addressing the urgent system strength requirement.

40 As noted within AEMO's inertia shortfall declaration and 2018 NTNDP discussed in section 2.4 of this report.

41 ElectraNet, 2018 TAPR, June 2018, p.88.

However, should any of these options proceed, or other options which contribute to system strength capability emerge in the South Australian region in future, their implementation can help alleviate further constraints on intermittent generation currently imposed by AEMO in order to maintain system security, in addition to enhancing system strength capability.[42]

4.4.1 New generation

A number of proposed and announced generation developments of varying technologies are at various stages of development throughout South Australia. The majority of these involve non-synchronous generation sources, such as wind and solar PV generation[43].

The remaining generation developments that involve synchronous plant either have limited system strength capability and availability and/or are designed for operation at peak times, rather than low demand and price conditions, when system strength services are more likely to be required. These projects are also at various stages of commitment.

Given the localised need for system strength services, new sources of interstate generation would not make a material contribution to the current shortfall in South Australia, and therefore are not considered in the analysis.

In summary, ElectraNet is aware of no committed generation developments in South Australia that will materially address the declared fault level shortfall in the required timeframe.

4.4.2 Conversion of existing generation

The conversion of existing generation to synchronous condenser operation was assessed but not considered to be a credible option given expected system strength service costs and limited capability of the plant known to be withdrawing from service and therefore available for conversion. No such offers proposing this solution were put forward during the generator tendering process described in section 3.1.

4.4.3 Demand side solutions

Demand-side options provide no direct system strength capability, and load reduction would only increase the extent of the fault level shortfall, which typically occurs at times of low demand.

4.4.4 Network reinforcement

Network reinforcement options potentially lower system impedance and increase fault levels, contributing to system strength. These options include 275 kV tie-ins, installation of additional transformers, stringing vacant circuits and new transmission lines. However,

[42] For updated information on intermittent generation constraints imposed by AEMO, refer to AEMO's *Transfer Limit Advice – South Australia System Strength*, 5 December 2018: available at https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Security-and-reliability/Congestion-information/Limits-advice).

[43] While new generators that connect to the network in South Australia must meet 'do no harm' requirements under the Rules and make a contribution to system strength capability that leaves the power system no worse off, this does not contribute to the underlying fault level shortfall.

based on the relative cost and technical effectiveness of these options, they are not considered to be credible options.

While it is noted that a new interconnector could also contribute to improving system strength across the network, the expected timeframe for implementation falls well outside the required window for action, and any contribution to addressing the shortfall is expected to be relatively modest.

4.4.5 Further options

The likely impact of proposed Federal and State Government policies, including the National Energy Guarantee (NEG) and South Australian (SA) Energy Security Target, on future system strength requirements was also considered during the course of the assessment.

The Reliability Guarantee component of the NEG is yet to be approved by jurisdictions and is not intended to replace the minimum system strength or inertia standards.[44]

The SA Energy Security Target was initially proposed and subsequently deferred by the former State Government, and there is no commitment to this measure by the current Government. This measure would have required retailers to contract a certain minimum volume of synchronous generation output each year, but not necessarily at the times required for system strength.

[44] Energy Security Board, *National Energy Guarantee: Draft Design Consultation Paper* (NEG Consultation Paper), 15 February 2018. The Reliability Guarantee component is intended to provide incentives for adequate contracted capacity to meet peak demand requirements on a regional basis. However, there is no guarantee that this contracted capacity will necessarily be synchronous generation with system strength capability, nor that it will be continuously available on a real time basis. With respect to system strength issues, the NEG Consultation Paper (p. 52) recognises that there is “no direct interaction with the Guarantee” and “to the extent that minimum levels of inertia and system strength are procured from dispatchable resources, this could impact AEMO’s assessment of any future ‘gap’ in capacity”.

5. Estimating Net Market Benefits

5.1 Assessment methodology and assumptions

For the purposes of this assessment, we have adopted a real, pre-tax discount rate of 6%, which equates to a nominal pre-tax discount rate of 8.65%. We consider that this is indicative of a 'commercial' discount rate appropriate for the analysis of options.

Our economic analysis has been conducted over a ten year assessment period given the level of uncertainty beyond this timeframe and the potential for cumulative directions costs over a longer period to skew the results. We consider that a ten year assessment period takes into account the size, complexity and expected life of the options considered to provide a reasonable comparison of costs from the time a solution can be implemented.

We have estimated the total capital cost of Option 2 to be $160m as a central estimate, based on ElectraNet's recommended system strength solution and procurement opportunities to date.[45]

To account for synchronous condensers having asset lives greater than ten years, we incorporated the terminal value of the primary asset in the present value capital costs in the assessment. The terminal value of the synchronous condensers considers only the capital costs directly attributable to the synchronous condensers. The synchronous condenser assets are estimated to represent 70% of the total capital cost of Option 2. Connection costs and other substation and related costs are assumed to have no residual value beyond the life of the project.

AEMO has advised of possible future requirements for the regional provision of some frequency control services (i.e. for reasons unrelated to system strength or inertia). The mechanism to achieve this local frequency control (e.g. a local FCAS requirement) could result in increased commitment of synchronous generation, or could be delivered by battery systems, fast-start generating plant, Distributed Energy Resources (DER) and some renewable generation. If the commitment of large synchronous generating units is required due to changes in these frequency control requirements, the benefits of this project will decrease.

To account for this uncertainty, and to ensure no over-estimation of benefits, once a full synchronous condenser solution is commissioned (i.e. end 2020) we assume an ongoing cost of $12m per annum remains, based on the conservative assumption for 2 synchronous generation units to remain online thereafter. In reality, this potential future requirement might be delivered through market outcomes rather than through market direction. This conservative assumption results in a net reduction in annual direction costs of $22m (from the current annualised estimate of $34m) for the remainder of the assessment period.

[45] This indicative capital cost of $160m assumes four synchronous condenser units are required to meet the system strength requirement. Our preliminary analysis indicates that the addition of flywheels to these four units is sufficient to meet the 4,400 MWs minimum threshold level of inertia declared in AEMO's inertia shortfall notice (as described in section 2.4). We estimate the incremental cost of increasing the flywheel size of each unit to be minimal, in the order of $1m per unit.

5.2 Key market benefits in this assessment

The most significant category of market benefit for this economic assessment is avoided generator direction costs. Direction costs were calculated as described in section 4.1 when determining the base case and applied in the economic analysis to Option 2 as described in section 5.1 above.

The other relevant category of market benefit for this economic assessment relates to differences in the timing of unrelated transmission investment. The installation of synchronous condensers as described in Option 2 avoids the need for the installation of reactors on the South Australian transmission network at Para and Blyth West for voltage control purposes in the second half of the 2018-2023 regulatory control period (at an estimated cost of approximately $5m per site) delivering a cost saving of $10m that has been factored into the assessment.[46]

Further work to install these reactors on the network has therefore been deferred pending the outcomes of this economic assessment and subsequent regulatory approvals.

[46] As described in ElectraNet's 2018 TAPR, June 2018, pp.72-3 & 102-3.

6. Assessment of the credible options

6.1 Net present value assessment outcomes

The table below summarises the net market benefit for Option 2 in net present value (NPV) terms over the assessment period relative to a base case option of continuing generator direction by AEMO. The net market benefit is the gross benefit minus the cost of each option, all expressed in present value terms. Positive values denote either avoided costs or additional benefits relative to the base case, while negative figures (in brackets) denote additional net costs relative to the base case.

Table 3 – Estimated net market benefit for each option

Option	NPV ($m 2018-19)	Rank
Option 1 – Contracting existing synchronous generators	(428)	2
Option 2 – Installing synchronous condensers	38	1

Option 2 provides the greatest net economic benefit of the options assessed over the analysis period and results in significant generator direction cost savings for customers.

Based on the annualised costs incurred in 2018-19 to date, implementation of a synchronous condenser solution would avoid ongoing direction costs in the order of $2m a month.

Accelerating the installation of a synchronous condenser solution through the early implementation of an initial number of units would bring forward a portion of these benefits, and result in a net saving to customers of around $3m per annum.[47]

6.2 Sensitivity testing

We have undertaken sensitivity analysis to test the robustness of the results presented in section 6.1 to underlying assumptions regarding key variables. The capital cost assumptions for the synchronous condensers as well as assumed direction costs in the base case were both tested. For the purposes of this analysis, all other variables have been held constant.

Figure 3 illustrates the NPV of Option 2 relative to the base case across a range of capital costs assumptions from $140m to $180m.

Figure 4 illustrates the NPV of Option 2 relative to the base case across a range of assumed direction costs.

[47] Assuming an initial number of units are installed at a cost of $80m and that this delivers half of the total estimated direction cost savings of a full synchronous condenser solution (i.e. $11m per annum).

Figure 3 – Sensitivity of Option 2 to project capital cost assumptions

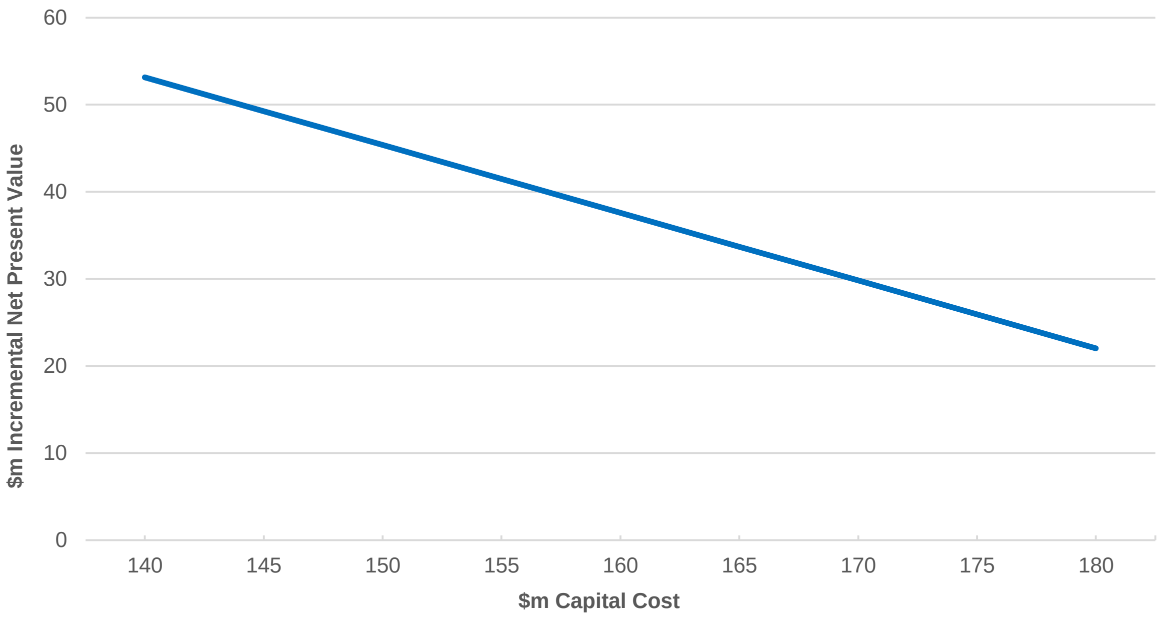

Figure 3 shows that while holding all other parameters constant, Option 2 returns a net market benefit across the full range of capital cost estimates.[48]

Figure 4 – Sensitivity of Option 2 to different direction costs in base case

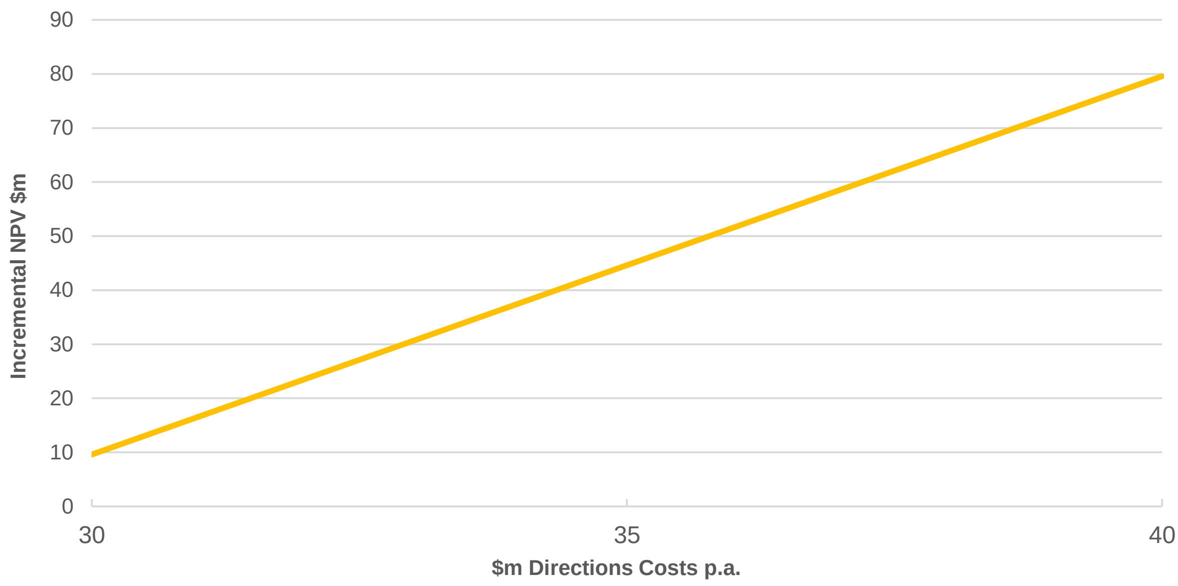

Figure 4 shows that while holding all other parameters constant, Option 2 returns a net market benefit across the full range of direction cost assumptions.[49]

48 Sensitivity tests using a 5 year assessment period also demonstrate significant net market benefits (albeit reduced) across the same range of capital cost assumptions.

49 The results are also robust to changes in the assumed discount rate, including a lower bound consistent with the regulated, real pre-tax weighted average cost of capital (WACC), 3.62%, and a symmetrical upper bound of 8.38%.

6.3 Incremental costs and benefits of high inertia capability

AEMO's ISP, 2018 NTNDP and inertia shortfall declaration all presume that system strength and inertia requirements will be met in a coordinated manner, as the most efficient means of addressing both requirements. The scope of our proposed synchronous condenser solution (Option 2) reflects this by including high inertia flywheels which provide inertia capability across four machines as the recommended full solution.

As discussed in section 4.3, the increase in flywheel size to make these high-inertia units is sufficient to meet the 4,400 MWs minimum threshold level of inertia declared by AEMO.

Leaving aside the inertia shortfall, the synchronous condensers require a base level of inertia capability in order to provide a technically compliant system strength solution. However, the installation of high inertia machines increases the total cost of the synchronous condenser solution. Therefore, we also assessed the additional costs and benefits of making the units high inertia machines.

The additional cost of increasing the flywheel size to each unit to provide high inertia capability is marginal at approximately $1m per unit, or $5m in total across four machines including associated costs. Importantly, a larger flywheel option cannot simply be retrofitted later, and needs to be designed for upfront. This cost is included in the capital cost of the preferred option, representing around 3% of the central estimate of $160m.

If we assume synchronous condensers without high-inertia flywheels were installed, the only alternative option to address the inertia requirement would be to contract with existing gas-fired generators, as considered for system strength. However, this solution would need to be delivered at a fraction of the estimated annual cost of a system strength contract solution of $85m to present a more cost-effective option than the incremental cost of installing high inertia flywheels[50]. Consequently, this is not considered a credible option.

The incremental benefits of increased flywheel size would be derived from the avoided direction costs attributable to meeting inertia requirements. The entirety of avoided direction costs assumed in this assessment relate to directions for system strength. As the more onerous constraint, the system strength requirement currently masks the inertia requirement, which arises when SA is either islanded or at credible risk of islanding.

Unlike for system strength, it is therefore not possible to use historical direction costs to estimate the incremental benefit of avoiding directions for inertia. However, given the minor incremental cost of increased flywheel size, only a small number of avoided directions for inertia would be required in order to deliver offsetting benefits.

A total of 140 directions has been issued for system strength purposes in the 12 months to September 2018 at an average net cost of $300,000. Were only two such directions to be required for inertia purposes per annum, this would more than outweigh the incremental cost of the high inertia flywheels. This is considered a reasonable and conservative assumption from an operational and planning perspective.

Fitting larger high inertia flywheels to the proposed synchronous condensers therefore satisfies both the system strength and inertia requirements as a least cost solution.

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50 This solution would need to be available at an annual cost of approximately $500,000 or around 0.5% of the tendered value, which is not considered realistic.

7. Conclusions and customer impacts

7.1 Preferred option

The results of this assessment clearly demonstrate that:

- Installing synchronous condensers on the South Australian transmission network (Option 2) at an indicative capital cost of $140m to $180m by end 2020 is the most efficient and least cost solution available in the short to medium term and results in significant generator direction cost savings for customers.
- This outcome remains robust across a range of cost sensitivities and assumptions.
- Implementation of a synchronous condenser solution would avoid ongoing direction costs in the order of $2m a month. Early delivery of an initial number of units would result in a net saving to customers of around $3m per annum.
- Contracts with existing gas-fired generators would not be an economically viable solution (Option 1) based on the market costs of this option.
- The costs, operational challenges and wider market impacts of the current generator direction process continue to grow (base case) which reinforces the need for urgent action.
- Installing synchronous condensers remains a no regrets measure to meet the minimum need for system strength in the absence of any other available solutions in the immediate term, also noting that any future sources of system strength that emerge will help address wider constraints on the power system.
- This system strength solution is also expected to efficiently meet the minimum threshold level of inertia in South Australia through the installation of high inertia machines, at minimal additional cost.

Given the urgency and impact of the system strength gap, and its wider implications for power system security in South Australia, the installation of synchronous condensers on the South Australian transmission network is the most efficient and timely option available, and the preferred option to be implemented.

The detailed design and delivery of a final synchronous condenser solution will be chosen so as to optimise the balance between cost, timing and capability of the required units in the interests of an overall least cost outcome for customers.

7.2 Indicative customer bill impact

Indicative analysis shows that the installation of synchronous condensers, assuming capital costs of $140-$180m, avoided direction costs of $22m per annum and avoided reactor investment costs of $10m, results in a net cost saving equivalent to $3 to $5 per year off a typical South Australian residential electricity bill once the synchronous condensers commence operation.

8. Next Steps

We continue to work with AEMO to confirm the scope of the full synchronous condenser solution that will address the declared system strength gap in South Australia. Detailed technical studies have been progressed as a high priority and will confirm the number, location and technical design parameters of the synchronous condenser units required to address the declared system strength gap.

The next steps to implement Option 2 to address the system strength gap will include:

- Securing competitive provision of two synchronous condensers (as high inertia machines) together with associated network equipment from the relevant supplier(s) on suitably commercial terms through direct sourcing, subject to technical and commercial due diligence, by mid-2020;
- continuing to work with AEMO to confirm the additional synchronous condensers and associated network equipment required to implement a full solution to address the declared system strength gap by end 2020 – AEMO confirmation of ElectraNet's recommended solution is expected by early March 2019;
- lodgement of a contingent project application with the AER to secure approval of the required revenue to fund the capital and operating expenditure required for the implementation of the full solution;
- developing the detailed technical specification and design of synchronous condenser units and associated equipment in consultation with AEMO and synchronous condenser manufacturers;
- competitive sourcing of the remaining synchronous condensers and associated equipment from the relevant supplier(s) on suitably commercial terms through direct sourcing;
- seeking timely approval by AEMO of the technical specifications, performance standards and arrangements for enabling the system strength services for the full solution, in accordance with the Rules;[51]
- continuing preparations to secure land and approvals to enable a solution to be implemented in a timely manner; and
- completion of construction, installation, connection and commissioning of the full solution by end 2020.

ElectraNet will continue to provide information and updates to stakeholders as the implementation of the project progresses, including ongoing reporting on progress as a Group 1 priority project identified in the ISP.

Once the technical specification of the synchronous condenser units has been agreed by AEMO, and the units have been ordered, ElectraNet will assess how the specified secure operating level of inertia of 6,000 MWs is best delivered.

51 In accordance with clause 5.20C.4(e) of the Rules.

ElectraNet