Business case: CER compliance

2025-30 Regulatory Proposal

Supporting document 5.7.3

January 2024

SA Power Networks

Empowering South Australia

Contents

Glossary

Acronym / term	Definition
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
API	Application Programming Interface
Capex	Capital expenditure
CEC	Clean Energy Council
CECV	Customer Export Curtailment Value
CER	Customer Energy Resources
CSIP-AUS	Common Smart Inverter Profile – Australia. The Australian profile for the IEEE2030.5 communication standard for inverters that enables flexible exports / dynamic operating envelopes
DER	Distributed Energy Resources
DERIWG	Distributed Energy Resources Integration Working Group
DNSP	Distribution Network Service Provider
ECA	Energy Consumers Australia
EG	Embedded Generation
ESCOSA	Essential Services Commission of South Australia
EVM	Enhanced Voltage Management
FCAS	Frequency Control Ancillary Services
LDC	Line Drop Compensation
LEG	Large Embedded Generation
LV	Low Voltage
MEG	Medium Embedded Generation
NEM	National Electricity Market
NER	National Electricity Rules
NPV	Net Present Value
OEM	Original Equipment Manufacturer
Opex	Operating expenditure
OTR	South Australian Office of the Technical Regulator
PIAC	Public Interest Advocacy Centre
PQ	Power Quality
PV	Photovoltaic
RCP	Regulatory Control Period
SEC	Smart Energy Council
SEG	Small Embedded Generation
SIRG	Solar Industry Reference Group
STC	Small-scale Technology Certificates
VPP	Virtual Power Plant

1 About this document

1.1 Purpose

This document provides the business case for expenditure to execute the second phase of the long-term CER compliance program set out in our Compliance Strategy, building on our 2020-25 program.

1.2 Expenditure category

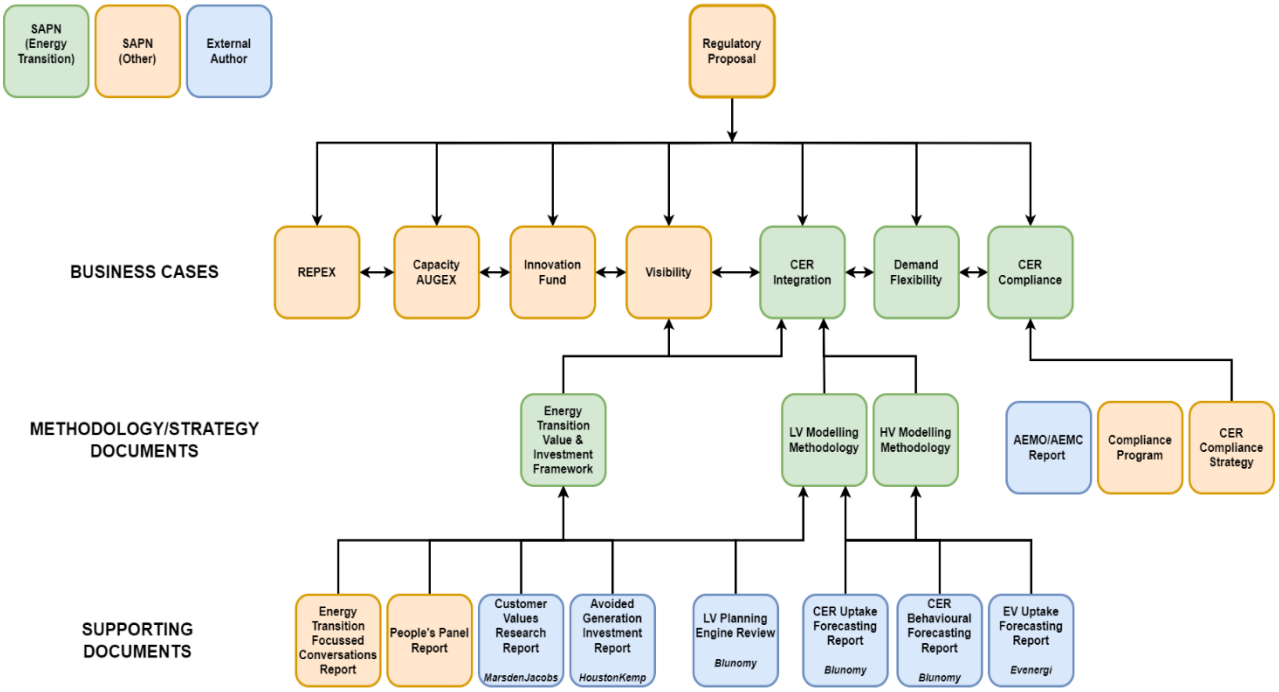
- Non-network capex

1.3 Related documents

Table 1: Related documents

Ref	Title
1	5.7.2 - Compliance Strategy
2	5.7.4 - CER Integration - Business Case
3	5.7.5 - Demand Flexibility - Business Case
4	5.7.6 - Network Visibility - Business Case
5	5.7.15 - CER Integration Strategy - Strategy

Figure 1: Related documents



2 Executive summary

Overview

This document sets out the business case for expenditure to execute the second phase of the long-term Customer Energy Resources (**CER**) compliance program set out in our Compliance Strategy[1], building on our 2020-25 program. Total capital expenditure (**capex**) proposed is **$4.96** million over the 2025-2030 Regulatory Control Period (**RCP**)[2], with an associated operating expenditure (opex) step change of **$2.24** million over the period.

Drivers for change

CER like solar and battery systems must conform to a suite of technical standards and regulatory requirements. Conformance of CER with these standards and requirements plays a critical role in ensuring that the distribution network and the broader electricity system can be operated safely and reliably at the very high levels of CER penetration experienced in South Australia, and many of them have been introduced or updated in the last five years as an urgent response to the growing risks to system security at times of minimum demand.

The Australian Energy Market Operator (**AEMO**) relies on compliance by CER with these standards and regulations to ensure the system operates correctly and to help stabilise the system when a major incident occurs. SA Power Networks relies on compliance by CER with these standards and regulations to facilitate the performance of its responsibilities with respect to system security and maintaining quality of supply. Unfortunately, recent studies by AEMO, SA Power Networks and others have revealed significant levels of non-compliance to these standards and regulations across the population of installed CER equipment in South Australia.

SA Power Networks has developed a Compliance Strategy that sets out a ten-year program of work to improve levels of compliance to CER technical standards by installers and customers, and we are currently executing the first phase of this strategy. We propose to continue with our compliance program in the 2025-2030 period.

Our proposed 2025-30 compliance program

Phase 1 of our compliance strategy, currently underway, is focused on improving the CER connection application process and raising industry understanding of compliance obligations. It has put in place a new connections portal and new systems and business processes to help CER installers achieve a compliant installation, and to hold them accountable for adhering to the connection workflow.

In phase 2, from 2025 onwards, we propose to continue to build out our suite of supporting systems. We will shift focus to include detecting and requiring the correction by installers and customers[3] of potential non-compliance with these standards and regulations in already-installed CER, making use of the increasing availability of smart meter data to detect potential compliance issues automatically through data analytics. Continuing this program will involve the same internal and external resources, and broadly the same level of annual capex, as phase 1, a total of $4.96 million over the 2025-30 period.

Phase 2 also includes a small increase in the number of dedicated staff resources to support the broadening scope of compliance activities, giving an opex step change of $2.24 million over the period.

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1 **Supporting document 5.7.15 - CER Integration Strategy - Strategy**

2 Figures are in June $2022.

3 Noting that it is not SA Power Networks' responsibility to correct non-compliance in customer CER installations, rather our aim is to help installers and customers to recognise non-compliant installations and take corrective action.

Cost/benefit analysis and options

The key benefits arising from the program will be:

- increased export hosting capacity from improved compliance to AS4777 power quality settings;
- reduced FCAS costs from increased compliance to AS4777 disturbance ride-through requirements; and
- reduced system-security risk during minimum demand contingencies.

We also considered options to either (a) discontinue the compliance program or (b) undertake a more comprehensive phase 2 program that also includes field auditing.

Related expenditure

The CER compliance program has links to the following expenditure items described elsewhere in our proposal and included in other discrete business cases:

- CER integration expenditure[4];
- demand flexibility expenditure[5]; and
- network visibility expenditure[6].

[4] **Supporting document 5.7.4 - CER Integration - Business Case**

[5] **Supporting document 5.7.5 - Demand Flexibility - Business Case**

[6] **Supporting document 5.7.6 - Network Visibility - Business Case**

3 Background

3.1 The scope of this business case

This business case proposes new and recurrent expenditure on systems, business processes and personnel to improve the level of compliance by installers and customers with technical standards, connection rules and regulatory and policy requirements for CER installations in South Australia in 2025-30. The scope of the compliance program includes small, medium, and large inverter-based generation as well as other generators connected to the distribution network.

3.2 Our performance to date

We are currently executing the first phase of our CER Compliance Strategy.[7]

The first phase of our compliance program has focused primarily on improving compliance to CER technical standards at the time of installation, through enhancements to our CER application, installation and commissioning processes, initially for new solar installations, with batteries and other CER to follow.

This has been driven primarily by the introduction of new technical requirements arising from the SA Government Smarter Homes regulations and our 'flexible exports' connection offer[8], both of which generally require a new solar installation to have remote communications capabilities. This makes the installation and commissioning process a little more complex[9] and requires additional configuration and testing activities by the installer to ensure the site is working correctly.

Our new application and commissioning process uses new on-line tools to guide the solar retailer and installer through the process from start to finish, from the initial application through to testing and site commissioning. Completion of basic training on compliance obligations is now a pre-requisite for submitting applications via the on-line portal.

We have also significantly strengthened incentives for solar retailers to encourage them to conform to the requirements and achieve a compliant installation. Solar retailers are unable to claim the Small-scale Technology Certificates (**STCs**) for installed systems without evidence of a compliant installation from SA Power Networks and we now only provide this once all steps in our new application and commissioning process have been successfully completed.

In addition, we introduced a 'baseball 3 strikes' process to identify installers with a poor record of compliance, hold them accountable and work with them to help them to improve. Through this process, installers that repeatedly fail to meet their compliance obligations will lose access to the standard automatic approval process for new installations until such time as they have resolved their non-compliance issues.

Since commencing phase 1 of our compliance program in 2021 we have undertaken the following activities:

- developing a compliance strategy and roadmap;
- transforming our solar approvals team into a New Energy Services capability that administers automated application approvals, oversees the operational compliance program and provides industry support via phone and email. The New Energy Services team also provides support, testing and subject matter expertise in the development of new embedded generation capabilities and compliance functionality;

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7 **Supporting document 5.7.3 - CER Compliance - Business case**

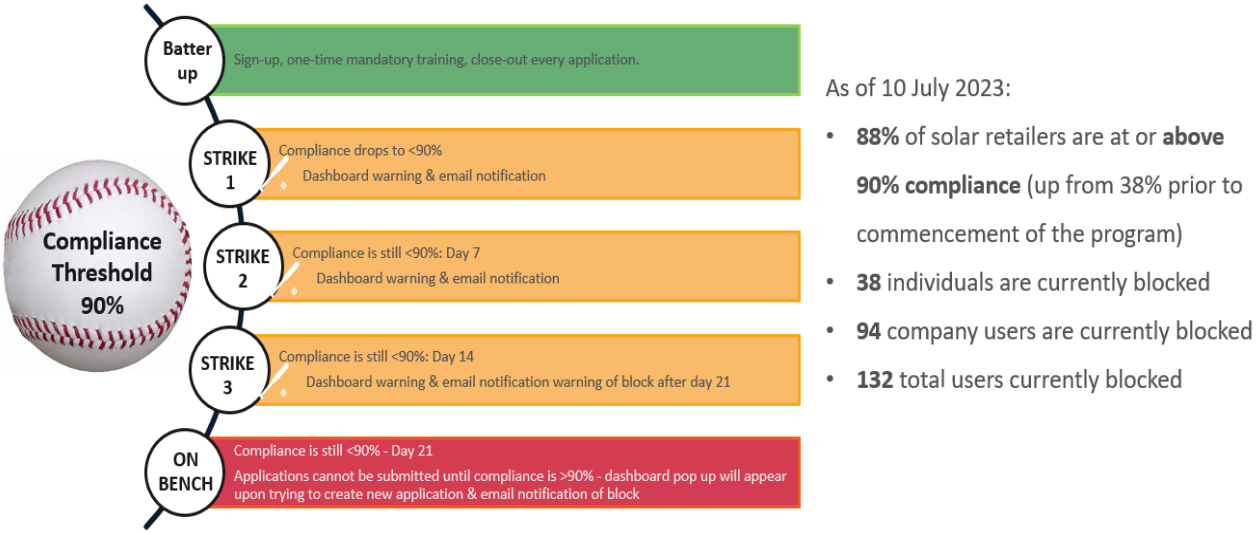
8 'Flexible exports' is the name for our new standard connection offer for small-scale solar, which has a 1.5kW – 10kW dynamic export limit (dynamic operating envelope). We are currently rolling out this offer across the network, with a target of complete network coverage by end 2024, after which the legacy 5kW fixed limit will no longer be available.

9 Noting, however, that even prior to Smarter Homes and flexible exports, many CER products already came with internet communications capabilities that the installer would often configure for the customer at time of installation.

- an industry outreach program via multiple channels to raise awareness and build industry understanding of compliance obligations, roles and responsibilities through stakeholder engagement, training programs, online materials, industry events and roadshows;
- developing training modules for CER installers in collaboration with the Clean Energy Council (**CEC**) and Smart Energy Council (**SEC**);
- adding a close-out and commissioning phase to our embedded generation application process and developing our new *SmartApply* and *SmartInstall* on-line portals which guide the installer through the application, commissioning and close-out process for new installations;
- establishing detection capabilities for applications without completed close-out or commissioning;
- enhancing our embedded generation applications portal with capabilities to display non-compliances to solar retailers and installers;
- developing a 'baseball 3-strikes' process for responding to identified instances of non-compliance, combining activities to work with industry participants to help them address non-compliance with the potential for preventative actions in response to repeated non-compliance, including blocking solar retailers or installers from access to our fast-track automated connection approval process;
- enhancing our DER Register to facilitate new compliance functionality;
- expanding these function to support medium and large embedded generation;
- developing a detailed compliance plan for the rollout of flexible exports across the network; and
- conducting initial trials of automated detection of non-compliant systems via analysis of smart meter data.

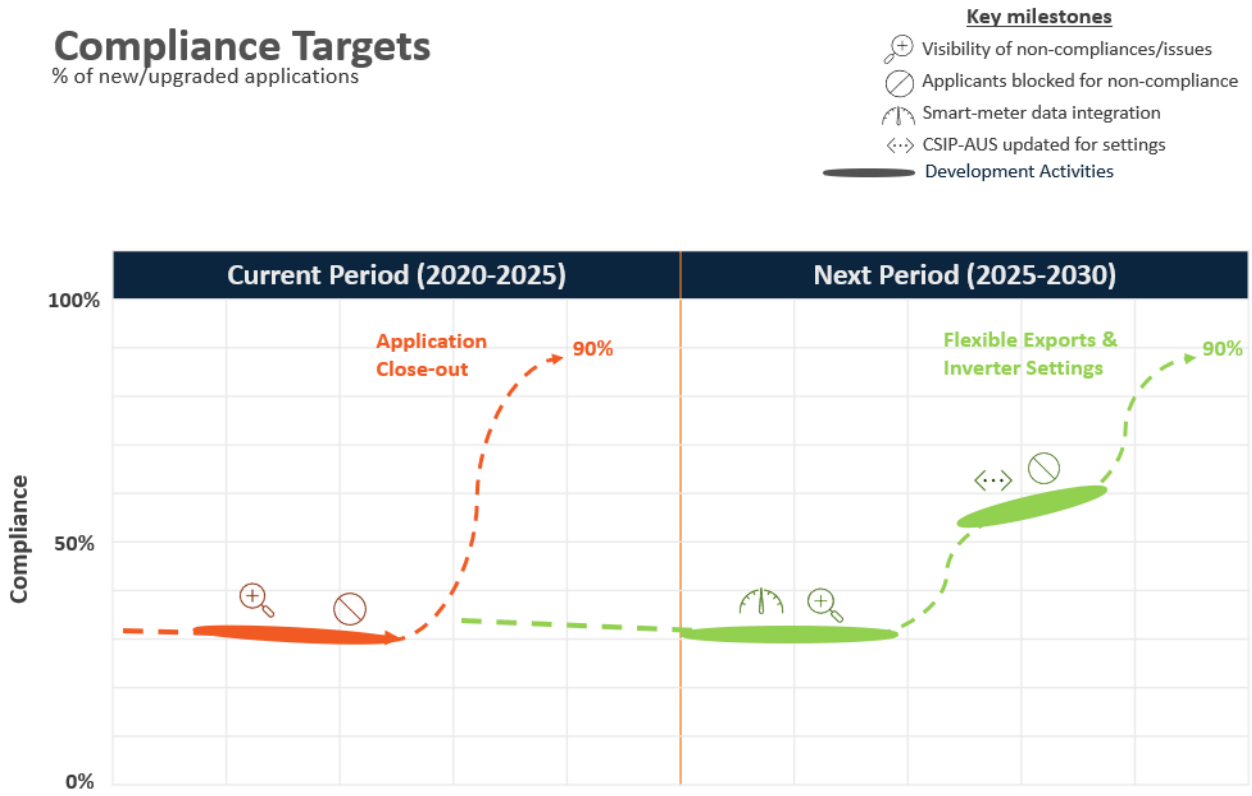
The close-out process and 'baseball' method of compliance went live in May 2023. As noted above, this is currently focused specifically on improving industry compliance to our new commissioning and application close-out processes. Figure 2 below illustrates the process and the compliance improvements achieved from this initiative.

Figure 2: SAPN Phase 1 DER Compliance Management Approach



The following figure indicates the progress made in the current period (Phase 1) and our targets for compliance in the next period (Phase 2). Phase 2 will extend the program beyond the application close-out process to help address broader non-compliance to inverter technical standards and flexible exports connection requirements. This will include developing capabilities to analyse time-series data from CER and smart meters.

Figure 3: SAPN DER Compliance Program targets



Further information on our Phase 1 compliance systems and the resources we have developed to support the CER industry is included in Appendix 0.

3.3 Drivers for change

South Australia has the highest ratio of rooftop PV generation to operational consumption of all the National Electricity Market (**NEM**) regions. At the present time (December 2023), more than 35% of premises in South Australia have rooftop PV, a total of 350,000 systems with a combined capacity of 2.56 GW. There are also more than 48,000 small-scale batteries in the state with a combined capacity of more than 240MW, more than South Australia's original 'big battery' at the Hornsdale Power Reserve[10]. More than a third of these batteries are enrolled in Virtual Power Plant (**VPP**) schemes and actively orchestrated in response to market price signals. Rooftop solar, battery storage and VPP enrolment are forecast to continue to grow strongly in the state through to 2030 under all AEMO ISP scenarios.

The high levels of rooftop solar coupled with low underlying load in our state lead to extremely low levels of minimum operational demand during spring and early summer. Minimum operational demand in the state reached a new record low of just 21 MW in September 2023 and is likely to become negative in coming months, as shown in the figures below.

[10] The capacity of the Hornsdale Power Reserve since the 2020 expansion is 150MW/194MWh.

Figure 4: South Australian Operational Demand and Generation Mix on 16 September 2023[11]

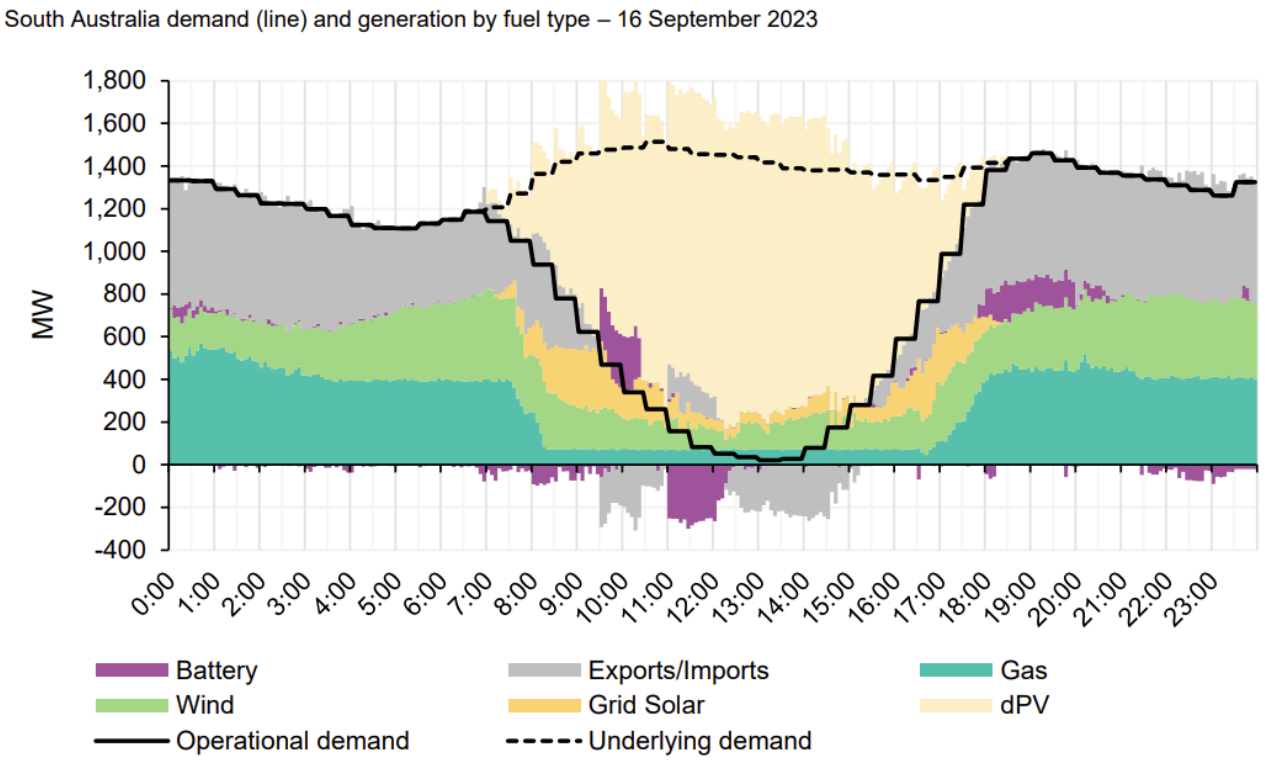
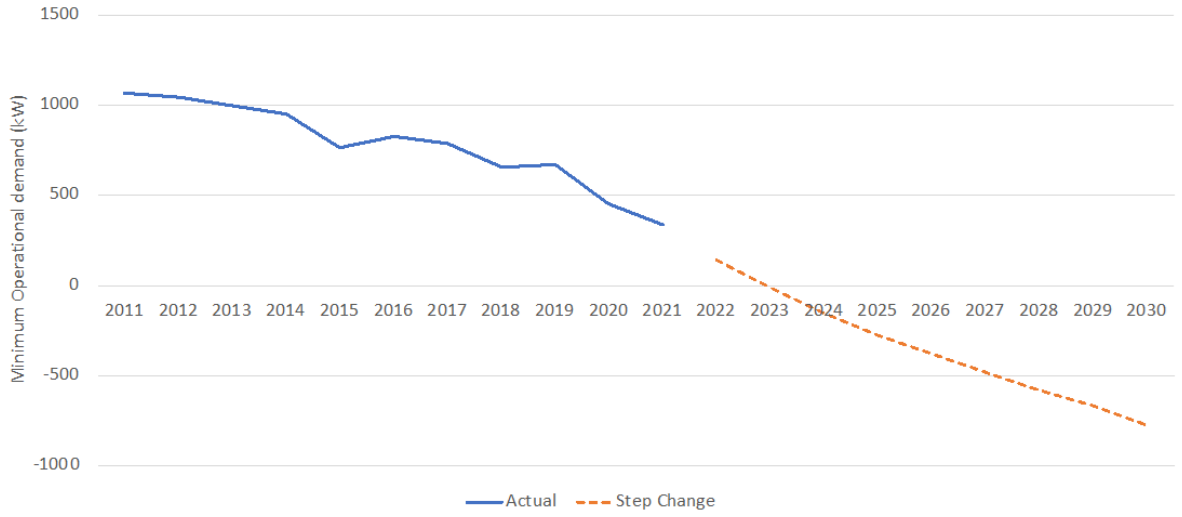


Figure 5: South Australia minimum operation demand forecast (AEMO ISP 2022 Step Change, Summer 90POE)



Extreme minimum demand conditions in South Australia pose significant challenges for AEMO in maintaining system security, particularly during contingent events such as extreme weather or major equipment failure where the system is exposed to significant perturbations. Very low levels of inertia at minimum demand times mean that the system can become destabilised, potentially leading to a complete collapse of system frequency and another state-wide blackout event.

During minimum demand contingency events AEMO can direct Electranet to enact emergency generation shedding to reduce the level of generation and bring the system back into a stable configuration. Electranet passes this directive to SA Power Networks, and we invoke a range of emergency measures to reduce the level of active generation on the distribution network. This occurred in March 2021 and again in November 2022, when South Australia became islanded from the rest of the NEM due to storm damage to transmission network infrastructure.

[11] AEMO, *Quarterly Energy Dynamics Q3 2023,* November 2023. Accessible on: [https://www.aemo.com.au.].

High levels of embedded solar generation also lead to operational challenges for SA Power Networks during system normal conditions. In spring and early summer we now see periods when net demand across the whole distribution network falls below zero, meaning that our network is effectively operating as a net generator into the transmission network. This has occurred with increasing frequency since 2021, with the highest net negative demand recorded so far being -385 MW in October 2023. We are not aware of any other gigawatt-scale distribution network that is operating in these conditions. The very high reverse power flows in local areas of the distribution network at these times can cause localised over-voltage problems or transformer overloads if not managed.

3.4 Industry practice

Given the technical challenges of integrating high levels of embedded generation into the electricity system, generators connected to the South Australian distribution network must conform to a suite of technical standards and regulatory requirements. Compliance by installers and customers with these standards and requirements plays a critical role in ensuring that the distribution network and the broader electricity system can be operated safely and reliably at the very high levels of CER penetration experienced in South Australia and many of them have been introduced or updated in the last five years as an urgent response to the growing risks to system security at times of minimum demand.

AEMO and SA Power Networks rely on installers and customers complying with these standards and regulations to ensure the system operates correctly and to stabilise the system when a major incident occurs. Examples include:

- **Inverter overvoltage trip settings**

  Customer inverters are required to disconnect automatically if network voltage becomes too high. This is a key protection for the customer's on-site equipment and a key backstop to prevent uncontrolled voltage rise in areas of very high solar penetration. We also rely on compliance of CER with these settings for the correct operation of its emergency solar curtailment system, Enhanced Voltage Management (**EVM**), which raises network voltage at the feeder level to cause PV generation to disconnect. This system has been activated twice at AEMO's direction since it was put in place in 2021 and is a key part of the state's 'last line of defense' solar curtailment capabilities required to protect the system during major system incidents.

- **Inverter anti-islanding settings**

  Customer inverters are required to shut down if grid supply is lost. This is an important safety measure that ensures that parts of the network that have become isolated, e.g., due to storm damaged infrastructure, don't become energised by local PV systems, which would pose a serious safety hazard to members of the community and workers working to repair downed power lines.

- **Inverter Volt-VAr and Volt-Watt response modes**

  The National Electricity Rules (**NER**), the latest version of AS4777.2:2020, and SA Power Networks' connection rules require all embedded generators to implement AS4777 Volt-VAr and Volt-Watt response curves, which cause inverters to progressively shift power factor and then ultimately self-curtail as voltage levels approach the upper limit. Correct Volt-VAr response plays an important role in maximising hosting capacity in voltage-constrained networks because it offers an effective means to reduce voltage rise issues with minimal loss of real power output for customers. Volt-Watt provides an important backstop to limit voltage rise in areas where measures such as flexible exports aren't sufficient, e.g. due to a large number of legacy, non-flexible systems.

- **AS4777.2:2020 disturbance ride-through requirements**

  AS4777.2:2020 introduced new requirements for inverters to be able to ride through transient voltage excursions without disconnecting, following an AEMO analysis of the South Australian power system that found that the level of voltage disturbance arising from a credible system fault could result in widespread disconnection of rooftop solar, and that this could move the system into a state that was unrecoverable.

These requirements were made mandatory in South Australia for all new systems in September 2020 as part of the SA Government Smarter Homes legislation, and AS4777.2:2020 was subsequently incorporated into the NER in December 2021 as mandatory for all new systems anywhere in the NEM.

- **SA Government Smarter Homes remote disconnection requirements**

  In 2020 the SA Government's Smarter Homes regulations introduced a requirement for all new solar PV systems to have a facility for emergency remote disconnection. SA Power Networks relies on this facility as one part of a package of emergency generation-shedding measures that it can deploy when directed to do so by AEMO (via Electranet) during a minimum demand contingency event.

- **SA Power Networks' Flexible Exports connection requirements**

  Customers taking up our new flexible exports connection arrangement need to install equipment that is compatible with the national CSIP-AUS standard and related requirements set by the Office of the Technical Regulator in South Australia (**OTR**). Since July 2023, under the government's Smarter Homes regulations, all new solar PV systems installed in SA are required to be compatible with these requirements. We rely on compliance with these standards to provide our flexible exports connection service to CER customers. Compliance by installers and customers to these standards is necessary to ensure that the service is operating correctly and that available network hosting capacity is allocated efficiently and fairly to export customers. As the service transitions from pilot to being our standard connection offer in 2023, the flexible exports system will also progressively become the primary means for emergency solar curtailment in South Australia.

3.5 Current levels of non-compliance

Unfortunately, while these CER technical standards, requirements and regulatory obligations play a critical role in ensuring the safe, efficient and reliable operation of the electricity system, recent studies by AEMO, ourselves and others have revealed very significant levels of non-compliance to these standards across the population of installed equipment in South Australia.

In early 2023, AEMO undertook a comprehensive investigation into the level of compliance of CER with required technical settings in Australia. This study was intended to support and complement the broader review into customer energy resources technical standards being undertaken by the Australian Energy Market Commission (**AEMC**) at the time[12].

AEMO published the findings of their review in April 2023. Their report[13] found that:

> *"…In the field, compliance with technical settings is poor; a wide range of data sources* ***consistently indicate that less than half of systems installed are set correctly to the required standard****. … This suggests significant deficiencies in governance frameworks for monitoring and enforcing compliance with technical settings in the field."* (emphasis in original)

and

> *"Some DNSPs are already implementing significant programs of work to monitor and actively improve compliance in their networks. However various DNSPs have raised concerns as, whilst they recognise this issue as significant, they may not have sufficiently comprehensive governance frameworks to support and efficiently coordinate the required rectification actions to achieve and maintain high rates of compliance."*

[12] See report available at https://www.aemc.gov.au/market-reviews-advice/review-consumer-energy-resources-technical-standards, accessed July 2023.

[13] Available at: https://aemo.com.au/initiatives/major-programs/nem-distributed-energy-resources-der-program/standards-and-connections/compliance-of-der-with-technical-settings, accessed July 2023.

AEMO's findings are consistent with those of the University of New South Wales (UNSW) Curtailment and Network Voltage Analytics Study (**CANVAS**)[14] undertaken in 2021 under the RACE for 2030 CRC, which found that only 0.5% of the systems analysed in South Australia appeared to implement the correct Volt-VAr response, as shown in the extract included below.

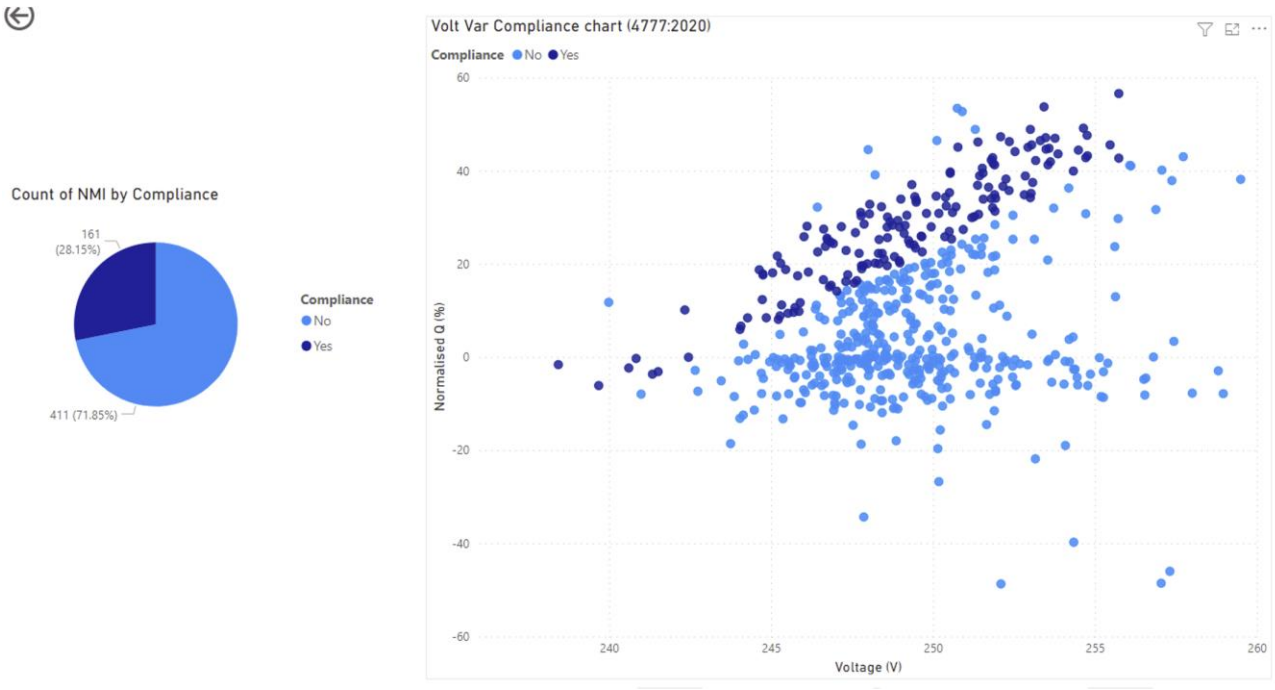
> *"The V-Var analysis found that the majority of BESS and D-PV did not appear to operate according to the recommended V-Var curves outlined by the current standards."*

Table IX Percentage of D-PV inverters with different V-VAr response and PF characteristics

	Reference V-VAr curves (Figure 27)	No V-VAr response, unity PF (Figure 28)	No V-VAr response, increasing PF with real power (Figure 29)	No V-VAr response, decreasing PF with real power (Figure 30)	Other (Figure 31)
Percentage of D-PV inverters (%)	0.5	80	15	2.5	2

In mid-2022, we conducted our own study into inverter settings and standards compliance using a small sample of 572 sites with results also indicating a very low level of compliance, as shown in the sample data included below[15].

Figure 6: SA Power Network's Inverter Settings Compliance Analysis, n = 572 NMIs



AEMO's report identifies a variety of implications from low compliance rates, including:

- system and network instability, potentially leading to load shedding or even a system black event;
- increased cost of system frequency support services (e.g. FCAS);
- local quality of supply issues such as excessive voltage that can harm customer equipment; and
- reduced renewable output through:

[14] See report available at: https://racefor2030.com.au/project/low-voltage-network-visibility-and-optimising-der-hosting-capacity-fast-track/, accessed July 2023.

[15] Noting that this study used smart meter data, we would expect the level of compliance to AS 4777:2020 in this sample to be higher than the broader population, since it is biased towards newer installations (i.e it doesn't include any older installation that don't have smart meters).

- reduced network hosting capacity;
- increased curtailment of market-facing generators due to lower network stability limits for transmission network and interstate interconnectors;
- increased amounts of curtailment from autonomous inverter power quality response modes and inverter tripping; and
- reduced export limits for flexible export customers.

These issues have technical and financial implications for customers with CER and the broader community. At best, poor levels of compliance to CER technical standards by installers and customers have a negative impact on network hosting capacity and quality of supply. In the worst case, where emergency measures fail due to a lack of compliance by CER to the necessary standards, the outcome can be catastrophic. The state-wide blackout in South Australia in 2016 is estimated to have caused $360 million in economic damage[16].

3.6 Recent recommendations from AEMO, AEMC and the AER

AEMO's recent report[17] makes specific recommendations for DNSPs to consider uplifting their capabilities to improve compliance by installers and customers to key CER standards through activities such as:

- a mandatory close-out process following installation;
- updating the Model Standing Offer;
- implementing processes to detect non-compliance through in-field analysis; and
- working with OEMs to request remote updates to settings at sites where non-compliance is identified.

AEMO also recommended that clear frameworks be implemented to outline which parties are responsible for each of the aspects of DER compliance, monitoring, assessment and enforcement[18].

As noted above, AEMO's study was intended to support and complement a broader review into CER technical standards being undertaken by the AEMC at the time. The AEMC published the draft findings of its review in April 2023. The AEMC report notes the significant levels of non-compliance to CER technical standards in the NEM and that non-compliance for new installations is an ongoing issue, citing AEMO findings that *"approximately 65 per cent of new installations in quarter 1 of 2022 were non-compliant across the NEM"*. The report concludes that:

> *"This unsuccessful implementation situation for both existing and future CER technical standards cannot continue — it raises significant concerns about the NEM's technical integration of CER. Ultimately, if left unaddressed, this continued non-compliance threatens to undermine the NEM's reliability, affordability, and transition to zero-emissions technologies."*

and

> *"Improving compliance with CER technical standards will benefit all electricity consumers in the national electricity market (NEM)"*

[16] See South Australian blackout costs business $367m, fears summer outages on way, lobby group says - ABC News, accessed July 2023.

[17] As described in the preceding section. Report available at https://www.aemc.gov.au/market-reviews-advice/review-consumer-energy-resources-technical-standards, accessed July 2023.

[18] Noting that it is not SA Power Networks' responsibility to correct non-compliance in customer installations; rather our aim is to detect potential non-compliance using data available to us and engage with the relevant customer and/or their installer to ensure non-compliance is rectified.

The AEMC report makes 13 draft recommendations, including:

> *"…that OEMs provide CER device compliance data to DNSPs and AEMO. Such data would enable DNSPs and AEMO to better monitor compliance with CER technical standards and therefore be in a better position to take action to rectify the identified non-compliance"* (recommendation 10)

and

> *"DNSPs to develop and follow a defined process for contacting customers suspected of non-compliance and also explaining options for returning to compliance"* (recommendation 11).

These recent reports by AEMO and AEMC express the clear expectation that DNSPs and industry participants should take a more active role in addressing the serious levels of non-compliance to CER technical standards. While they make clear that DNSPs are not responsible for rectifying the non-compliance itself, they recommend that DNSPs could take actions such as active steps to monitor and detect potential non-compliance, contacting non-compliant customers, assisting customers in relation to the rectification of non-compliant devices efficiently and effectively and working with OEMs to explore options for over-the-air reprogramming to address non-compliant inverter settings.

In its 2023 *Draft interim export limit guidance note*, the AER makes clear its expectations on DNSPs with respect to compliance to CER technical standards, stating that:

> *"DNSPs should take practical steps aimed at improving rates of compliance of consumer energy resources with relevant technical standards. This includes being innovative in looking for solutions that benefit consumers more in the long term…*

and

> *"…In their expenditure proposals, DNSPs should demonstrate any steps they have taken to improve compliance for new CER connections. As per section 4.3.2 (engagement and awareness) of this guidance note, we expect to see DNSPs set aside regulated revenue for engagement and awareness because this feeds into compliance."*

4 The identified need

In considering options for how to respond to the high levels of CER non-compliance in South Australia and the specific recommendations from AEMO, AEMC and the AER described in section 3.6 above, we considered the regulatory framework under the NER and the National Electricity Law (**NEL**) and, in particular, how any expenditure in relation to CER compliance is required to achieve the expenditure objectives and reasonably reflects the expenditure criteria, having regard to relevant expenditure factors. We also considered our relevant regulatory obligations and requirements under the NER, NEL and jurisdictional instruments. As a result of these considerations, the identified need is as follows:

- to prudently and efficiently meet and manage demand for customer export services and comply with applicable regulatory obligations and requirements applying to the management and operation of our distribution network that may be impacted by CER non-compliances as further detailed below;[19]
- to the extent that there is no relevant regulatory obligation/requirement with respect to a particular aspect of reliability or security of supply, to prudently and efficiently maintain reliability and security of supply where the maintenance of that aspect of reliability and security of supply may be impacted by CER non-compliances as set out in further detail below;[20] and
- to respond to customers' concerns,[21] identified through our consumer and stakeholder engagement process, regarding the importance of ongoing CER compliance activities and our broader CER integration strategy.

Our regulatory obligations and requirements that may be impacted by CER non-compliances include the following:

- *clause 5A.B.2(b)(7)(v), 5A.C.3* and *clause S5 A.1, Part B, (a)(7a) of the NER* which require DNSPs to include in model standing offers for basic micro-embedded generators connecting to distribution networks an express requirement to comply with the CER technical standards (defined as 'DER Technical Standards' in the NER, which include the requirements set out in AS4777.2:2020 as updated from time to time). Our model standing offer includes this requirement. All new connection and replacement inverters and connection alternatives (including upgrade, extension, expansion or augmentation) are also required to comply with the CER technical standards;
- *clause 4.3.4 of the NER* requires each DNSP to *"use reasonable endeavours to exercise its rights and obligations in relation to its networks so as to co-operate with and assist AEMO in the proper discharge of the AEMO power system security responsibilities"* and *"cooperate with AEMO in relation to … each emergency frequency control scheme which is applicable in respect of the Network Service Provider's transmission system or distribution system"*. Our current and proposed compliance program underpins our capability to meet this requirement, as it facilitates efforts to enforce the terms in our model standing offer, including compliance to the key CER technical standards that our emergency system security response capabilities (e.g. emergency generation shedding via Enhanced Voltage Management, Smarter Homes and Flexible Exports) depend upon;
- *clause 13* of the SA Power Networks' *Distribution License* requires us to comply with any directions given to us by AEMO as the System Controller. Poor compliance to CER technical standards by customers and installers may impact on our ability to meet this obligation because it degrades the level of response we are able to achieve from our emergency generation shedding schemes when we are directed to activate them by AEMO (as occurred in March 2021 and again in November 2022);
- *Regulation 55H* of *the Electricity (General) Regulations 2012* (SA) requires us to comply with technical and operational standards published by the OTR that relate to managing the electricity system in an

[19] These are relevant expenditure objectives under clauses 6.5.6(a)(1) and (2) and 6.5.7(a)(1) and (2) of the NER.

[20] These are relevant expenditure objectives under clauses 6.5.6(a)(3) and 6.5.7(a)(3) of the NER.

[21] This is a relevant expenditure factor under pursuant to clauses 6.5.6(c)(5A) and 6.5.7(c)(5A) of the NER, which requires regard to be had to the extent to which forecast capex seeks to address the concerns of distribution service end users identified by the distributor's engagement process.

emergency.[22] As above, poor compliance to CER technical standards by customers and installers undermines our capability to meet these obligations as it degrades the performance of the systems we have put in place to respond to system security emergencies; and

- *Regulation 46(a)* of the *Electricity (General) Regulations 2012* (SA) requires us to ensure that our network is operated so that at a customer's point of supply the voltage is as set out in AS 60038. We rely on compliance to the CER technical requirements in our model standing offer and associated connection rules by customers and installers as part of our overall voltage management strategy. Poor compliance by customers and installers to these requirements undermines our ability to maintain customer voltage within the required range.

[22] See *Technical Regulatory Emergency Standards – Voltage Management and Under Frequency Load Shedding (version 1.1)*, dated 7 March 2023.

5 Comparison of options

As our proposed 2025-30 compliance program is the second phase of a small program of work that is already planned and underway, the only credible options considered here are to continue the program as planned or to stop the program.

5.1 The options considered

The table below summarises the options considered in this business case.

Table 2: Summary of options considered

Option	Description
The base case (Option 0)	Abandon our CER compliance program (do not continue beyond 2025). This option is included here only as a counterfactual to provide a baseline for assessment of the benefits of option 1
Option 1 – Continue CER compliance program	Execute phase 2 of our CER compliance strategy, extending the program beyond the application close-out process to help address broader non-compliance to inverter technical standards and flexible exports connection requirements. This will include developing capabilities to analyse time-series CER data, as well as additional staff resources.

5.2 Options investigated but deemed non-credible

We initially considered a more comprehensive compliance program in 2025-30 including a field auditing component similar to the compliance and safety solar auditing scheme performed in Victoria. This would require additional staff to undertake field-based auditing and compliance activities, with a significant step increase in operating costs.

Our early stakeholder engagement suggested that the associated increase in expenditure would be unlikely to be supported by customers, particularly given the difficulty of quantifying the additional benefits this would provide compared to a lower-cost approach based primarily on data analytics to assist with the detection of non-compliant installations (the approach proposed in option 1). For this reason, this option was not developed in detail and was not included in the later stages of our stakeholder engagement process.

5.3 Analysis summary and recommended option

To inform the comparison of the options under consideration we undertook a quantitative 20-year NPV analysis of costs and benefits over the period from 2025 to 2044.

This analysis has considered the following quantified benefit streams:

Benefit	Description
CECV benefit (reduced export curtailment)	This benefit reflects the additional export hosting capacity achieved in voltage-constrained parts of the network when more customer inverters are compliant to the required AS4777 Volt-VAr power quality settings. This benefit is quantified using a modified version of the AER's Customer Export Curtailment Value (**CECV**)[23] to determine the dollar value of the additional energy that is able to be exported when hosting capacity improves. The future benefit is estimated using a 'with and without' analysis performed with the LV Planning Engine model developed for our CER integration planning. We compare the CECV created for our proposed export capacity investment program, which assumes that our 2025-30 compliance program will also be undertaken, with the CECV outcome in a counterfactual scenario where the compliance program does not occur and hence levels of compliance to AS4777 improve more slowly. This model is described in detail in our CER integration business case[24].
FCAS benefit	In a 2023 study commissioned by the AEMC as part of its review into CER technical standards[25], economic consultant Oakley Greenwood examined the extent to which poor levels of compliance to AS4777 disturbance ride-through requirements were contributing to increased FCAS costs in each NEM region, building on earlier work by AEMO[26]. They then quantified the dollar benefit in FCAS savings of improving levels of compliance. We have used Oakley Greenwood's value of increased compliance to estimate this benefit in South Australia. Our forecasts for the rate of improvement in compliance are more conservative than the assumptions used by Oakley Greenwood and hence predict a slightly lower future benefit.

Further details of the method used to quantify these benefit are included in section 8, section 9, appendix 0 and appendix 0.

The program will deliver other material benefits, notably in supporting the effective operation of our emergency generation shedding schemes, which are described further below. At this stage we have not sought to quantify these benefits due to the difficulty in quantifying the value of contributing to the avoidance of a High Impact, Low Probability event (**HILP**) such as another state-wide blackout. We understand, however, that AEMO has recently undertaken some work in quantifying these kinds of risk, and we are examining whether this could provide a basis for quantifying this benefit stream in future.

[23] Our version of the CECV includes an additional component to quantify the benefit of avoided generation capacity investment.

[24] **5.7.4 Business case: CER Integration.**

[25] AEMC, *Final report: review into consumer energy resources technical standards*, 21 September 2023.

[26] Oakley Greenwood, *Benefits of CER Compliance, CER Technical Standards*, 23 August 2023.

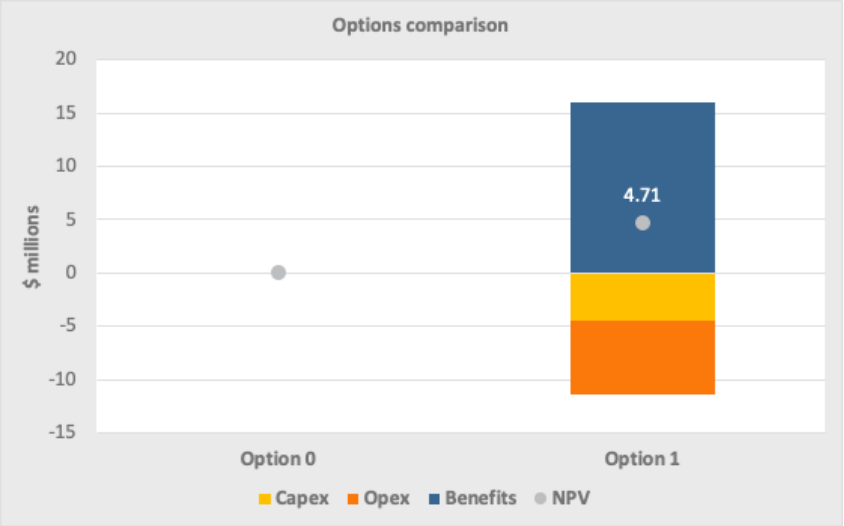
5.3.2 Options assessment results

The table and figure below summarise the results of the comparison of options.

Table 3: Costs, benefits and risks of alternative options relative to the base case over the 20-year period, $m, $ June 2022 real. The Option 0 (Base Case) costs have been subtracted from all options.

Option	Costs		Benefits[27]			NPV[28]	Risk Level[29]	Ranking
	Capex[30]	Opex[31]	Capex	Opex	Customer			
Option 0 – Base Case	-	-	-	-	-	-	Medium	N/A[32]
Option 1 – Compliance program	4.52	6.83	-	-	16.07	4.72	Low	1

Figure 7: Options comparison summary



Assumptions

- Assumed CER uptake rates are based on AEMO's ESOO 2022 forecasts for the Step Change ISP scenario, which AEMO considers as the central case.
- Other assumptions are documented in sections 8 and 9 below.

[27] Represents the total capital and operating benefits, including any quantified risk reductions compared to the risk of Option 0 (base case), over the 20-year cash flow period from 1 July 2025 to 30 June 2045 expected across the organisation as a result of implementing the option.

[28] Net present value (**NPV**) of the option over 20-year cash flow period from 1 July 2025 to 30 June 2045, based on discount rate of 4.05%.

[29] The overall risk level for each option after the option is implemented. Refer to Appendix B for details.

[30] Represents the present value of total capex associated with the option over the 20-year cash flow period from 1 July 2025 to 30 June 2045.

[31] Represents the present value of total opex increase associated with the option above the current level of opex, over the 20-year cash flow period from 1 July 2025 to 30 June 2045.

[32] The base case is not ranked as it is included as a counterfactual.

5.3.3 Recommended option

Our recommended option is option 1, continue with our 2025-30 compliance program as planned.

This option is recommended because:

- it meets the identified need set out in section 4;
- it aligns with recommendations by AEMO and the AEMC as described in section 3.6;
- it is the continuation of our current compliance program, in line with our compliance strategy;
- it is estimated to have net positive monetised benefits based only on the benefits of reduced export curtailment and FCAS cost reduction; were we able to quantify the material additional benefits in improved system security, customer safety and emissions reductions, we expect that the net present value would be strongly positive; and
- the program was included within the overall CER enablement program endorsed by customers and other stakeholders through our stakeholder engagement process.

Further information on the options and the cost/benefit analysis is included below in the remainder of section 5 and further information on our stakeholder engagement is included in section 6.

5.4 Scenario and sensitivity analysis

The following sections provide further details on the options considered and the sensitivity analysis undertaken.

5.4.1 Option 0 – base case

5.4.1.1 Description

Option 0, the base case for this options analysis, assumes that we do not proceed to the second phase of our compliance program in 2025-30. Under this option there will be no new investment in compliance systems. The current compliance team will continue as part of our broader New Energy Services team and will continue to focus on the connection approval and commissioning process.

5.4.1.2 Costs

There is no new capex under this option. Operating costs are expected to continue at the current level, based on the average staff effort allocated to compliance activities in the current team, which is ~4.5 FTE. This would be an ongoing cost of $0.9 million p.a. ($ June 2022) or $4.5 million over the 2025-30 period, included within existing operating expenditure allowances. For the options analysis in this business case the cost of option 0 has been baselined at zero, and only additional costs are included in the other option.

5.4.1.3 Risks

Table 4: Risk assessment summary

Risk consequence category	Current risk level[33]	Risk cost[34]
Safety – Harm to a worker, contractor or member of the public	Medium	Not quantified
Performance and Growth – Financial impact	Medium	Costs of failure to reduce export curtailment and FCAS costs arising from non-compliance are quantified in section 5.4.2.4. Other financial impacts of poor compliance not quantified.
Performance and Growth – Non-compliance with regulatory, legislative and/or other obligations	Medium	Not quantified
Performance and Growth – Failure to deliver on strategic plan and growth objectives	Low	Not quantified
Customers – Failure to deliver on customer expectations	Medium	Not quantified
Overall risk level	Medium	

5.4.2 Option 1

5.4.2.1 Description

Option 1 is the continuation of our compliance program through 2025-30, scaling and extending our capabilities to detect and manage a growing number of compliance metrics across 20,000-30,000 new installation applications per year and more than 300,000 CER installations by 2030. New types of flexible connections for both load and generation, enabled by new and emerging CER technical standards, combined with the introduction of Home Energy Management Systems and smart Electric Vehicle charging will further increase the importance of this program.

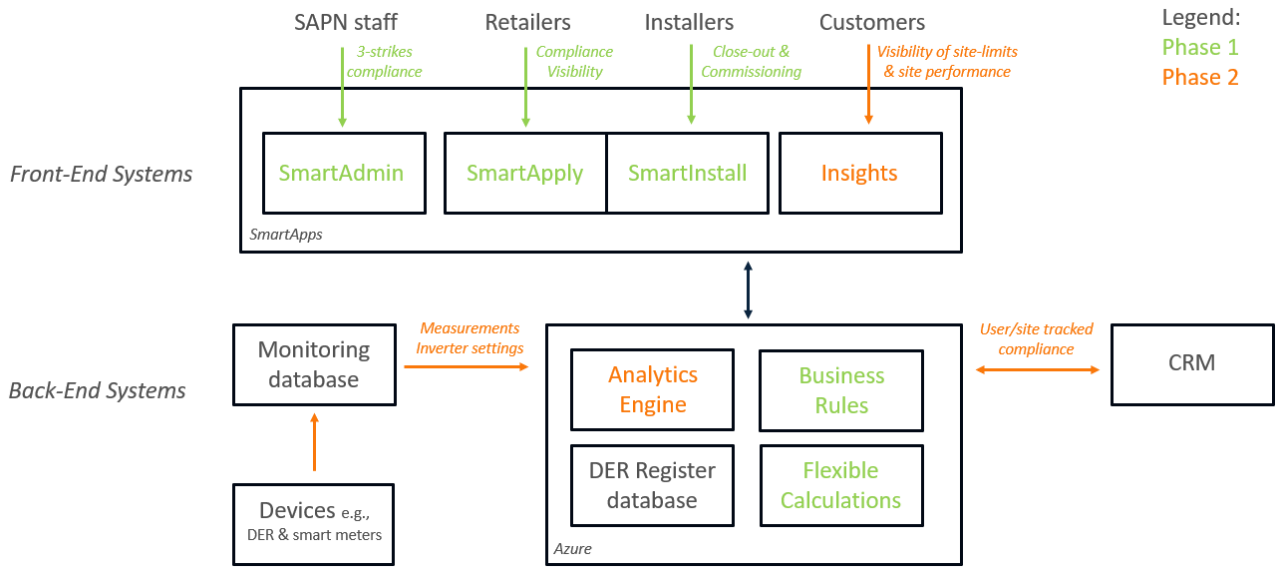
As detailed in section 3.2, phase 1 of our compliance program, currently underway, has focused on improving the CER connection application process and raising industry understanding of their compliance obligations. In the second phase of our compliance program, from 2025 onwards, the balance of expenditure changes, with most of the core development work on industry portals and our digital workflow for installers substantially complete, and development work shifting to focus on data analytics to detect non-compliance in the field, taking advantage of the expected increase in available data from smart meters and other connected DER in the 2025-30.

Figure 8 identifies the current (phase 1, 2020-25) and proposed (phase 2, 2025-30) system components of the compliance program.

[33] The level of risk post current controls (ie after considering what we currently do to mitigate the risk).

[34] Estimated cost of consequence(s) to SA Power Networks or its customers in an event this risk eventuates over the NPV analysis period.

Figure 8: Compliance Systems Architecture



The proposed phase 2 program includes the development of several new compliance analytics applications within our core compliance systems, with associated business rules for response to detected non-compliance. These systems will build upon the time-series data analytics platform developed in the current RCP and also extend the data exchange capabilities of our CSIP-AUS API to support detection of non-compliance and, potentially, automatic over-the-air update of inverter settings to correct issues detected[35]. The proposed expenditure under option 1 will add support for the following additional use-cases:

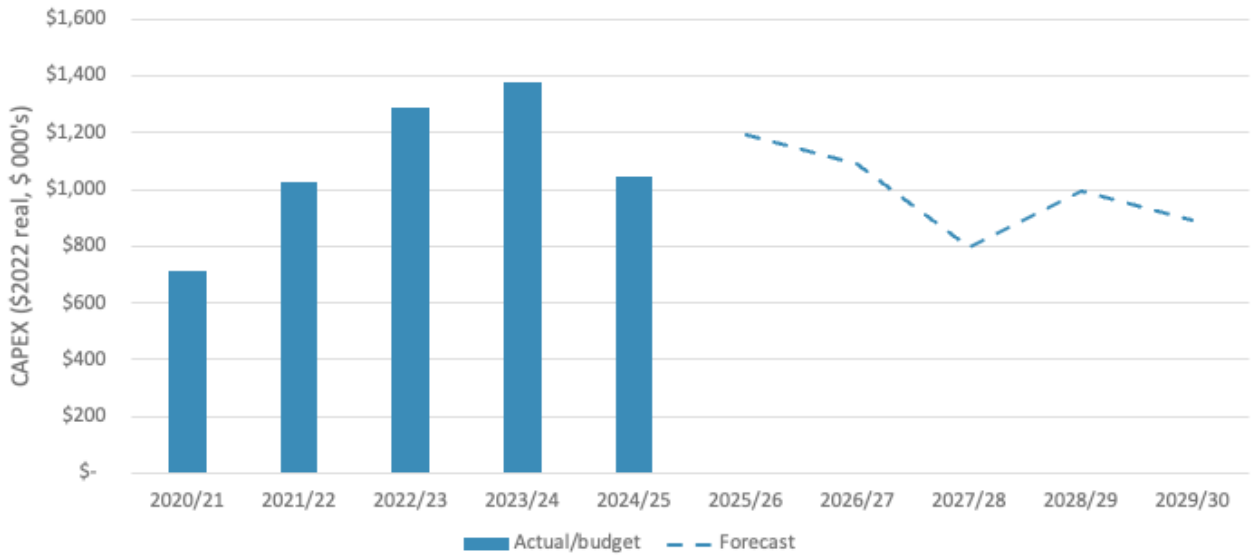
- CER detected without valid approval;
- unregistered export CER;
- export limit exceeded;
- flexible export limit exceeded;
- incorrect CER inverter standards and/or settings e.g., anti-islanding, volt-VAr, and volt-Watt;
- CER phase imbalance;
- incorrect or incomplete metering commissioning;
- incorrect Flexible Exports fallback behaviour;
- incorrect emergency solar curtailment behaviour; and
- installation of EV chargers that do not comply with connection rules and regulations.

[35] These capabilities are on the CSIP-AUS development roadmap. Details will be determined by the national CSIP-AUS working group of which we are a member.

5.4.2.2 Costs

Forecast capex for our 2025-30 compliance program is $4.96 million over the 2025-30 period[36], which is slightly less than the capital cost of the 2020-25 program, as shown in the figure below.

Figure 9: Compliance CAPEX



As noted in section 5.4.1.2 above, our current compliance activities are staffed by an allocation of ~4.5 FTE from our New Energy Services team, including oversight on a part-time basis by the New Energy Services Manager, with an associated average annual operating cost of $0.9 million.

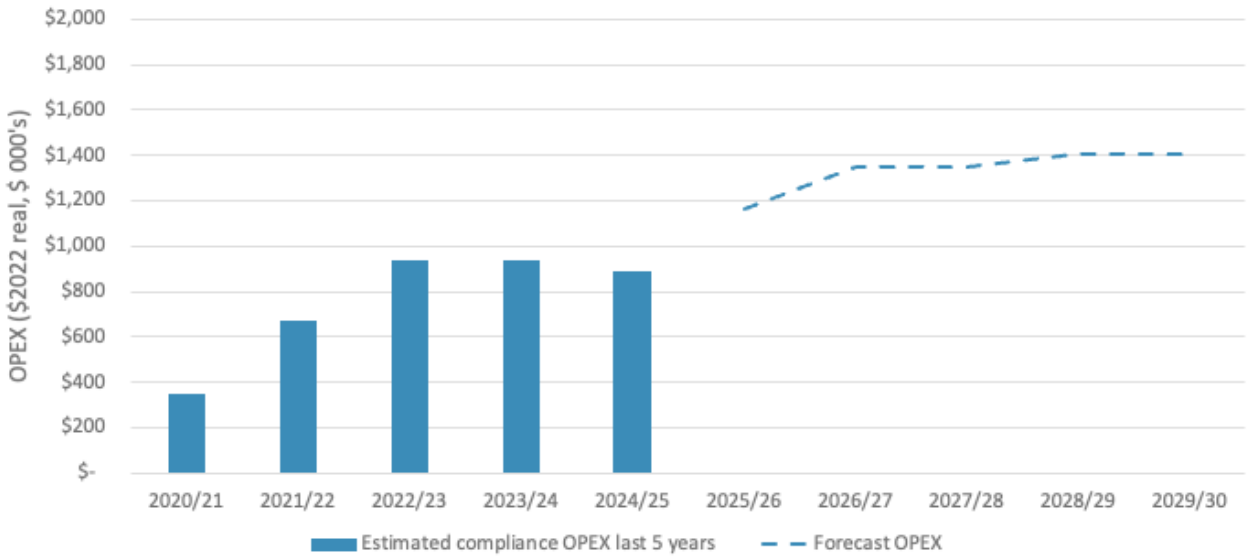
To support the extended scope of compliance activities proposed in phase 2 of our compliance program we intend to establish a new dedicated Compliance Manager role within the business, commencing in 2025, supported by a small increase in the level of resourcing dedicated to compliance activities within the New Energy Services team, ramping up through the 2025-30 period. At the end of the period, in 2030, the additional staff resourcing compared to the 2020-25 program will be:

- dedicated Compliance Manager 1 FTE;
- business and data analyst +0.5 FTE; and
- CER retailer and installer liaison and 2nd-line customer support +0.5 FTE.

As the additional staffing requirement arises from the impacts of CER and CER is not accounted for in the AER's standard opex output growth factors, option 1 has an associated opex step change of $2.24 million over the 2025-30 period, as shown in the figure below.

[36] All figures are in $ June 2022 real.

Figure 10: Compliance OPEX



The above estimate excludes staff effort to design and implement new business processes and workflows for new compliance analytics and capabilities, which we expect to average a further 1-2 FTE through the 2025-30 period. We anticipate that these activities can be carried out by existing staff resources as we automate existing processes and functions.

The costs of option 1 are summarised in the table below.

Table 5: Option 1 Costs by Cost Type ($ million June 2022 Real)

Cost Type	2025-26	2026-27	2027-28	2028-29	2029-30	Total 2025 - 30	2030-31	2031-32	2032-33	2033-34	2034-35	Total 2025-35
Capex	1.19	1.09	0.79	0.99	0.89	**4.96**	0.00	0.00	0.00	0.00	0.00	**4.96**
Opex	0.28	0.46	0.46	0.52	0.52	**2.24**	0.52	0.52	0.52	0.52	0.52	**4.84**
TOTAL COST	**1.47**	**1.55**	**1.25**	**1.51**	**1.41**	**7.19**	**0.52**	**0.52**	**0.52**	**0.52**	**0.52**	**9.79**

Further details on cost inputs are included in section 8.

5.4.2.3 Risks

Table 6: Risk assessment summary

Risk consequence category	Current risk level[37] (Option 0)	Residual risk level[38] (Option 1)	Risk cost[39]
Safety – Harm to a worker, contractor or member of the public	Medium	Low	Not quantified
Performance and Growth – Financial impact	Medium	Low	Reduced export curtailment benefit and FCAS cost reduction benefit included in quantified benefits in section 5.4.2.4. Other financial risk impacts of improving compliance not quantified.
Performance and Growth - Non-compliance with regulatory, legislative and/or other obligations	Medium	Low	Not quantified
Performance and Growth – Failure to deliver on strategic plan and growth objectives	Low	Low	Not quantified
Customers - Failure to deliver on customer expectations	Medium	Low	Not quantified
Overall risk level	Medium	Low	

5.4.2.4 Quantified benefits

The forecast quantified benefits of reduced export curtailment and reduced FCAS costs (refer section 5.3 above) for option 1 in the 2023-30 period and over the 20-year options evaluation period are summarised below.

Table 7: Option 1 Benefits by Expenditure Type ($m June 2022 Real)

Benefit Type	2025-26	2026-27	2027-28	2028-29	2029-30	Total 2025 - 30	Total 2025-45
Capex	0.00	0.00	0.00	0.00	0.00	**0.00**	**0.00**
Opex	0.00	0.00	0.00	0.00	0.00	**0.00**	**0.00**
Customer	0.00	0.04	0.07	0.45	0.47	**1.02**	**27.99**
TOTAL	**0.00**	**0.04**	**0.07**	**0.45**	**0.47**	**1.02**	**27.99**

Further details on these benefit estimates are included in section 8 below.

5.4.2.5 Unquantified benefits

As noted above, our proposed program will deliver some notable additional outcomes that have not been quantified in this business case, but which we expect will confer material benefits on the community in reducing the risk of certain low-probability but potentially catastrophic events. As described in appendix 0, the key risk is that we may fail to achieve the required level of emergency generation shedding response when directed by AEMO to activate our emergency generation shedding schemes in a minimum system load contingency event. If these emergency systems fail to operate correctly this could lead to another state-wide blackout. The 2016 blackout was estimated to have caused $360 million in economic damage[40].

[37] The level of risk post current controls (i.e. after considering what we currently do to mitigate the risk).

[38] The level of risk post proposed controls (i.e. after considering the impact of our proposed expenditure).

[39] Estimated cost of consequence(s) to SA Power Networks or its customers in an event this risk eventuates over the NPV analysis period.

[40] See South Australian blackout costs business $367m, fears summer outages on way, lobby group says - ABC News, accessed July 2023

Other anticipated benefits that have not been quantified include:

- improved customer quality of supply and reduced incidence of local over-voltage events that can cause inverter tripping or appliance damage;
- additional benefits in compliance to 'flexible load' technical standards, potentially increasing the benefits from our proposed demand flexibility program[41];
- emissions reduction benefits associated with improvements in hosting capacity and reduced export curtailment, contributing to the achievement of South Australia's targets for reducing greenhouse gas emissions (in line with recent changes to the National Electricity Objective[42]); and
- improved efficacy of network-side dynamic voltage management methods such as LDC, as higher levels of compliance lead to more consistent and predictable voltage performance across the network and a narrower spread of voltage. This will also facilitate efforts to lower average system voltage, as described in our network visibility business case.[43]

5.5 Sensitivity analysis

Our benefits forecast relies on assumptions regarding the efficacy of our proposed compliance program (option 1) in increasing the rate of compliance to CER technical standards year-on-year compared to the underlying improvements in compliance over time associated with the enduring impact of the compliance processes we have put in place so far (option 0).

To account for uncertainty in these assumptions we have also modelled:

- a 'low efficacy' sensitivity case, reflecting more pessimistic assumptions regarding the impact of the program in improving compliance rates; and
- a 'high efficacy' sensitivity case, reflecting more optimistic assumptions regarding the impact of the program.

In addition, we have assessed sensitivity to our assumed discount rate of 4.05% by repeating the NPV analysis using a lower discount rate of 3.5% and a higher one of 4.5%.

Further details of the assumptions and sensitivity cases are included in Appendix 0.

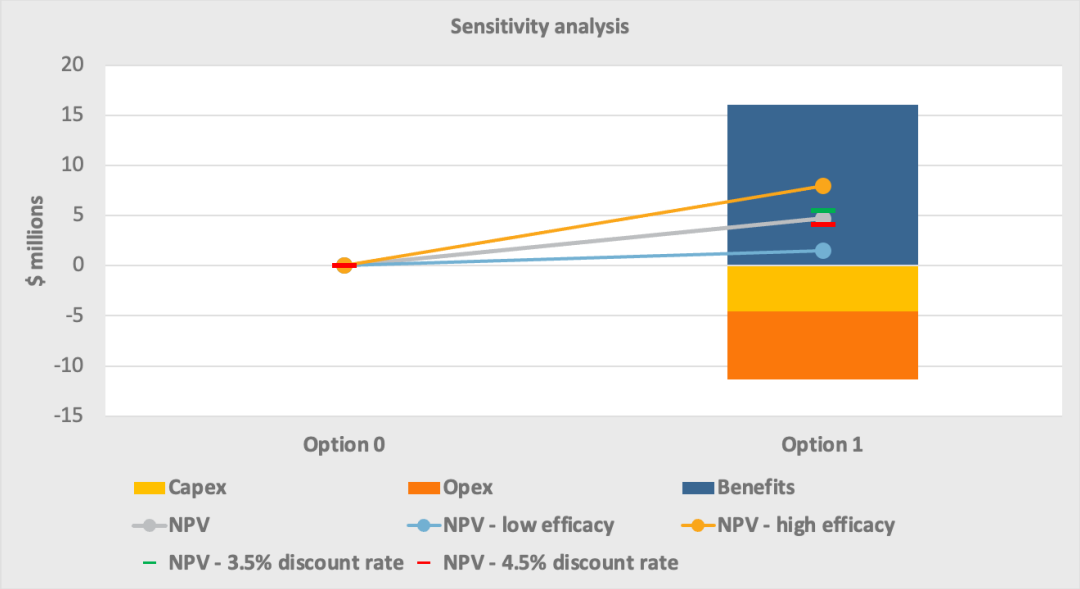
The outcome of this analysis is that option 1 has forecast positive net benefits in both upper and lower sensitivity cases, as shown in the chart below, although the 'low efficacy' sensitivity gives a relatively marginal net benefit/cost ratio of only 1.13. Given that only the hosting capacity and FCAS benefits have been included in the quantitative analysis and we consider the additional non-quantified benefits (system security, safety, emissions reduction and others) to be material, we consider that the program is highly likely to deliver significant overall benefits even under pessimistic assumptions regarding efficacy.

41 **5.7.5 - Demand Flexibility - Business Case**

42 See https://www.aemc.gov.au/regulation/neo, accessed September 2023.

43 **5.7.6 - Network Visibility - Business Case**

Figure 11: Sensitivity analysis summary



6 How the recommended option aligns with our engagement

6.1 Alignment to our customer expectations

We undertook a comprehensive stakeholder engagement program for our 2025-2030 Proposal involving more than 700 participants across 56 workshops and other activities around the state since the program commenced in late 2021.

During this process our proposed compliance program was canvassed along with our broader CER integration strategy as part of our 'Energy Transition' topic area. During three 'deep dive' focused conversation workshops, stakeholders were briefed on our compliance activities and our plans to continue them into 2025-30. The expected cost of the compliance program was factored into the anticipated bill impact for our CER integration expenditure when different expenditure options were discussed.

Stakeholders in Focused Conversation workshops and our subsequent People's Panel strongly supported our CER integration program, including our compliance program, and endorsed the proposed expenditure, taking into consideration forecast bill impacts and weighing the benefits of expenditure in this area against other aspects of our proposal. Further details of this process can be found in our CER integration business case[44].

The final cost estimates included in this business case are slightly lower than the level of expenditure endorsed by our People's Panel, as the forecast 2025-30 staff requirements were reduced slightly through subsequent rounds of internal review after our stakeholder engagement activities were complete.

6.2 Alignment to the views of the CER industry

All evidence from our own engagement and from public submissions to the recent consultation undertaken by the AEMC on CER technical standards[45] suggests that the CER industry recognises the critical importance of compliance to CER technical standards and supports efforts to improve compliance levels.

We have engaged on this aspect of our proposal with our DER Integration Working Group (**DERIWG**), which comprises a mix of senior CER industry stakeholders from across Australia as well as senior representatives from Energy Consumers Australia (**ECA**), the Total Environment Centre, the Clean Energy Council (**CEC**), the Electric Vehicle Council, the South Australian Government and AEMO. This group is described in more detail in our CER Integration business case.

We have also engaged extensively with the South Australian solar and battery installer community, including through our Solar Industry Reference Group (**SIRG**)[46] and our membership of the CEC to co-design aspects of our compliance strategy and the online tools and processes for installers developed during phase 1. Some of the materials developed through this engagement are illustrated in appendix 0.

As part of our engagement activities, we conducted a survey across the solar industry between December 2021 and February 2022. Although our compliance processes place some additional administrative burden on installers, stakeholder submissions indicated a general understanding of the need to improve compliance to CER technical standards and support for us to take proactive approach in ensuring compliance. Where respondents raised specific concerns around the administrative effort involved in the process and the need to enter the same information into multiple systems, this feedback has been used to improve the workflows in our SmartApply and SmartInstall portals.

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44 **5.7.4 - CER Integration - Business Case**

45 See: https://www.aemc.gov.au/market-reviews-advice/review-consumer-energy-resources-technical-standards , accessed July 2023.

46 See: https://www.talkingpower.com.au/solar-industry-reference-group , accessed July 2023.

In submissions to the AEMC's 2022 review into consumer energy resource technical standards[47], industry stakeholders including a coalition seven leading equipment manufacturers, the CEC, Standards Australia and others all expressed concern with current levels of non-compliance to CER technical standards and supported the need to improve compliance.

6.3 Alignment to the views of consumer advocates and other stakeholders

The South Australian Government has also recognised the need to improve levels of compliance to CER technical standards to address system security risks and improve CER hosing capacity and customer quality of supply. It has established a dedicated DER Compliance Officer within the Energy and Technical Regulation division of the South Australian Government Department of Energy and Mining that has been examining the issue of CER compliance, including the potential for remote update of inverters to improve compliance of already-installed systems, which is one of the focus areas for our proposed 2025-30 program. We have engaged with the SA Government throughout the development of its compliance strategy, both to provide advice and technical input from a DNSP perspective, and to ensure alignment of our own compliance strategy with government policy and direction.

Finally, and importantly, national energy consumer advocacy groups have recognised the risks to consumers from poor compliance to CER technical standards and expressed their support for efforts to improve compliance. In its submission to the AEMC's 2022 review[48], Energy Consumers Australia wrote:

> *"How technical standards are developed, implemented and enforced may have a direct impact on the performance, functionality and cost of Consumer Energy Resources (CER). This affects not only the broader market and system operation, but how consumers view, relate to and operate these assets, impacting the routines of daily life inside Australian homes and business*
>
> *"The impact of [CER] non-compliance from a consumer's perspective, is the risk of more frequent disconnections, zero export limitations, and not being able to get the most value from their investment … ensuring compliance with mandated technical standards, while extremely important now, will only grow in importance."*

Similarly, in its submission, the Public Interest Advocacy Centre (**PIAC**) wrote:

> *"Ensuring robust CER standards, interoperability and improved CER standard compliance are crucial. They are necessary to underpin consumers ability to connect more CER devices to the network and ensure all consumers, not just those with the requisite technology, benefit from optimised CER penetration and utilization"*

[47] See: https://www.aemc.gov.au/market-reviews-advice/review-consumer-energy-resources-technical-standards , accessed July 2023.

[48] Ibid.

7 Alignment with our vision and strategy

In response to growing concerns around the levels of non-compliance we developed a CER Compliance Strategy in 2021[49]. The Compliance Strategy identified the need for us to take a more proactive approach to working with the CER industry, AEMO, government and other stakeholders to improve levels of compliance. It called for the establishment of a formal compliance function within the business, set out key compliance principles and identified four priority focus areas. A summary of the strategy, our focus areas and strategic objectives are shown in the figures below.

Figure 12: CER Compliance Strategy

CER Compliance Strategy

Guiding principles

- Prevention before intervention
- Remediate the root cause
- Define clear responsibilities and obligations
- Align incentives on the right parties
- Simplify rules and processes where possible

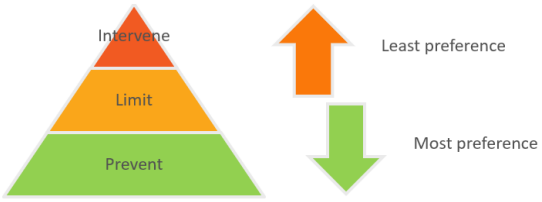


Figure 3: Prevention before intervention

1. Customers, Solar Retailers & Installers

a. Upskill stakeholders to reflect their evolving roles and responsibilities
b. Assist retailers and installers in their compliance responsibilities by facilitating information, training, and system improvements.
c. Engage and listen to feedback to develop, implement, and improve systems and processes.
d. Action critical non-compliances.

2. Develop SAPN systems

a. Using a variety of data sources, develop visibility and traceability so that non-compliance can be identified.
b. Develop and deploy capabilities to limit the impact of non-compliant installations and operations.
c. Provide autonomy to prevent non-compliance approvals
d. Simplify processes for ourselves and external stakeholders.

3. Government and Industry

a. Influence to embed roles and responsibilities
b. Align and communicate key responsibilities to industry
c. Reduce touchpoints for installers between entities
d. Engage to ensure industry can support new requirements

4. OEM & Tech Provider Capabilities

a. Support Technology Providers across current initiatives
b. Develop alignment with local, national, or international industry approaches to align capabilities with industry.
c. Communicate and accelerate the importance of smart DER

[49] **Supporting document 5.7.2 - Compliance Strategy**

Figure 13: CER Compliance methodology

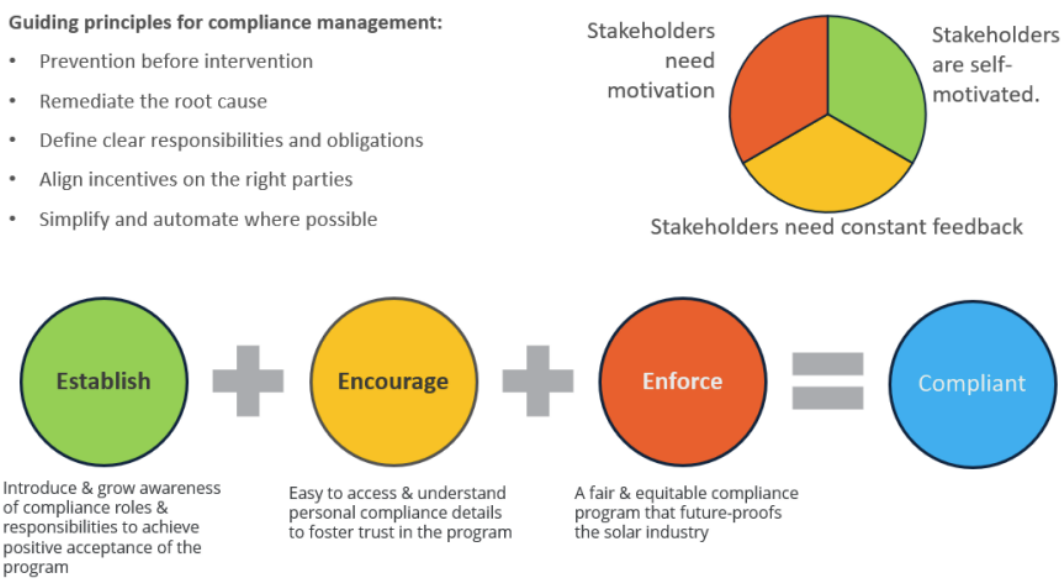
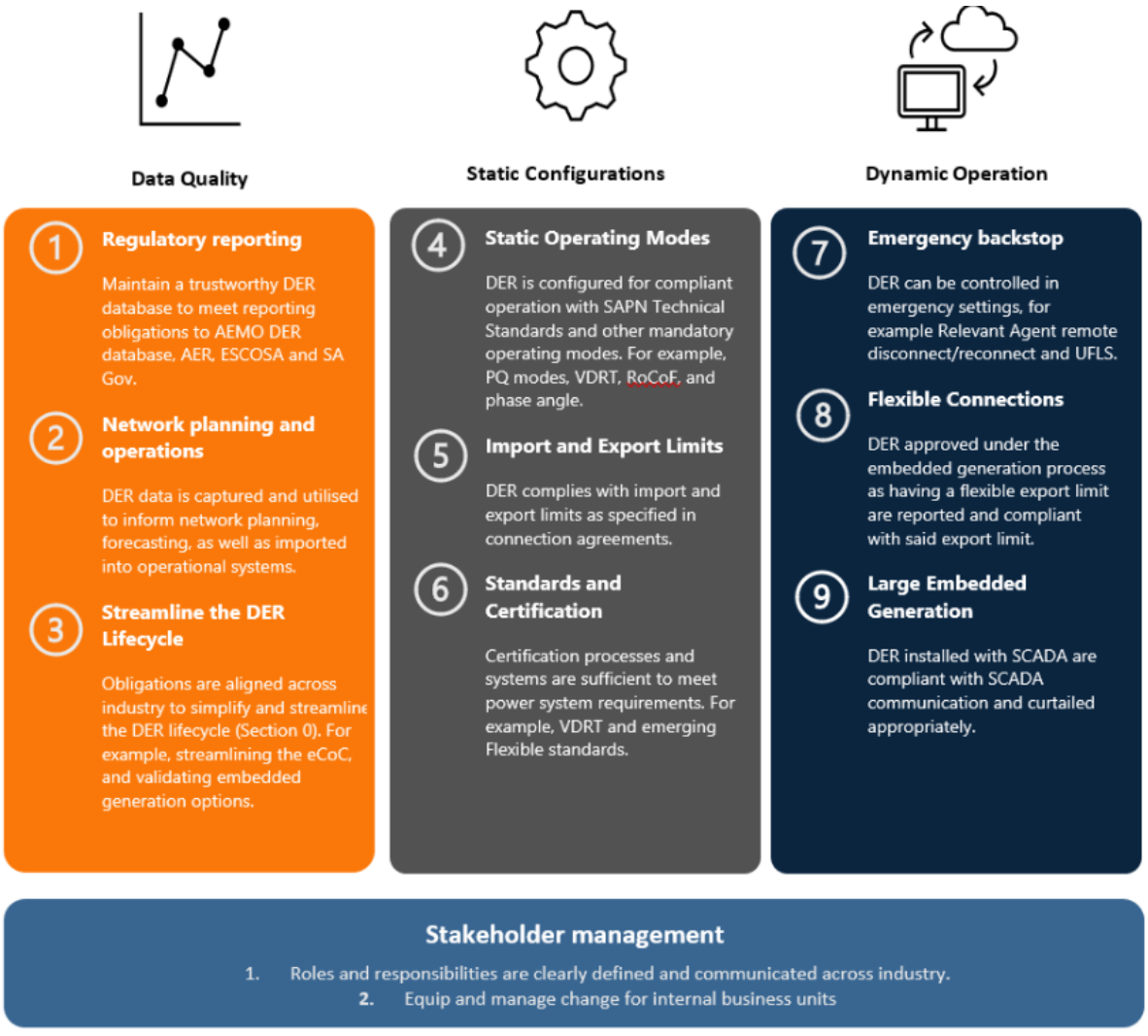


Figure 14: CER compliance strategy focus areas



8 Reasonableness of cost and benefit estimates

The tables below provide a summary of the methods used to estimate costs and benefits.

8.1 Costs

Table 8: Basis of cost estimates

Cost item	Basis of estimate
Systems costs for compliance systems	CAPEX costs for the extension of our existing compliance systems to support the new functions proposed were estimated based on the historical costs to develop the systems that support our existing compliance activities, taking into consideration the similarity between systems already developed and projects already undertaken and those proposed. Relevant system development projects already undertaken during phase 1 of our compliance strategy include: ▪ SmartApply, related enhancements to the DER register and associated business process development; ▪ Embedded Generation (EG) portal enhancements; ▪ EG smart forms; ▪ meter data integration (FutureGrid platform); and ▪ meter data analytics trials.
Staff costs to support additional compliance activities	These costs were estimated based on the composition of the current compliance team within our New Energy Services group and the effort required to support current compliance activities that are comparable to those additional activities proposed for 2025-30. Estimates in $2022 are based on 2022 staff rates for the proposed roles. The compliance team currently comprises 2 x analyst FTEs and 3 x call centre support resources, with oversight from the New Energy Services manager (0.25 FTE). 2025-30 resource estimates were refined via an internal review and challenge process. Through this process, 1-2 FTE effort initially included to develop new business processes was removed as opportunities were identified to accommodate these activities within current staffing levels. A further small reduction in the final 5-year opex estimate was made after the conclusion of our stakeholder engagement program through more detailed resource profiling over the period.
Top-down challenge	After individual cost items had been estimated as above, the overall program cost was subject to internal top-down review to consider the staging of work over time and potential program-level synergies and efficiency gains in common activities such as change management and project management. This activity resulted in a small reduction to the original bottom-up cost estimates.

8.2 Benefits

Table 9: Basis of benefit estimates

Benefit item	Basis of estimate
CECV benefit (reduced export curtailment)	This benefit reflects the additional export hosting capacity achieved in voltage-constrained parts of the network when more customer inverters are compliant to the required AS4777 Volt-VAr power quality settings. Inverter compliance to AS4777 Volt-VAr settings has a direct positive impact on hosting capacity in most voltage-constrained areas of the network. The AS4777 Volt-VAr response mode operates automatically by progressively changing the inverter power factor when local voltage approaches the upper end of the allowed range. This has the effect of counteracting local voltage rise during times of high solar exports, effectively increasing the amount of energy that can be exported before voltage limits are reached and active curtailment using flexible exports is required. The future benefit of increasing compliance is estimated using a 'with and without' analysis performed with the LV Planning Engine model developed for our CER integration planning[50]. One input to the LV Planning Engine model is a growth curve that indicates the forecast level of compliance to AS4777 in the installed DER population year-on-year. The model uses this to factor in an associated annual increase in underlying hosting capacity in the network as compliance improves over time. This reduces the forecast level of export curtailment for customers in the base case, before any investment in export capacity augmentation. To estimate the benefit of our 2025-30 compliance program we use two different input curves for AS4777 compliance: one that reflects the expected growth in compliance if we undertake our proposed 2025-30 program, and one for the 'without' case, in which we still expect levels of compliance to increase over time (due to the enduring impact of our 2020-25 program on improving compliance rates for new installs), but more slowly. These curves are included in appendix 0. We then calculate the value of the difference in expected export curtailment between the two cases, i.e. the value of the additional export curtailment that is alleviated when we undertake our 2025-30 program compared to the counterfactual where we do not. The value of this reduction in export curtailment is quantified using a modified version of the AER's Customer Export Curtailment Value (CECV)[51]. Note: this analysis is based on our forecast of the level of export curtailment before making the investments in additional export capacity proposed in our CER integration business case[52]. This ensures that there is no double-counting of benefits: the CECV value attributed to the compliance program in this business case is not included in the CECV values associated with the network capacity upgrade options considered in the CER integration business case. Rather, all the options for network investment considered in the CER integration business case start from a baseline that assumes that our 2025-30 compliance program will go ahead, and underlying hosting capacity will grow accordingly. This also means that the CECV benefit attributed to our compliance program is independent of the level of investment in additional export capacity (i.e. independent of which investment option of those considered in the CER integration business case is chosen).
FCAS benefit	In a study commissioned by the AEMC in 2023, economic consultant Oakley Greenwood estimated the future rise in FCAS costs across the NEM with increasing CER uptake if the current poor levels of compliance to AS4777 disturbance ride-through requirements for new installs continued, building on earlier work by AEMO[53]. They estimated a cumulative cost in excess of $450 million over the period between 2022/23 and 2035/36 arising from non-compliant new systems, as shown in the figure below, plus a further cost of around $65 million from non-compliant replacements of older systems.

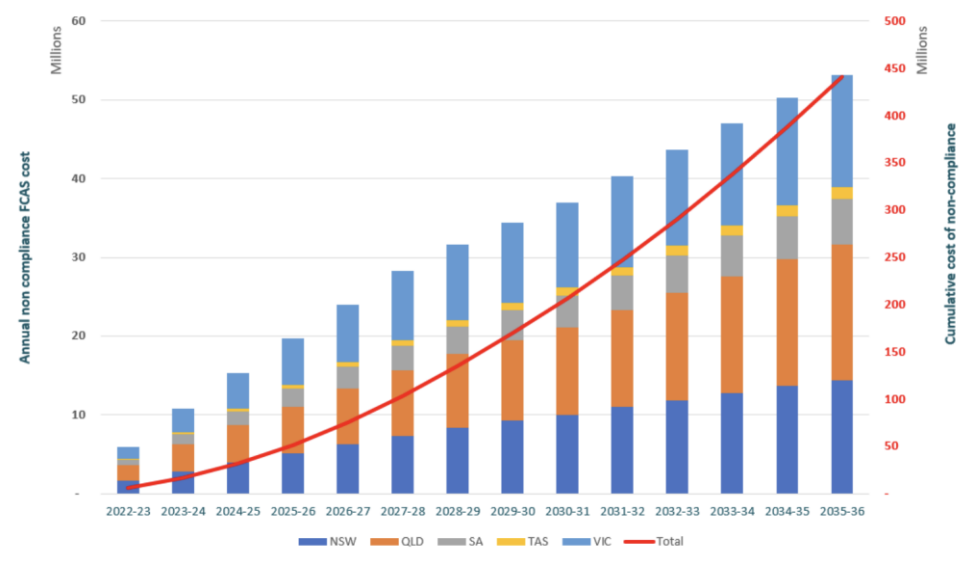
50 For more details on the LV Planning Engine model, refer to **supporting document 5.7.4 CER integration – Business Case.**

51 Our version of the CECV includes an additional component to quantify the benefit of avoided generation capacity investment.

52 **Supporting document 5.7.4 - CER Integration - Business Case**

53 Oakley Greenwood, *Benefits of CER Compliance, CER Technical Standards*, 23 August 2023.

Figure 15: FCAS cost of non-compliance ($ million) for new systems, from Figure 1 in Oakley Greenwood's 2023 report on Benefits of CER Compliance[54]



Oakley Greenwood estimate the future benefit of improving compliance by comparing the above forecast FCAS costs, representing a 'do nothing' baseline scenario where the level of compliance for new and replacement systems remains unchanged from today's levels, with forecast FCAS costs in a 'take action' scenario where 90% of new and replacement systems are compliant from 2023 onwards.

We have used Oakley Greenwood's FCAS price forecasts for South Australia and adapted their methodology to align with the assumptions in this business case in order to quantify this benefit for our 2025-30 compliance program.

Our methodology differs from theirs as follows:

- our forecast begins in FY2025-26 whereas Oakley Greenwood's begins in FY2022-23, and we extrapolate beyond the 2036 horizon in Oakley Greenwood's forecast to forecast to FY2044-45;
- we assume in the base case (our option 0) that compliance rates for new and replacement systems will increase over time even if we take no further action, due to the enduring benefits of the compliance initiatives we have undertaken so far. We assume in the 'take action' case (our option 1) that compliance rates for new and replacement systems do not immediately reach 90% but ramp up to 90% over the 2025-30 period as our proposed new initiatives are deployed. Both of these assumptions give a more conservative estimate of the benefit attributable to our compliance program (the difference between the two cases); and
- we assume a 15-year replacement cycle for inverters. Oakley Greenwood modelled both a 10-year and a 15-year cycle.

Further details of our compliance forecasting method and growth curves are included in appendix 0.

[54] Ibid.

9 Reasonableness of input assumptions

The table below provides a summary of key input assumptions.

Table 10: Basis of key input assumptions

Input assumption	Basis
Current levels of compliance to CER technical standards	Modelled based on historical CER growth and replacement rates, the years in which relevant standards were introduced and the empirical evidence of actual vs expected compliance levels from recent studies by AEMO, UTS, SA Power Networks and others. Refer Appendix 0 for details.
Efficacy of our compliance program in increasing levels of compliance	To quantify the efficacy of our future compliance program we have estimated: ▪ our future capability to influence compliance levels for new installs - estimated based on experience from our current compliance program. ▪ our future capability to detect non-compliance using smart meter data analytics - estimated based on initial trials with sample data; and ▪ achievable correction rates for detected non-compliance - estimated based on current and proposed business processes. Noting that the above are influenced by many factors that can't be known with certainty, we have tested the impact of 'high efficacy' and 'low efficacy' assumptions in our sensitivity analysis. Refer Appendix C for details.
Effectiveness of Volt/VAr response in increasing hosting capacity	This is estimated based on an empirical study using the DigSilent PowerFactory tool to simulate the voltage performance of sample LV networks of different kinds at different levels of PV penetration and different levels of Volt-VAr compliance, the same approach that was used to estimate this for our 2020-25 regulatory proposal. Refer Appendix 0 for details.
CER uptake forecasts - **Solar** - **Battery** - **EV** **Peak demand growth forecasts** **Load profiles (customer underlying demand, hot water, batteries, EV charging, etc)**	Benefits are quantified using the LV Planning Engine model described in our CER integration business case and hence rely on the same set of input assumptions for external factors. The LV Planning Engine uses CER growth forecasts derived from AEMO's August 2022 ESOO forecasts for South Australia based on the ISP Step Change scenario as the central case. Load profiles are based on an analysis of sample smart meter data and other data sources. Input data has been prepared using independent modelling and advice from external consultants Blunomy (formerly Enea) and EVenergi. Further details are included in the CER integration business case and associated methodology document.
Network capacity (export)	Intrinsic network hosing capacity (export capacity), which is a key input to estimating future CECV benefits, has been estimated using our LV Planning Engine using the methodology described in our CER integration methodology document.

Appendix A - Risk assessment

				Current risk (Option 0)			Residual risk (Option 1)		
ID	Risk scenario	Consequence description	Consequence category	Consequence	Likelihood	Risk Level	Consequence	Likelihood	Risk Level
1	Poor compliance leads to underperformance of emergency generation limiting capabilities (EVM, smarter homes, flexible exports curtailment) when we are directed to operate them by AEMO in a minimum system load contingency event, thereby failing to avert a major system instability leading to widespread outage or a system black event	Major financial impact for South Australia, potentially hundreds of millions of dollars in the case of another statewide blackout.	**Performance and Growth** - Financial impact	4	2	Medium	4	1	Low
		Widespread and prolonged loss of electricity supply exposes segments of the community who are highly dependent on electricity for their wellbeing to material risk of harm, particularly during extreme summer weather conditions when there is an elevated risk of minimum system load conditions coinciding with a destabilising event such as extreme weather or bushfire.	**Safety** - Harm to a worker, contractor or member of the public	4	2	Medium	4	1	Low
		Failure to meet our regulatory and legislative obligations to act in response to directions from the system operator.	**Performance and Growth** - Non-compliance with regulatory, legislative and/or other obligations	4	2	Medium	4	1	Low
		A serious failure would be a material setback to the delivery of South Australia's decarbonization plans as it would undermine confidence in the ability to operate the system securely at 100% renewable penetration.	**Performance and Growth** – Failure to deliver on strategic plan and growth objectives	3	2	Low	3	1	Low
		Any widespread and prolonged loss of electricity supply falls short of community expectations for a reliable electricity system.	**Customers** - Failure to deliver on customer expectations	3	2	Low	3	1	Low
2	Poor compliance to AS4777 PQ response modes (Volt-VAr, Volt-Watt) leads to poor quality of supply, reduced hosting capacity and reduced inverter performance.	Poor compliance to Volt-VAr reduces hosting capacity in voltage-constrained networks, which leads to higher levels of curtailment of solar exports and a corresponding loss of value for customers.	**Performance and Growth** - Financial impact	3	3	Medium	3	2	Low

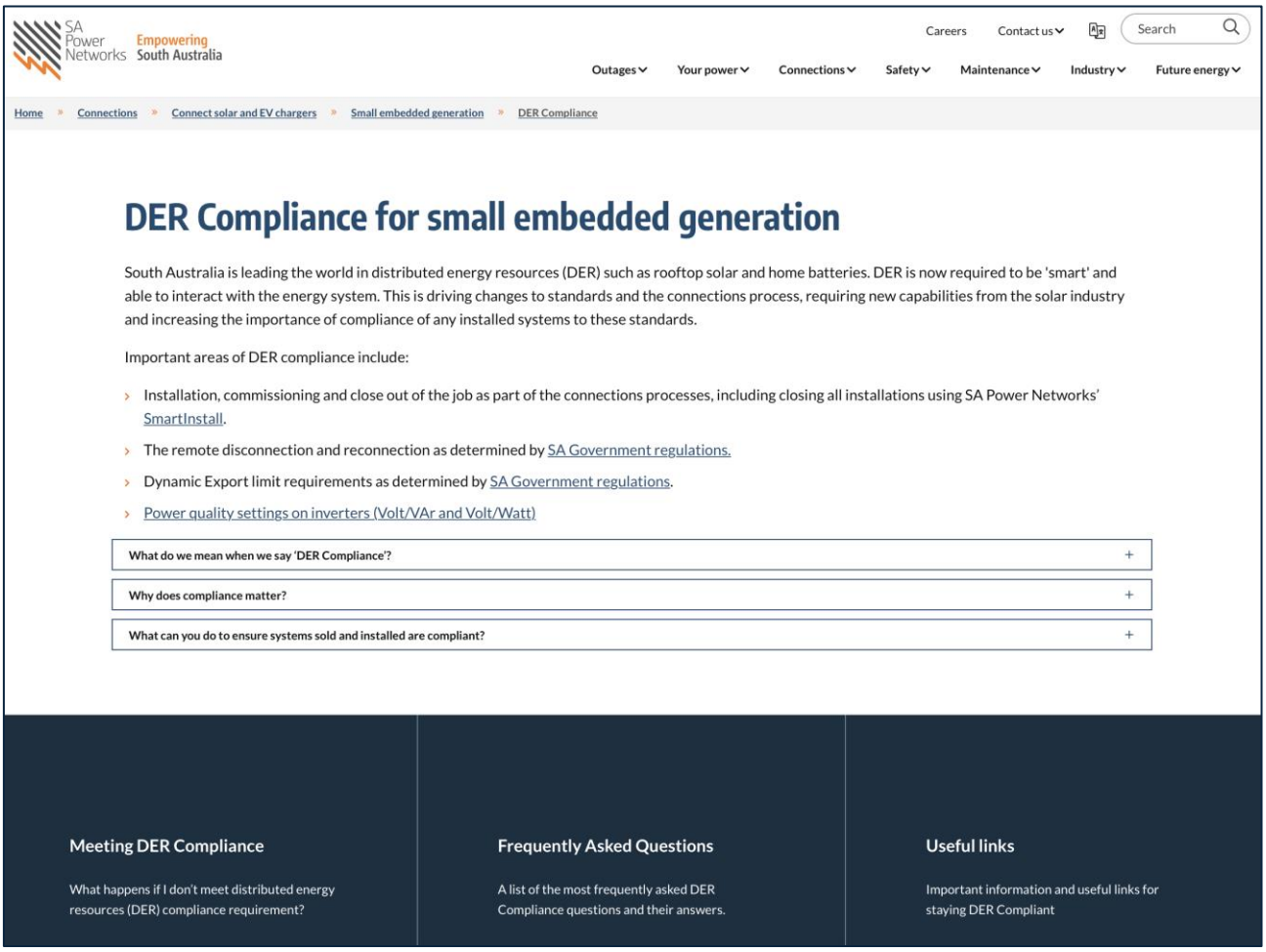
				Current risk (Option 0)			Residual risk (Option 1)		
ID	Risk scenario	Consequence description	Consequence category	Consequence	Likelihood	Risk Level	Consequence	Likelihood	Risk Level
		Impact on hosting capacity means that export service levels do not meet customer expectations; export customers will pay to export via an export tariff and expect to receive a reasonable level of service in return.	**Customers** - Failure to deliver on customer expectations	3	3	Medium	3	2	Low
		Failure to maintain voltage at the customer connection point in accordance with regulatory requirements.	**Performance and Growth** - Non-compliance with regulatory, legislative and/or other obligations	3	3	Medium	3	2	Low
		Poor quality of supply (daytime overvoltage) leads to damage or reduced lifespan of customer equipment.	**Performance and Growth** - Financial impact	3	2	Low	3	1	Low
		Increased tripping of solar and battery inverters leads to loss of customer financial benefit from their CER investments. Where there is enough smart meter data to detect unexpected excessive voltages when they arise, this consequence would be partially mitigated by increasing the amount of active curtailment of flexible customers to compensate, which would transfer some of this risk consequence from the 'financial impact' category to 'failure to deliver on customer expectations' – hence the lower likelihood of consequence rating here.	**Performance and Growth** - Financial impact	3	2	Low	3	1	Low
			Overall Risk Level[55]			Medium			Low

[55] For each option, the overall risk level is the highest of the individual risk levels.

Appendix B – Examples of installer and customer resources

As part of phase 1 of our CER compliance strategy, SA Power Networks has established a web page and associated online resources for installers and solar retailers[56], shown below.

Figure 16: SA Power Networks Website for Installers and Solar Retailers



The site provides links to resources to help installers and solar retailers understand their obligations regarding compliance, and ensure that they can achieve a compliant installation, including:

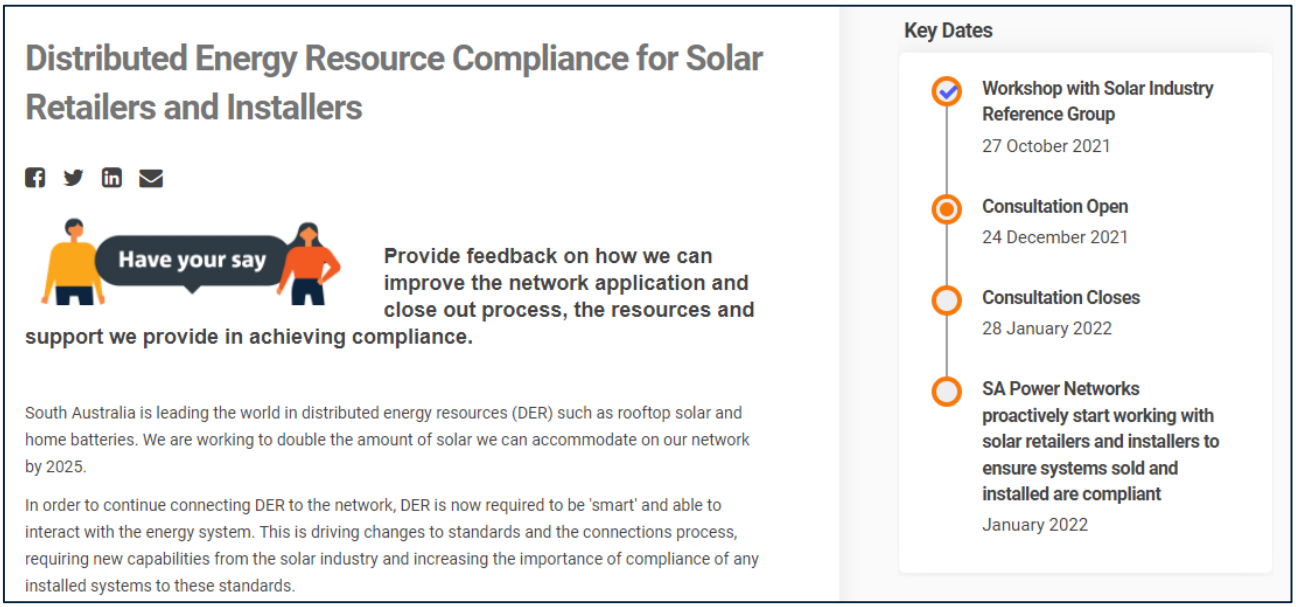
- a quick reference guide[57]; and
- two free training courses that SA Power Networks has developed in partnership with the Clean Energy Council (CEC), 'SA Power Networks Embedded Generation Compliance for SA', and 'What you need to know about flexible exports'. Installers completing these courses earn CPD ('Continuous Professional Development) points required for CEC accreditation.

56 See: https://www.sapowernetworks.com.au/connections/connect-solar-and-ev-chargers/small-embedded-generation/der-compliance/, accessed July 2023.

57 See https://www.sapowernetworks.com.au/public/download.jsp?id=322557, accessed July 2023.

These and other materials were developed with extensive consultation with the solar industry through regular bi-monthly meetings and face-to-face and online workshops with our Solar Industry Reference Group (SIRG)[58] as well as public webinars and broader public consultation facilitated via our *talkingpower*[59] web site.

Figure 17: information on consultation process on our *TalkingPower* web site



In addition, we have established a training and demonstration facility at our Network Innovation Centre including an 'inverter wall' with examples of inverter products commonly installed in South Australia, developed technical guides that show installers how to apply the correct settings at time of installation for a broad range of inverter makes and models, and collaborated with the Smart Energy Council (**SEC**) to deliver off-site training sessions to the solar industry.

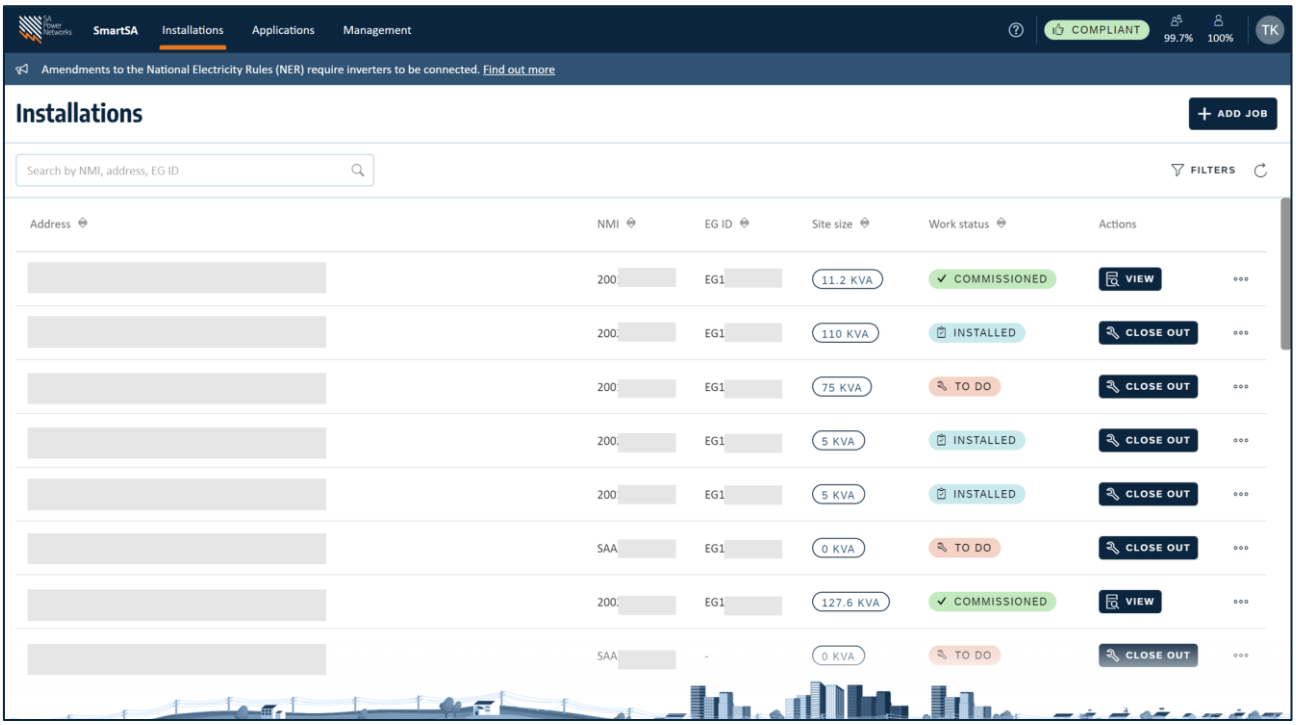
Figure 18: Solar installer training at the Network Innovation Centre and joint training seminar in partnership with the SEC

Finally, we have updated our online Embedded Generation Portal used by installers and solar retailers to incorporate new features called *SmartApply* and *SmartInstall*, online workflows that guide the installer through the process from connection application through installation and commissioning, to help them achieve a compliant installation.

[58] See https://www.talkingpower.com.au/solar-industry-reference-group, accessed July 2023.

[59] https://www.talkingpower.com.au, accessed July 2023.

Figure 19: The *SmartInstall* portal



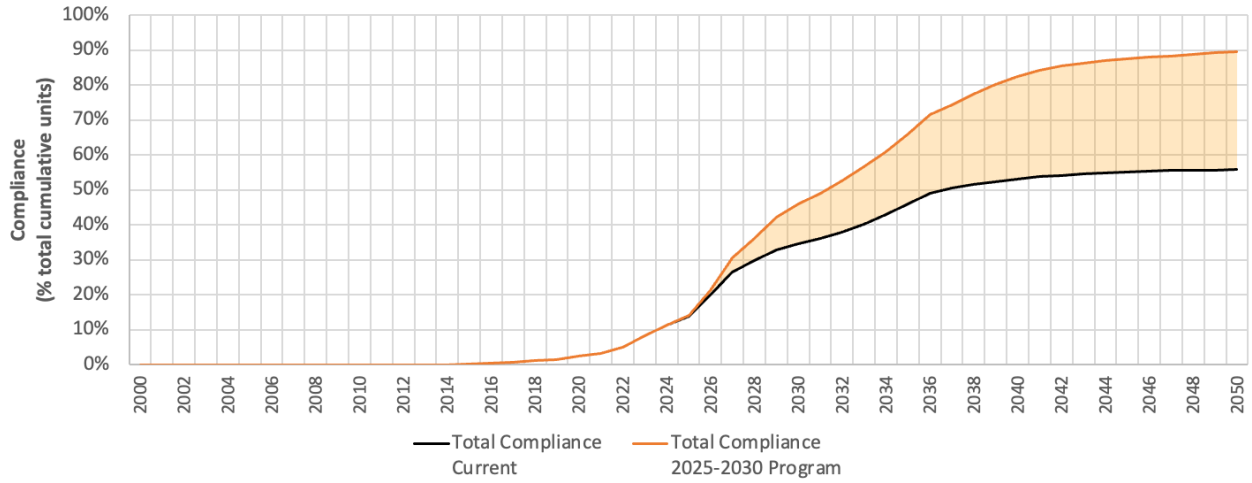
Appendix C – Compliance forecasts and sensitivities

We have modelled the expected percentage of the installed solar inverter fleet that is compliant to AS4777.2 from 2020 to 2050 taking into consideration various factors including:

- historical and forecast rates of new installations and replacements
- the date at which the AS4777.2 standard became mandatory for new and replacement installations
- levels of compliance observed in practice in recent studies by AEMO and others
- the impact of our 2020-25 (phase 1) compliance program on improving compliance rates for new installations; and
- the expected impact of our proposed 2025-30 (phase 2) compliance program on further improving compliance rates for new installs and on addressing non-compliance of already-installed solar systems.

The figure below shows the forecast future level of compliance to AS4777.2 with and without the impact of our proposed 2025-30 compliance program.

Figure 20: CER compliance forecasts (AS 4777.2)



Our NPV analysis considers how sensitive the NPV of our proposed work program is to variations in key input assumptions. The sensitivity analysis includes low-efficacy and high-efficacy sensitivity cases that apply a multiplier to the forecast CECV and FCAS benefits, as well as testing sensitivity to different assumed discount rates. These are shown in the table below.

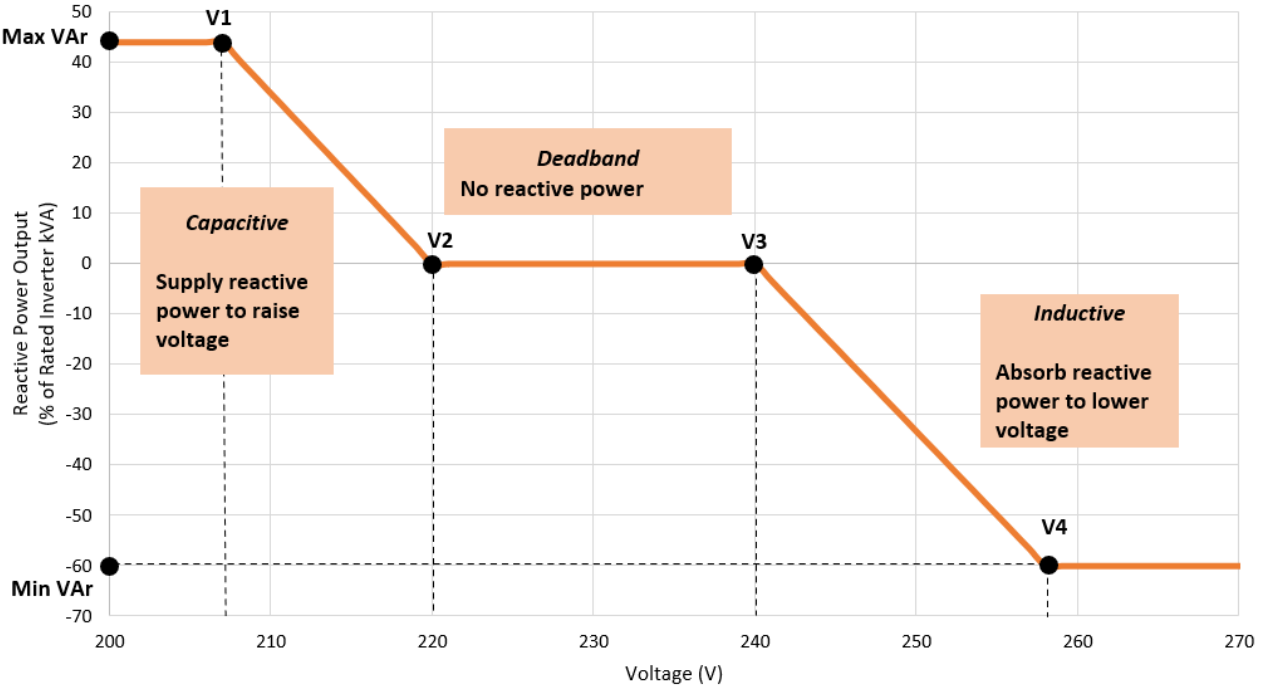
Table 11: Sensitivity analysis – input factors

Input factor	Low	Central	High
Efficacy – CECV benefit	80%	100%	120%
Efficacy – FCAS benefit	80%	100%	120%
Discount rate	3.50%	4.05%	4.50%

Appendix D – Impact of Volt-VAr on hosting capacity

The AS4777.2:2020 Volt-VAr response mode improves export hosting capacity by reducing the tendency of rooftop solar to drive up local network voltage. It does this by progressively changing the power factor of the inverter as voltage rises above 240V to be increasingly negative. A negative power factor causes the inverter to absorb reactive power, which has the effect of lowering voltage. The response curve is shown below.

Figure 21: AS 4777.2:2020 Volt-VAr curve



The benefit of Volt-VAr response in improving hosting capacity depends on the kind of local LV network and the nature of the hosting capacity constraint. High-impedance networks (e.g. overhead networks with thin conductor) tend to be the most affected by voltage rise from rooftop solar, and these are the networks where Volt-VAr can be most beneficial. The benefit is lower for low-impedance networks (e.g. newer underground networks). In some LV networks the limiting factor may be the reverse thermal capacity of the transformer, rather than a voltage rise issue, in which case Volt-VAr will not help.

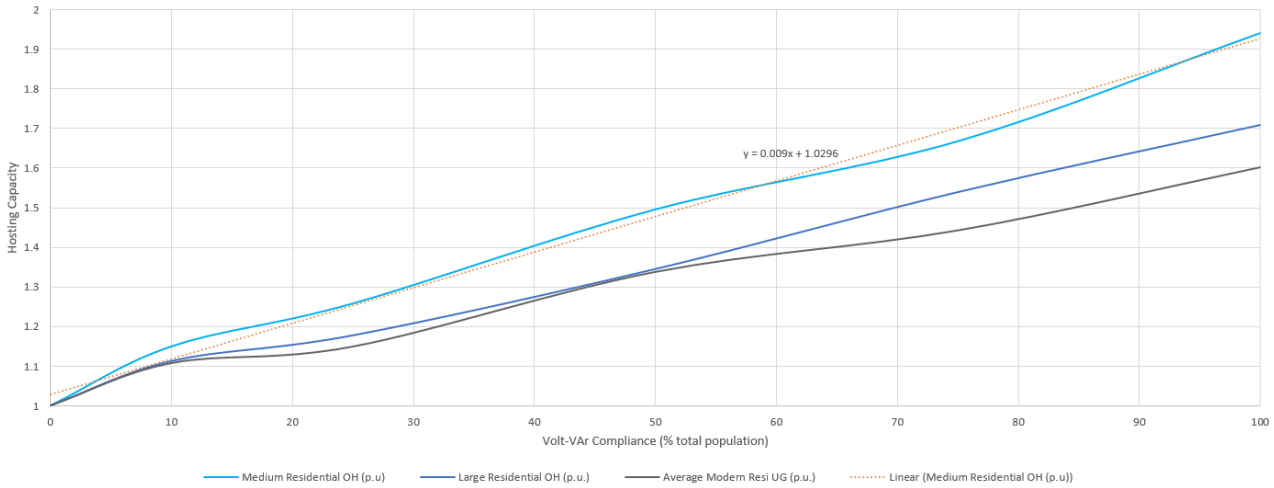
We have used the DigSilent PowerFactory modelling tool to estimate the impact of AS4777.2 Volt-VAr response on hosting capacity for different kinds of LV network, using the following methodology:

- build detailed electrical models of sample LV networks of various common construction types using accurate data on network construction, line length and type, transformer size, tap setting, customers, etc, informed by field audits of the sample networks;
- for each network model:
  - simulate behaviour when all customers exhibit their native load only (i.e. no solar) and determine the maximum voltage seen by any customer;
  - simulate behaviour for one or more reference levels of solar PV, distributed over customers, to determine the voltage rise per kW PV for each customer, assuming all PV systems operate at unity power factor (i.e. zero Volt-VAr response);
  - the base hosting capacity is then the maximum amount of PV that can be installed in the LV network before voltage exceeds the regulated upper limit of 253V for any customer; and

- repeat the simulation with increasing numbers of PV systems enabled with Volt-VAr response to determine the percentage increase in hosting capacity for every percentage increase in the level of Volt-VAr compliance.

The output of this modelling is shown below for a selection of common network types. Increasing from 0% to 100% compliance to Volt-VAr has the effect of almost doubling hosting capacity for medium-sized residential overhead networks.

Figure 22: hosting capacity vs Volt-VAr compliance for different network types



These Volt-VAr efficacy curves are used in our LV Planning Engine to adjust the underlying hosting capacity of each LV network year-on-year based on the expected level of compliance to AS4777.2:2020. A high level of compliance to AS4777.2:2020 has the effect of reducing forecast export curtailment and hence reducing the level of network investment required to maintain export service levels.