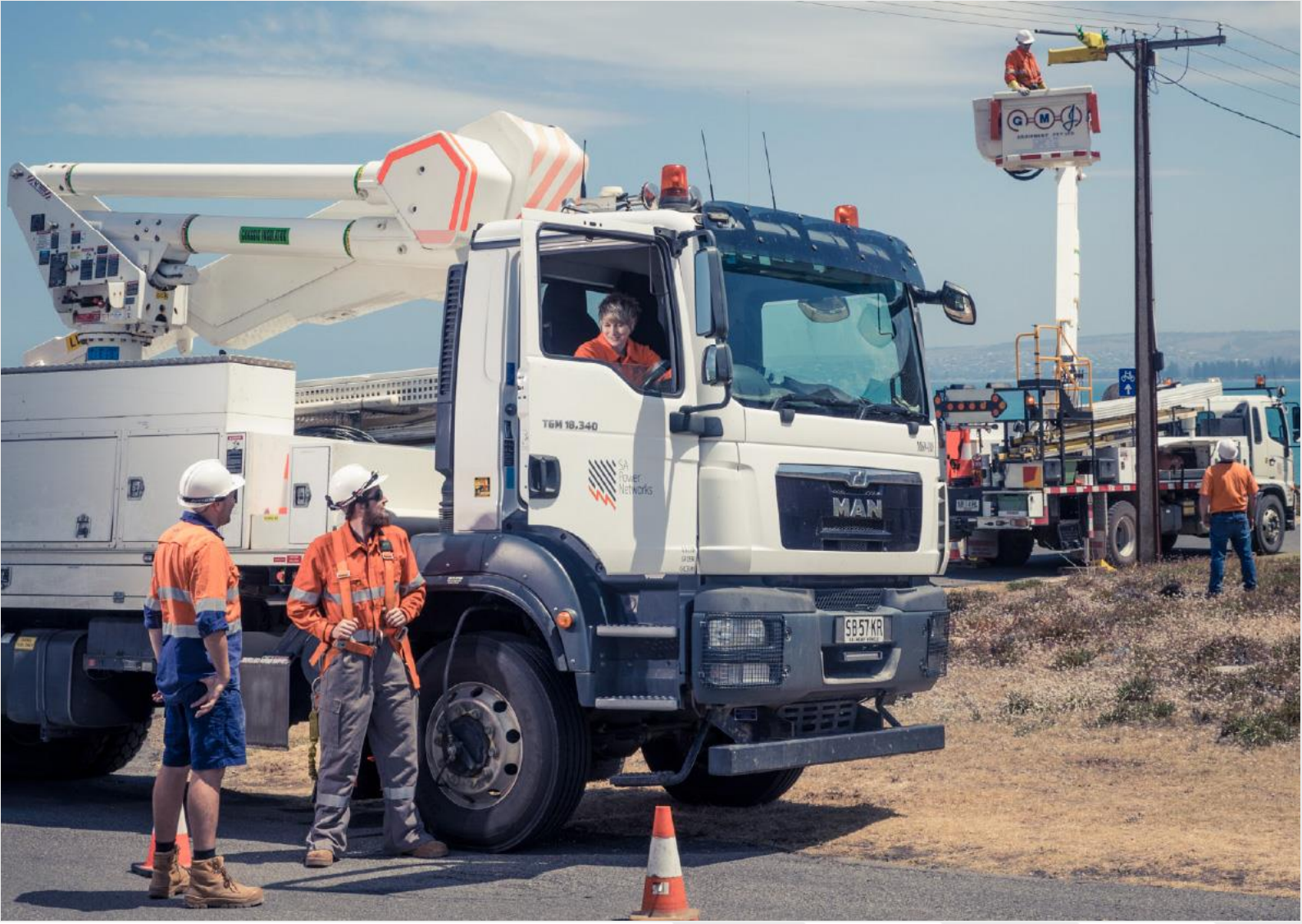


Reliability Management Expenditure (Augex) Forecasting Structure

Supporting document 5.9.1

January 2024

SA Power Networks

Empowering South Australia

1. Introduction

1.1 Program overview

The Reliability Management Programs are required to:

- maintain underlying reliability of the supply to SA Power Networks' customers at historical levels (consistent with the STPIS setting for the next regulatory period); and
- improve the reliability of supply to the worst served areas of the SA Power Networks network where the Service Targeted Performance Incentive Scheme (STPIS) does not provide sufficient incentive to undertake the investment.

The improvement programs include some elements where it is expected that our network could exceed jurisdictional reliability service standards applicable in the next regulatory period. However, the reliability improvement component only includes programs supported by our customers that can be demonstrated to provide a net-benefit to customers. [1]

These improvement programs are focused on improving the supply reliability for the following worst served customers:

- CBD improvement program - customers in the CBD, where the reliability of the network has been declining significantly over the recent regulatory period and is now expected to exceed the jurisdictional service standards applicable for the next regulatory period;[2]
- supply restoration time improvement program - customers supplied from rural feeders whose average time to restore supply following an interruption has been declining and is expected to exceed the jurisdictional service standards associated with maximum restoration times applicable for the next regulatory period;
- low reliability feeder improvement program - customers supplied from a feeder whose reliability performance over the last five years has been consistently much poorer than the regional average resulting in the feeder being defined as a 'low reliability feeders' on multiple occasions under the jurisdictional service standard arrangements[3]; and
- regional improvement program - customers in those regions that have the worst reliability compared to the overall regional average or regions where reliability has seen an appreciable decline recently.

Our stakeholder and customer engagement, conducted in early 2022, (called 'Broad and Diverse Engagement'[4]) sought to explore and seek views from those parties on various reset themes, identified in the earlier stages of engagement. This engagement found some support for programs of this type, with customers very supportive of SA Power Networks maintaining supply reliability and complying with jurisdictional standards, and more supportive than not for improving reliability for the worst served customers. Specific matters raised by customers through this engagement were:

- the importance of reliability for vulnerable customers such as those on low incomes, those on life support, and businesses that are adversely impacted by outages
- the need to consider the regions with varying service levels
- the use of enhanced automation and fault indication for poorly served areas.

[1] Though the ESCOSA review, we will later determine the extent to which some of these programmes may be required on regulatory compliance grounds.

[2] These standards are currently being reviewed by ESCOSA and will be defined in South Australian Electricity Distribution Code. ESCoSA has highlighted the poor performance of CBD feeders in its Issues Paper pg 7, available via [www.escosa.sa.gov.au] last accessed 24/1/2024.

[3] The definition of a 'low reliability feeder' under the jurisdictional service standard arrangements is defined in the South Australian Electricity Distribution Code and is summarised further in this forecasting approach document.

[4] A more detailed explanation of the 'Broad and Diverse' engagement phase and associated findings available via our reset engagement website, [www.talkingpower.com.au] last accessed 24/1/2024.

We will continue to engage with our stakeholders and customers on the Reliability Management Programs as the programs' expenditure and benefits are more accurately forecast. This engagement will seek to understand our customers' preferred tradeoff between the costs and benefits of these programs.

1.2 Where this program fits into SA Power Networks' proposal

The Reliability Management Programs form part of our network augmentation capital expenditure (augex) forecast, which relates to our assets that are used to provide Standard Control Services (see Box 1 for an overview of our augex forecast).

The Reliability Management Programs allow for the need to install additional network assets and/or upgrade the service provided by existing assets to address customer supply reliability performance issues.

The Reliability Management Programs have elements of asset replacement. But this replacement activity is not driven by the condition of the network assets, rather, the need for the enhanced service provided by the new asset[5]. Therefore, all expenditure for these programs has been treated as augex and allocated to the reliability component of the augex forecast. The interactions with other elements of our proposal and how there are accounted for is covered in more detail in the sections below.

Augex has recently made up approximately 20% of our capital expenditure (capex) providing Standard Control Services, with the capex associated with equivalent Reliability Management Programs accounting for approximately 15% of this augex (approximately 3% of overall capex). It is anticipated that the Reliability Management Programs will form a similar portion of capex in the next regulatory period, dependent on the level of investment that customers support.

Box 1 Augex description

The SA Power Networks augex forecast comprises the following components:

- Capacity driven augmentation works required to meet forecast demand that necessitate the extension or upgrade of the sub-transmission, distribution and LV networks;
- Reliability installation of assets required to maintain the reliability of supply services, ensure compliance with jurisdictional reliability service standards, and improve poor reliability where there is customer support;
- Resilience to prepare the network and customer supplies to be resilient to major weather events to ensure supply to community specific services and/or vulnerable communities is maintained;
- Customer Energy Resource (CER) investments to integrate DER on the network;
- Strategic specific one-off programs to manage key network risks and compliance issues and/or optimise long term expenditure;
- Environmental works necessary to address environmental risks within the network to comply with Environmental Protection Authority (EPA) requirements;
- Safety expenditure necessary to maintain the safety of our network (excluding repex) for SA Power Networks' workforce and the general public, which also includes a number of initiatives arising from our customer engagement program; and
- Power Line Environmental Committee (PLEC) expenditure to underground parts of the network in accordance with State Government legislation.

[5] Programs covering the replacement of assets primarily due to the age/condition of the asset and the risks associated with the age/condition-related failure of the asset are included in our repex forecast.

1.3 Program history

SA Power Networks has historically implemented reliability programs as part of its business-as-usual (BAU) practices, which are aimed at maintaining reliability, complying with jurisdictional reliability standards and improving reliability where there are sufficient STPIS rewards.

As part of the development of these programs, we routinely monitor customer supply reliability and investigate network outages and their impact on customer reliability throughout each year. These investigations are aimed at identifying matters such as emerging trends influencing reliability and our worst served customers. The findings of these investigations guide which works need to be undertaken through the reliability management programs and other programs (particularly the asset replacement programs, if there is found to be an emerging issue of asset condition-driven failures).

Maintaining underlying reliability

We have been implementing a number of programs aimed at the 'underlying' reliability during the current Regulatory Control Period (RCP) as part of our routine practices. These programs include:

- a program to install remote switches and automation;
- a program to install animal guards to counteract an increasing number of outages due to grey-headed flying foxes (fruit bats)[6]; and
- a general program which allows for the broader range of solutions necessary to address outage causes and maintain reliability.

Although there is an increasing trend in animal-related outages, due to a continuing increase in fruit bat colony sizes during the current period, we are not proposing any specific 'uplifts' in its program forecast for the next period to maintain underlying reliability. Consequently, it is expected that the historical average actual expenditure for these programs during the current RCP should be a reasonable basis for the ongoing needs into the next RCP to maintain this level of underlying reliability. Therefore, the forecast for this component of the Reliability Management Program uses a top-down approach, based on the average historical expenditure during the current RCP, broadly in line with previous forecasting methods for this component.

Addressing worst served customers

A Low Reliability Feeder Program is being implemented during the current RCP, largely in line with the proposed plan included in our 2020-25 Regulatory Proposal. To June 2022, we have undertaken approximately 30% of the proposed program with a further ramp up of expenditure planned in our 2022/2023 work program.

We propose to continue the Low Reliability Feeder Program into the next RCP, targeting additional 'low reliability' feeders that have worsened during the current RCP or new feeders that have entered the list of 'low reliability' feeders during the current period.

The 'CBD improvement program', 'supply restoration time improvement program' and 'regional improvement program' are three new programs for the next RCP, targeting other worst served customers that are unlikely to be adequately addressed through the 'maintain' or 'Low Reliability Feeder programs'.

All four 'improvement' programs will be supported by cost-benefit analysis, using a similar modelling approach applied for the Low Reliability Feeder program in our 2020-25 Regulatory Proposal. We will also be seeking gauging support for these programs through our consumer engagement process. The needs and drivers of these four programs are discussed further below.

[6] Grey-heading flying foxes are not native to South Australia, however they migrated and established a colony in 2010.

1.4 Document purpose

This document outlines our methods for forecasting capital expenditure pertaining to the Reliability Management Programs, covering the RCP from 1 July 2025 to 30 June 2030 (2025-30 RCP).

This document forms part of a suite of documents supporting these programs, which explain the forecasting approach, the modelling methods used in this approach, and the forecasts resulting from this approach, as set out in Table 1. The Value Framework is a document common across all proposal expenditure categories, which defines how we value (in dollar terms) risks and benefits, including those associated with customer supply reliability.

Table 1 Reliability Management Programs document suite

Document	Description
5.1.5 - Value framework	A document common across all proposal expenditure categories, defining how SA Power Networks values (in dollar terms) risks and benefits, including how the Value of Customer Reliability (VCR) should be used to quantify in dollar terms the reliability risks and benefits.
5.9.3 - Maintain underlying reliability performance programs - Business case	Reliability programs and justifications to address areas of declining reliability performance and high priority electricity consumer needs

The Reliability and Resilience Management Programs documents also reference the following documents:

- National Electricity Law and National Electricity Rules;
- The SA Electricity Distribution Code, and the ESCOSA Electricity Distribution Code Review 2025 to 2030, which will decide the service reliability scheme applicable to the next regulatory period;
- AER Service Target Performance Incentive Scheme;
- SA Power Networks Asset Management Plan (Manual 15);
- The AER's Better Resets Handbook; and
- The AER's guidance note on network resilience.

2. Motivation for Reliability Management Programs

2.1 Customer supply reliability and regulatory requirements

Measures of customer supply reliability

The reliability of the electricity supply to electricity distribution network customers is usually measured and reported using three metrics:

- SAIDI (system average interruption duration index), which measures the average time (in minutes) customers within a defined group will have their supply interrupted over a defined time period.
- SAIFI (system average interruption frequency index), which measures the average number of times customers within a defined group will have their supply interrupted over a defined time period.
- CAIDI (customer average interruption duration index), which measures the average time (in minutes) of an interruption for a defined group of customers across all supply interruptions for that group over a defined time period.

The measures are related, in that SAIDI = SAIFI x CAIDI, and as such only two measures need to be specified, which is typically SAIDI and SAIFI. The defined customer group and defined time period associated with the measure can differ depending on the circumstances. For example:

- the customer group could be all network customers, or all customers in a defined feeder category (ie CBD, urban, short rural, long rural), or region, or all customers supplied from a single feeder - or some other grouping; and
- the time period, could be all interruptions over a year, a month or day – or some other period.

The measurement requirements for these metrics define the types of interruptions that should be included or excluded in the measure. For our regulatory requirements, the inclusions and exclusions cover:

- exclude all interruptions due to planned network outages;
- only include 'sustained' interruptions, which are defined as interruptions of supply that last longer than 3 minutes);[7]
- exclude interruptions due to events associated with the transmission network, generation, faults at the customers premises, or outages required in an emergency situation (eg bushfires), which are all considered outside the control of SA Power Networks; and
- exclude interruptions commencing on days where the daily SAIDI is above a defined upper limit; these days are defined as major event days (MEDs)[8] and usually relate to severe weather events causing multiple network outages across the network that we need to make safe, repair and restore supply.

Jurisdictional reliability obligations for South Australia

The South Australian Electricity Distribution Code (Code) sets out consumer protections that apply to the distribution of electricity to customers in South Australia, including customer service standards, network reliability standards and a Guaranteed Service Level (GSL) scheme.

The reliability standards defined in the Code cover the current RCP, and operate as a 'best endeavours' regime, with targets that we must use our 'best endeavours' to achieve each regulatory year and a reporting threshold that defines when we must report on how we have applied 'best endeavours' if we fail to meet the reporting thresholds.

[7] Interruption shorter than this limit are defined as momentary interruptions. These can be measured via another metric (MAIFI), which is equivalent to SAIFI. However, we do not have a specific regulatory requirement associated with this measure.

[8] The requirements specify how this upper limit is defined, which is set to exclude the days where the daily log(SAIDI) or log(SAIFI) is greater than 2.5 standard deviations of the daily log(SAIDI) or log(SAIFI) over the year.

The network reliability targets are defined by feeder type (ie CBD, urban, short rural and long rural), and have been established using average performance over the ten years to 30 June 2019 to maintain reliability as the average of recent historical performance, prior to the start of the current RCP. As part of the reporting requirement, we must also report the reliability performance for ten separate regions covering our supply areas[9].

The current targets and thresholds are shown in table 2 below.

Table 2 Jurisdictional network reliability targets and thresholds

		Feeder type			
		CBD	**Urban**	**Rural Short**	**Rural Long**
SAIDI	Target	15	110	200	290
	Reporting threshold	20	125	220	330
SAIFI	Target	0.15	1.15	1.65	1.75
	Reporting threshold	0.2	1.35	1.85	2.10

These targets and thresholds only apply to unplanned interruptions and have similar inclusions and exclusions as covered above.

The reliability standards also define targets and reporting thresholds for the interruption duration (called Network Restoration Time). This applies a similar 'best endeavours' regime where we must use our best endeavours to achieve the minimum network restoration time targets for the proportion of the customers in each feeder category that experience an unplanned interruption that exceed a specified time in hours (each feeder category has different periods) during each regulatory year, and we must report on how we have applied 'best endeavours' if we fail to meet the reporting thresholds.

The current targets and thresholds for the Network Restoration Time are shown in table 3 below.

Table 3 Jurisdictional network restoration time targets and thresholds

		% of total customers in feeder category per annum			
		CBD	**Urban**	**Rural Short**	**Rural Long**
=> 1 hour	Target	11			
	Reporting threshold	13.5			
> 2 hour	Target	4	27		
	Reporting threshold	6.5	29.5		
> 3 hour	Target		11	27	
	Reporting threshold		13.5	29.5	
> 4 hour	Target				30
	Reporting threshold				32.5
> 5 hour	Target			8	
	Reporting threshold			10.5	
> 7 hour	Target				10
	Reporting threshold				12.5

[9] The ten regions cover nine distinct geographic regions (excluding major regional centres) and a tenth that combines these major regional centres.

The Essential Services Commission of South Australia (ESCoSA) reviews the jurisdictional service standards that apply to SA Power Networks every five years, prior to the commencement of a new RCP.

ESCoSA is currently conducting the review that will establish the reliability standards for our 2025-30 RCP. It is anticipated that the standards regime will be similar to the current regime, but with revised targets and reporting thresholds based on the last 10 years performance. One matter that ESCOSA has raised as a concern through this review is the declining performance of the CBD network, where it is expected that the current performance will exceed the revised targets. The primary cause of this decline in CBD reliability and the need for the CBD improvement program is discussed further below, along with the relevance of these matters to other elements of our Regulatory Proposal.

Service Target Performance Incentive Scheme (STPIS)

We are subject to the AER's STPIS. The STPIS rewards improvements in performance and penalizes declines in performance. The STPIS targets applicable to a RCP are set based on the historical performance (normally five years) with any adjustments to reflect forecast movements expected from the expenditure forecast in a Regulatory Proposal.

The current SA Power Network STPIS targets for the 2020-25 regulatory period are summarised below.

Table 4 SA Power Networks STPIS service reliability targets

		Feeder type			
		CBD	Urban	Rural Short	Rural Long
SAIDI	Target	22.539	105.093	181.893	277.847
SAIFI	Target	0.185	1.057	1.427	1.526

The STPIS targets only apply to unplanned interruptions and have similar inclusions and exclusions as covered above. Importantly, the STPIS can incentivise some reliability improvements, particularly where modest investments can reduce interruptions to large numbers of customers.

However, there are limitations to the regime. For example:

- there is less incentive to improve reliability to smaller groups of customers who could have a level of reliability much poorer than the relevant target performance (which is based on the historic average across the network)
- there is no incentive to make customers less vulnerable to the types of major events that result in MEDs, which are excluded from this mechanism, unless the investments have broader benefits to reliability more generally.

In both cases, the STPIS can provide insufficient incentive (ie reward) to improve the supply to these poorly served customer groups, without the necessary expenditure being specifically allowed for in the Distribution Determination expenditure forecast[10]. The improvement programs in the Reliability Management Programs are specifically aimed at these circumstances.

[10] This can typically occur when effected customer densities are significantly less than the average for the network type or the solutions are weighted towards improving CAIDI much more than SAIFI.

2.2 Explanation of needs and drivers

The reliability of customer's supply (due to unplanned activities) is driven by various factors, including:

- unplanned network outages, which can be due to many causes including asset failure due to their age/condition, vegetation and animals contacting the network, lightning, and third parties contacting or damaging the network; where storm activity can be a significant driver of many of these causes;
- network protection and switching arrangements, particularly where switches are located on the network, and the method to switch (eg via manual actions requiring a field trip, remote switching from the control room, or automatic switching or reclosing), which affects how many customers are interrupted due to a network outage, how fast the network can be rearranged to restore some or all interrupted customers, or whether the switch can automatically restore the network if the outage was only temporary;
- fault response arrangements and practices, which affects how network outages are identified and responded to, including addressing or repairing specific causes of outages, and restoring supply to interrupted customers;
- where a customer is located on the network, how far a customer is located from a bulk supply point and the length of line that supplies a customer from the bulk supply point and the terrain the lines traverse.

Furthermore, reliability patterns change over time, driven by:

- internal factors, such as the aging of the network assets; and
- external factors, such as the changing environment of the network and changing customer patterns.

These changes result in new issues emerging that cause outages, or changes in the pattern of outages, or changes in the customers who receive poor performance (compared to other similar cohorts).

As discussed above, we have BAU programs to mitigate these ongoing changes (eg our network inspection, maintenance and repex programs address the ageing of the network assets). Nonetheless, historically, we have always required ongoing reliability programs to maintain reliability and improve it where appropriate. The works undertaken under the reliability programs typically involve:

- addressing outage causes (excluding those addressed through the other BAU programs) by upgrading the network to make it less prone to certain outage causes (eg replacing bare wire overhead spans with covered conductor or undergrounding);
- reduce the number of customers interrupted due to a network outage by adding mid-line switches to feeders; and
- reducing the restoration time of interruptions by enhancing operational practices, installing remote controlled switches and automation, and fault locating devices.

Moving forward, it is still expected that reliability programs will be required to maintain underlying reliability to historical levels and continue to meet our jurisdictional reliability standards, and to improve reliability to customers with poor reliability that constantly do not meet service targets.

The following section explains the needs and drivers of the individual programs within the Reliability Management Programs in more detail.

Maintaining underlying reliability

We are proposing a program to maintain underlying reliability at historical levels and to continue to meet jurisdictional reliability standards. This program is focused on ensuring that reliability as measured by the annual SAIDI and SAIFI measures are maintained in line with the targets relevant to the next RCP.

This is a general-purpose program covering the range of recurrent works necessary to maintain overall underlying reliability and customer service, which covers a broad combination of activities to address outage

causes, reduce customers interrupted, and improve operational practices across the network. It is expected that this program will be similar in nature to the current program, allowing for the continued focus on installing animal guards to address the escalation in fruit bat-related outages.[11]

Improving reliability for our worst served customers – improving annual reliability

We are proposing four programs aimed at improving the reliability to our worst served customers. These programs are focused on improving the reliability of these customers as measured by their annual unplanned SAIDI, SAIFI and supply restoration time measures (reportable through the STPIS and jurisdictional standards).

The expenditure forecast for these four programs only include the network upgrades not allowed for in the 'maintain underlying reliability' component forecast and where the STPIS would not be sufficient to incentivise the upgrade.

The programs address a combination of three broad needs:

- reliability performance that has been degrading historically and is expected to continue;
- aspects of the current jurisdictional targets and thresholds are being exceeded and there is a heightened risk that they will be exceeded in the next regulatory period; and
- recent recurrent poor reliability performance compared to similar SA Power Networks customer types.

The significance of these needs differs between the programs and further details of these needs is discussed in the table below. Additionally, undertaking these types of programs are important to:

- achieve greater equity for all customers in the quality of the supply service they receive; and
- improve supply to vulnerable customers, including those where supply if critical for 'life support'.

Table 5 Summary of improvement program needs and drivers

Program	Purpose
CBD reliability improvement	• The reliability of supply to customers served by the CBD network has been degrading historically with recent performance over the last four years (2018/19 to 2021/22) averaging 24 minutes of SAIDI compared to the jurisdictional CBD target of 15 minutes (see Table 2 above). This degradation has been driven by the aging of the CBD cable network, with much of the cable network entering its end-of-life phase, resulting in escalating cable faults. • We are replacing CBD cables and are proposing a CBD cable replacement program for the next RCP. However, this level of cable replacement is only expected to arrest the decline, and not significantly improve the current poor CBD reliability performance. • The CBD reliability improvement program is aimed at installing automated switches in key CBD locations. These automated switches will rapidly switch supply around a faulted cable section, in order to reduce the number of customers who will experience a sustained interruption due to the cable faults. • The intention of the CBD improvement program and the CBD cable replacement program, is to bring CBD reliability closer to the jurisdictional CBD feeder category target of 15 minutes.
Supply restoration time improvement	• This program aims to improve the interruption duration for customers in remote regions. This program will focus on improving the restoration times on Long Rural feeders which are consistently not meeting the jurisdictional network restoration time targets (see Table 3 above). • This program will upgrade manually monitored and controlled reclosers to provide remote monitoring and control facilities. This will enable rapid identification and reporting of network outages, allowing earlier crew dispatch as well as reducing the time taken to travel to switches to confirm fault targets and restore supply[12].

[11] Currently, bat-related outages contribute 9 minutes of network SAIDI per annum, approximately 6% of the total network SAIDI.

[12] This can require multiple trips to a switch to first confirm the fault status and then restore supply.

Program	Purpose
Low Reliability Feeders	• The low reliability feeder program is aimed at improving the reliability for feeders that have been identified as consistently having much poorer SAIDI than their regional average SAIDI. The criteria to define a feeder as a 'low reliability feeder' in any particular year is defined in the jurisdictional service standards[13], and a feeder could be considered for upgrade under this low reliability feeder program where it has been classified as a low reliability feeder at least twice over the last five years. • The aim of this program is to bring these feeders more in line with the average reliability for their region. This program can cover a range of remediation works specific to the feeder and its outage causes. These may be works to address recurrent outage causes or to reduce the number of customers interrupted.

Regional reliability improvement	• This program is aimed at improving the reliability to those regions that have experienced an appreciable decline in reliability recently or the regional average reliability is significantly poorer than the overall regional averages.
	• Three regions have been identified for further investigation:
	  • South East, which has seen a decline in its performance recently; and
	  • Fleurieu Peninsula and the Upper North, which both have performance much poorer than other regions.
	• This program can cover a range of remediation works specific to the region's feeders and their outage causes. These may be works to address recurrent outage causes or to reduce the number of customers interrupted.

2.3 Relationship to customer service outcomes

The primary aim of the Reliability Management Programs is to maintain or improve the reliability of the supply to our customers, as measured through metrics such as SAIDI, SAIFI and CAIDI[14].

As discussed above, the intended service outcomes differ between programs, where:

- the maintain underlying program is aimed at maintaining annual reliability metrics across relevant CBD, urban, short and long rural network types (excluding the impact of MEDs), which could affect any customers across our network;
- the four improvement programs targeting worst served customers are aimed at improving the annual reliability metrics (excluding the impact of MEDs) for these worst served customers.

All the programs should maintain or improve SAIDI to some degree, but the programs or elements of the programs achieve this through improving different reliability metrics as follows:

- reducing unplanned network outages, by addressing specific causes of an outage (resulting in an improved SAIFI);
- reducing the number of customers interrupted when an unplanned network outage occurs (resulting in an improved SAIFI);
- reducing the duration of interruptions to customer supplies resulting from an unplanned network outage (resulting in an improved CAIDI and jurisdictional restoration time measure).

Table 6 summarises the programs, their intended service outcomes, and their target reliability metrics.

[13] The SA Electricity Distribution Code defines a 'low reliability feeder' to be a feeder with an annual SAIDI is at least twice as high as the regional SAIDI target (calculated as the average SAIDI for the 10 years preceding the setting of the targets) for two consecutive regulatory years.

[14] Where SAIDI = SAIFI x CAIDI

Table 6 Summary of customer service outcomes of the Reliability Management Programs

Need	Service outcomes	Program	Primary metric addressed
Maintain	maintain annual reliability metrics	Maintain underlying reliability	Combinations of network outages (SAIFI/SAIDI), customer numbers interrupted per outage (SAIFI/SAIDI), interruption duration (CAIDI/SAIDI) depending on specific circumstances
Improving our worst served customers	improving the annual reliability metrics (excluding the impact of MEDs)	CBD reliability improvement	Customer (sustained) interruptions per outage (SAIFI/SAIDI), and should also improve interruption duration (CAIDI/SAIDI) through faster restoration of supplies to some customers through automatic and remote rearrangement of the network [note – the aim of the CBD cable replacement program, which forms part of the repex forecast, is to arrest the decline in the longer term network outages, due to cable failures (SAIFI/SAIDI)]
		Supply restoration time improvement (Long Rural feeders)	interruption duration (CAIDI/SAIDI) - through improved outage monitoring and remote control of switches
		Low reliability feeders	network outages (SAIFI/SAIDI) by addressing recurrent causes of outages, but could also include customer numbers interrupted per outage (SAIFI/SAIDI) and interruption duration (CAIDI/SAIDI)
		Regional reliability improvement	network outages (SAIFI/SAIDI) by addressing recurrent causes of outages, but could also include customer numbers interrupted per outage (SAIFI/SAIDI) and interruption duration (CAIDI/SAIDI)

2.4 Regulatory requirements and the principles underlying our approach

We have sought to align our approach to forecasting the Reliability Management Programs with the following.

Industry good practice

Our methodologies used to prepare the augex forecasts of our Reliability Management Programs represent a good practice approach within the electricity industry for these purposes. These methods include:

- detailed analysis of historical outage data to determine trends, identify escalating causes, and worst served and vulnerable customers;
- analysis of past reliability improvement works to assess effectiveness and costs to mitigate reliability;
- cost benefit analysis of the options to ensure all preferred solutions maximise the net benefit to customers; and
- estimating the effect of the program on existing reliability and opex incentive mechanisms to ensure that program costs and any reliability improvements are treated correctly in our Regulatory Proposal.

National Electricity Rules (NER) requirements

Our forecasting approach and the resulting expenditure forecast accords with the expenditure objectives, factors and criteria in sections 6.5.7 and 6.5.6 of the NER:

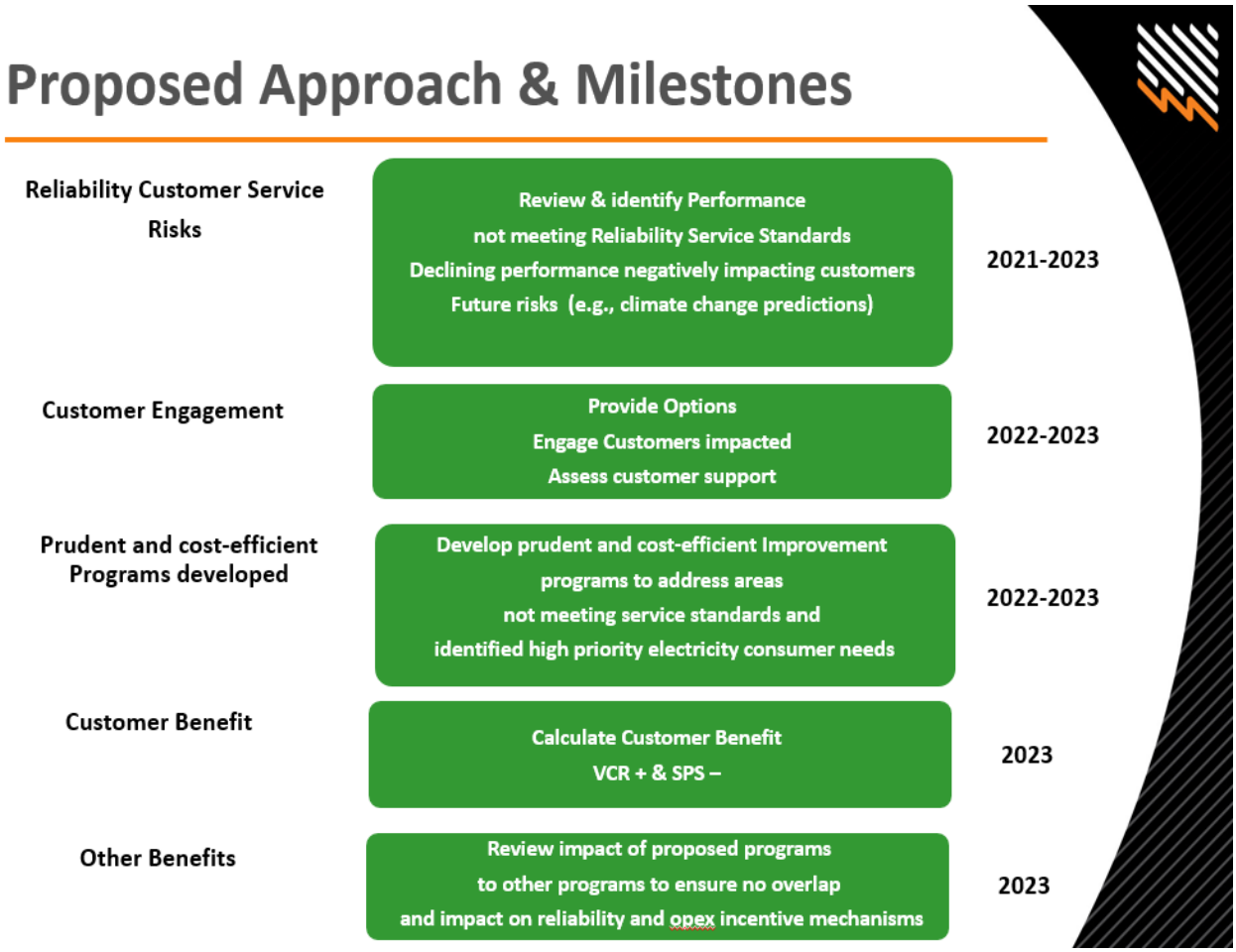
- the program's forecast capital expenditure accords with the NER capex objectives as it is required to continue to comply with regulatory obligations and maintain the reliability of the energy supply service provided by our network;
- the program's forecast capital expenditure accords with NER capex criteria, being a robust approach to quantify reliability risks and having applied cost-benefit analysis to ensure that the reliability improvement programs and all elements of the programs provide a net-benefit;
- we have engaged with our customers during the development of the program; and
- our approach considers trade-offs between different elements of our proposal, including the effect on the STPIS settings and future GSL payments.

3. Forecasting Approaches

3.1 Overall Approach

The overall process we are following to develop our Reliability and Resilience Management Programs is detailed in Figure 1.

Figure 1: Proposed approach and milestones



3.2 Program outcome scenarios

Five investment scenarios have been defined at this stage to inform the customer engagement for the development of our Regulatory Proposal. These scenarios weigh program investment costs against the outcomes delivered by the programs (ie the benefit of the risk reduction, resulting service outcomes, etc). In this way, the scenarios produce differing counterfactuals of service performance outcome (post investment risk) and program costs for customers to consider. These counterfactuals aim to transparently identify the trade-offs for customers between different levels of investment.

The scenarios currently proposed are shown in Table 7 below, indicating the programs covered by the scenario and the broad intention of the scenario on costs and service outcomes.

Table 7 Summary of Reliability Management Program Investment Scenarios

Scenario	Programs	Expected outcome Positive benefit	Negative benefit
0 a do-nothing approach No investment	No reliability programs undertaken	Capex Costs reduced from historical levels	• Overall underlying reliability across all customers will worsen • STPIS and jurisdictional targets very likely to be breached • CBD Performance will continue to decline and not meet jurisdictional targets • regional performance will decline from historical performance levels • performance to worst served customers including vulnerable and life support customers may further decline
1 a base case Maintain historical underlying investment level	Maintain underlying reliability (continue BAU program)	• Cost reduced from current period levels • Reliability at network-level and feeder category level should be maintained (note – this assumes other proposed non-reliability program still occur eg the CBD cable replacement program)	• Increased likelihood that aspects of jurisdictional standards may be breached, particularly CBD SAIDI/SAIFI targets and restoration time targets. • Worst served customers reliability would not be addressed and may deteriorate further, including the duration of interruptions for remote customers and reliability of some already poorly served regions.
2 Comply Maintain reliability + comply with jurisdictional standards	• Maintain underlying reliability (continue BAU program) • CBD reliability improvement • Supply restoration time improvement	• Reliability at network-level and feeder category level should be maintained • The jurisdictional standards should be met, including CBD SAIDI/SAIFI targets and long rural restoration time targets. • The reliability of supply for many CBD customers should be improved.	• Cost increase from current period levels • Many worst served customers reliability would not be addressed and may deteriorate further, including the reliability of some already poorly served regions.

Scenario	Programs	Expected outcome Positive benefit	Negative benefit
		• The average duration of interruptions for many customers supplied from Long Rural feeders should reduce.	
3 **New Value** Maintain reliability + comply with jurisdictional standards + improve worst served customer	• Maintain underlying reliability (continue BAU program) • CBD reliability improvement • Supply restoration time improvement • Low reliability feeders • Regional reliability improvement	• Reliability at network-level and feeder category level should be maintained • The jurisdictional standards should be met, including CBD SAIDI/SAIFI targets and long rural restoration time targets. • The reliability of supply for many CBD customers should be improved. • The average duration of interruptions for many customers supplied from Long Rural feeders should reduce. • Performance to many worst served customers, including vulnerable and life support customer, would improve. • Regional performance in decline would improve.	Cost increase from current period levels

3.3 Overview of the forecasting methodologies

The methodologies used to forecast the Reliability Management Programs fall into two categories:

- Analysis of historical trends – The forecast for the 'maintain program' is developed from a top-down analysis of the historical trend in reliability relative to actual reliability expenditure (excluding expenditure on the current Low Reliability Feeder program). This analysis is performed at the aggregate level (exclusive of MEDs) to determine the likely level of ongoing expenditure required to maintain reliability at historical levels (consistent with the STPIS targets set for the next RCP). As part of this approach, we will assess the historical trends in significant outage causes and related programs[15] and consider the broader expenditure trends of SA Power Networks.
- Detailed review and cost benefit analysis – All other programs are developed from a detailed review of the underlying factors and drivers of the 'identified need' and formal cost-benefit analysis of options developed to address the need.

Key features of the detailed review and cost-benefit analysis, include:

- Historical analysis - Analysis of historical reliability performance to identify worst served customers and customers vulnerable to extended outages, recurrent outage causes affecting these customers, the reliability impact of these outages, and the improvements in reliability achieved through previous reliability projects.
- Options development – Development of a set of options to address specific recurrent outage causes and/or reduce customer numbers interrupted - and/or interruption duration, including the scoping of these options, the development of a cost estimate for the option, and the estimate of the expected improvement in reliability that will be achieved by that option.

[15] For example, this will assess the trend in bat-related outages and the current reliability program to install animal guards.

- Option evaluation – The evaluation of the options using formal cost-benefit analysis techniques to develop a preferred solution and program that maximizes the net-customer benefit of the program.
- STPIS and Opex analysis[16] – The analysis of the STPIS and supply restoration Opex implications of the preferred program to determine the proportion of the program expenditure that could be covered by these mechanisms and the relevant adjustments to the settings of these mechanisms.
- Reconciliation with other programs – The preferred program and benefits are cross-checked with other programs to ensure there is no double counting of program elements and the expected benefits of the program or the other programs have been allowed for.
- Customer Values Research – Willingness-to-pay research with our customers to quantify the value they place on addressing worst served customers in regional areas (ie the value associated with the Low Reliability Feeder Program, Regional Improvement Program and Supply Restoration Time Improvement program). If feasible, an alternative VCR derived through this research will be used as part of the sensitivity analysis, discussed below.

Table 8 outlines the forecasting methodologies used to forecast the Reliability Management Programs.

Table 8: Overview of forecasting approach for each Reliability and Resilience program

Reliability and Resilience Program	Historical analysis	Detailed options development	Cost benefit analysis of options	STPIS and GSL analysis	Willingness-to-pay
Maintain underlying reliability	●				
Low reliability feeders	●	●	●	●	●
CBD reliability improvement	●	●	●	●	
Regional reliability improvement	●	●	●	●	●
Supply restoration time improvement	●	●	●	●	●

3.4 Program options for evaluation

For all programs, other than the Maintain Underlying Program[17], a set of typical 'base' options is developed forming the initial basis of the options development. These options are based on our industry experience of practical solutions that we have successfully applied historically to address similar needs, or that we know have been applied in Australia and internationally.

The 'base' options differ between the programs due to the differing needs and drivers. Table 9 outlines the 'base' options being considered for each program. These 'base' options will be expanded to include other options, if these additional options are considered credible and viable to address the identified customer service need.

Note, these options are not mutually exclusive. It may be that an optimal program will use elements of all available options for different feeders addressed through the program. It may also be that some options can be discounted as non-credible for specific circumstances, based on knowledge of the outages affecting performance for individual feeders. As such, it may be that for specific program elements (eg a recurrent outage or group of outages affecting a feeder) only one or two options will be credible for detailed cost-benefit analysis. These credible options are determined for each program element from a detailed review of

[16] If relevant, the implications of payments under the Guaranteed Service Level (GSL) scheme will also be considered. However, typically, these payments are immaterial on the overall cost-benefit analysis.

[17] Defining options for forecasting purposes is not required for the Maintain Underlying Program, as this uses the historical average expenditure to prepare the forecast expenditure.

the specific outage causes and feasible mitigating network upgrades, and the analysis of their effect on current and future reliability.

Table 9 Overview of forecasting approach for each Reliability and Resilience program

Reliability and Resilience Program	'base' option
Maintain overall underlying reliability	Specific options not evaluated for this program
Low reliability feeders	Options targeted at identified recurrent outage causes or interrupted customers, eg • Lightning proofing sections • Installing covered conductors • Installing mid-line switches and/or adding remote monitoring and control facilities
CBD reliability improvement	Installing switches and network automation facilities
Regional reliability improvement	Options targeted at identified recurrent outage causes or interrupted customers, eg • Lightning proofing sections • Installing covered conductors • Installing mid-line switches and/or adding remote monitoring and control facilities
Supply restoration time improvement	Remote monitoring and control of switches Remote LV outage monitoring

3.5 Program options costs

The capital and operating costs of the options have been estimated and verified using the following methods:

- for options (or option elements) that we have applied during the current RCP, actual costs and work volumes are used to estimate average unit costs and/or rates;
- for other options (or option elements) that are more complex and would be site specific, our experience and knowledge of the likely scope of works, unit costs and rates is used to estimate a reasonable cost of the option for the specific circumstances;
- where necessary, competitive prices are obtained or expert opinion is used to provide a reasonable cost estimate; and
- where relevant, these option costs are escalated to ensure that the costs are all on the same real dollar terms and consistent with the benefits value.

The sources and basis of specific option costs are detailed in the business cases supporting these programs.

3.6 Assessment of program benefits

Quantitative benefits are estimated for the four programs that are aimed at improving supply reliability for our worst served customers (ie CBD improvement program, supply restoration time improvement program, Low Reliability Feeder program, and regional reliability improvement program)[18].

The main program benefits being quantified relate to the improvement in customer supply reliability. The economic value of the improved reliability is calculated via the usual VCR/SAIDI/SAIFI methodology, which is explained in more detail in our Value Framework.

The relevant AER-defined VCR is used for the 'base-line' calculation of these benefits. However, if an alternative VCR is provided from the 'willingness-to-pay' research that we are conducting then this VCR will

[18] The benefits of the 'maintain underlying' program are not formally quantified, as the forecast for this program is prepared via a top-down approach, using historical average expenditure.

be used as part of the sensitivity analysis (discussed further below) and used to inform the preferred scenario that will be included in our Regulatory Proposal.

If considered material on the option evaluation, other benefits may be quantified, most notably:

- avoided network costs achieved by the option;
- the value of improved bushfire risk to customers located in bushfire risk areas, where the solution could reduce fire starts or reduce interruptions during major bushfires.

However, typically, these benefits are only included when they are material and worth the effort to estimate. More usually, it is assumed that these additional benefits are negligible for evaluating an option, to reduce the possibility of overstating the benefits of an option in its evaluation process.

3.7 Evaluation of options – determining preferred solutions

All credible options of all programs, other than the general maintain underlying program, are assessed using detailed cost benefit analysis. This analysis aims to ensure that only elements are included in the program forecasts where it can be demonstrated that the customer benefits achieved by that element will exceed its costs over the life of the investment.

Importantly, this analysis is performed at a granular level to ensure that the overall program should maximise the net-benefits. For example, in the low reliability feeder program, not only are individual feeders and the impact the proposed solution would have on each historical individual interruption evaluated, but possible solutions to specific matters driving the poor performance of that feeder could be separately evaluated.

3.8 Sensitivity studies

Sensitivity analysis are undertaken to test outcomes of the above evaluation process to changes in key inputs. The results of these studies have been used to inform the preferred forecast of the scenarios for discussions during the consumer engagement process.

The input parameters being analysed across all programs are:

- Capital input costs;
- Discount rate – the assumed discount rate;
- Assumed improvement rate of the option (ie assumed reduction in unplanned customer minutes achieved by the option);
- The VCR, including if available, testing the significance of an alternative ‘worst served’ VCR value provided by the willingness-to-pay research that we are currently undertaking with our customers.

3.9 Assessing and quantifying inter-relationships with other programs

As noted above, the Reliability Management Programs have some interrelationships with other programs in our Regulatory Proposal. These relationships cover both the effect on benefits (and underlying risks) achieved by the programs and the works activities that will form the programs.

This relationship is most material for the Replacement Program (ie the repex forecast) and the Bushfire Risk Mitigation and Network Resilience Programs (which form other components of the augex forecast). The following processes have been applied to ensure that these interrelationships are identified, quantified, and allowed for across our proposal:

- where the interaction of risk is anticipated then details of the program and risk impact are fed forward into these programs or fed back into the inter-related program;

- where the work elements could be similar then a reconciliation process is applied to ensure that no double-counting of similar works has occurred.

The greatest interaction between programs is likely to be between the worst served customer programs, addressing regional performance (ie low reliability feeder program, regional reliability improvement program and supply restoration time improvement program) and the Network Resilience Programs, which improve the resilience of customer supplies to extended interruptions due to major weather events. This interaction is because these programs are likely to target similar remote and rural communities.

The options being evaluated to improve network resilience are likely to be different (and be more costly) to those used to improve reliability, listed above. However, the Network Resilience Program has the potential to materially improve the reliability more generally for associated customers, as well as improve the resilience of their supplies to major weather events (ie events that typically result in MEDs). Therefore, the feeders (and associated communities) being addressed through these reliability and resilience programs will be identified and monitored through the forecasting process to ensure benefits of the programs are accounted for and the optimal solution across the programs is determined, accounting for the cost-service outcome our customers prefer[19].

The table below summarises the material interrelationships for each Reliability Management Program with other programs that could be included in the regulatory proposal.

Table 10 Summary of the material interrelationships for each Reliability Management Program

Reliability and Resilience Program	Risk/benefit interaction	Works interaction
Maintain overall underlying performance	• Not material	• Not material
CBD reliability improvement	• Repex - CBD cable replacement	
Supply restoration time improvement	• Network Resilience Programs • Opex– supply restoration cost reduction	• Repex – reclosers • Bushfire risk – protection (recloser) upgrades and customer interruption risk component • Network resilience
Low reliability feeders	• Network Resilience Programs • Repex – overhead insulator replacement, • Bushfire risk	• Repex – overhead insulator replacement, • Bushfire risk- protection (recloser) upgrades and customer interruption risk component • Network resilience
Regional reliability improvement	• Network Resilience Programs • Repex – overhead insulator and replacement, • Bushfire risk	• Repex – overhead insulator replacement, • Bushfire risk - protection (recloser) upgrades and customer interruption risk component • Network resilience

3.10 Individual business cases

A set of business cases will be prepared for the Reliability Management Programs. These documents set out the results of the above forecasting approach for each scenario relevant to that program, including:

[19] For example, the same poor performing feeder could be identified for one of the worst served reliability programs and the network resilience program. Both could have alternative preferred solutions that provide a net-benefit, but it could be expected that the resilience solution (eg a back-up micro-grid or extensive undergrounding) would be significantly more costly, but provide greater overall benefits. In this circumstance, the solution with the greatest net-benefit would be selected, where this aligns with customer preferences on the cost-service trade off.

- the preferred program scope and expenditure forecast;
- the options being evaluated and the basis of their costs and other assumptions;
- the benefits and net benefits associated with each option evaluated;
- the results of the sensitivity studies;
- the reasoning for the preferred options;
- the STPIS, GSL and Opex effects of the preferred options; and
- relevant interactions and interrelationships with other programs.

Two separate business cases will be prepared covering the programs aimed at worst served customers:

- The CBD improvement program addresses needs and customers quite distinct from the other programs aimed at worst served customers, and therefore, the CBD improvement program will have its own business case. This program also more clearly relates to the CBD cable replacement program, which forms part of the repex forecast, and therefore, the interactions with this replacement program will be discussed in that business case.
- The other three programs addressing regional worst served customers (the low reliability feeder program, the regional improvement program and supply restoration time improvement program) all primarily relate to regional performance. There could be some (actual and perceived) cross-over in the customers (or feeders) being addressed through these programs. Therefore, it is preferrable to cover all three programs in a single business case so the relationships between all three programs and their separate and combined effects on future regional performance can be more clearly set out. As noted above, these three programs are also more likely to interact with the Network Resilience Programs, and therefore, the significance of these interactions in selecting the preferred solution for these three reliability programs and their reliability benefits can also be addressed.

In addition, a document setting out the forecast for the 'maintain underlying program' will be prepared. This will not be a formal business case, covering the matters listed above, as these are not applicable to the program and methodology used to prepare its forecast. However, this document will be used to set out the overall historical network reliability performance and reliability expenditure, and explain the estimation of the forecast for this program. It will also be used to set out the rationale for the estimate of the decline in reliability performance associated with the 'do nothing' scenario.

The following table summarizes the three proposed business cases.

Table 11 Summary of business cases being prepared for the Reliability Management Programs

Business case	Programs	Needs addressed	Scenarios covered
Maintain Reliability	Maintain program	Maintain reliability to current period levels	Do nothing Base Case Comply New Value
Worst served customers - CBD reliability	CBD reliability improvement program	Improve the reliability for CBD customers and comply with CBD jurisdictional reliability standards	Comply New Value
Worst served customers - Regional reliability	Supply restoration time improvement program (long rural feeders) Low reliability feeder program	Improve supply restoration times for Rural long feeders and meet jurisdictional restoration time targets. Improve the reliability for other worst served customers, particularly in regional areas.	Comply (supply restoration time improvement program only) New Value (all three programs)

	Regional improvement program	Achieve greater equity for all customers. Improving supplies to vulnerable and 'life support' customers.	