CBD reliability - Business case addendum

2025-30 Revised Regulatory Proposal

Supporting document 5.3.12 - CBD Reliability - Business case addendum

December 2024

Empowering South Australia

Contents

Glossary

Acronym / term	Definition
ABA	Adelaide Business Area
AER	Australian Energy Regulator
Augex	Augmentation expenditure
CAF	Community Advisory Forum
Capex	Capital Expenditure
CBD	Central Business District
EDC	Electricity Distribution Code of South Australia
ESCoSA	Essential Services Commission of South Australia.
HV	High Voltage
kV	Kilo-Volt
LHS	Left Hand Side with reference to graph axis
LV	Low Voltage
NPV	Net Present Value
Opex	Operating Expenditure
PoF	Probability of Failure
Priority cable area	A discreet area of the network containing high-risk cable and for which investment options were considered
RAG	Reset Advisory Group
RCP	Regulatory Control Period
Repex	Replacement Expenditure
RHS	Right Hand Side with reference to graph axis
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
USAIDI	Unplanned System Average Interruption Duration Index
USAIFI	Unplanned System Average Interruption Frequency Index
VCR	Value of Customer Reliability

1 About this document

1.1 Purpose

This document is an addendum to our original business case '5.3.12 Business Case - CBD Reliability - January 2024' included in our Regulatory Proposal submitted to the AER on 31 January 2024 (**Original Proposal**). This document should be read in conjunction with the original business case, which contains background information including further context on the program, including the identified need, the preferences of our customers, and drivers of the program's expenditure.

This business case addendum responds to the Australian Energy Regulator's (**AER**'s) Draft Decision (**Draft Decision**) having not accepted and therefore substituted our proposed forecast capital expenditure (**capex**) for the Central Business District (**CBD**) reliability program, with a lower expenditure forecast (as a placeholder) for the 2025-30 Regulatory Control Period (**RCP**). This addendum addresses the concerns set out in, and that led to, that Draft Decision and contains our revised expenditure forecast as comprising our Revised Proposal.

1.2 Expenditure category

This addendum pertains to our proposed capex and comprises expenditure that is a component to both our forecast network asset augmentation expenditure (**augex**) and network asset replacement expenditure (**repex**). More specifically, it comprises:

- Network capex: replacement expenditure (cables)
- Network capex: augmentation expenditure (automated switches)
- Network capex: augmentation expenditure (feeder topology changes)

All expenditure forecasts outlined in this document are expressed in June $2022 (excluding overheads).

1.3 Related documents

This document should be read in conjunction with the following documents that specifically relate to this program:

- 5.3.12 Business Case: CBD Reliability - January 2024 — our original CBD business case. Further, this case was supported by other key documents including:
  - 5.3.3 Value Framework document January 2024 — describes how we value benefits; and
  - 5.3.2 Repex Forecasting Approach document January 2024 — provides a structural overview of the approaches used to prepare cable replacement forecasts.
- 5.3.12.1 - CBA Template - CBD Reliability - Option 1 - Preferred — Our standardised NPV model used to derive the NPV referenced within this document (Available on request).
- 5.3.12.2 - CBA Template - CBD Reliability - Option 2 — Our standardised NPV model used to derive the NPV referenced within this document (Available on request).
- 5.3.12.3 - CBA Model - CBD Reliability — Our model used to develop programs of various investment options to form options 1 and 2 (Available on request).

2 Executive summary

This business case addendum recommends, as our Revised Proposal, forecast capex of $53.1[1] million to implement a program to improve the reliability service performance of the Adelaide CBD. This expenditure is required to bring performance into line with the jurisdictional reliability service standard set by the Essential Services Commission of South Australia (**ESCoSA**) in the South Australian Electricity Distribution Code (**EDC**).[2] The recommended program comprises of an optimised selection of the various solutions available to us to achieve the need, including:

- repex: replacing 11.4km of CBD high-voltage cable ($30.7 million);
- augex: upgrading the CBD network by installing 35 automated load switches at key CBD locations ($20.7 million), and
- augex: upgrading the CBD network via changes in topology, installing 655m of cable and undertaking changes to feeder tie points ($1.8 million augex)[3].

The business case in our Original Proposal had forecast $78 million capex for the CBD reliability program. This forecast comprised of replacing 23 km of high-voltage cable replacement ($55 million) and installing 39 automated load switches ($23 million).

The AER's Draft Decision accepted the identified need for the program and requested additional data on the challenge that we need to respond to. The program responds to an identified need to improve CBD reliability to bring it into line with the jurisdictional standard, noting that:

- we have failed to meet the CBD reliability standards for System Average Interruption Frequency Index (**SAIFI**) and System Average Interruption Duration Index (**SAIDI**) in multiple reporting periods from 2017/18 to 2023/24;
- in 2024/25, the annual SAIDI target has already been exceeded 4 months into the reporting period;
- the primary driver for the decline in CBD reliability is underground cable failures;
- without additional investment, we forecast to not comply with our targets in the next RCP; and
- investment action is supported by ESCoSA who stated that:

  "The Commission expects SA Power Networks to make sufficient investment to deliver minimum network performance standards for CBD feeders, and that the efficient expenditure required to do so will be included in SA Power Networks' regulatory proposal." [4]

We do not accept the Draft Decision, which substituted our forecast expenditure on the program with a lower forecast of $10.5 million. This substitute forecast was recognised as only a 'placeholder', pending several concerns being addressed in the Revised Proposal, including in relation to:

- the calculation of the baseline level of service - determining the gap to the target service level;
- assumptions on the likelihood of consequence of cable failures – determining forecast risk;
- assumptions on outage duration – determining forecast risk;
- considering an additional investment option that does not hold the CBD network topology fixed; and

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1 All financial figures in this document are presented in millions of dollars ($m) as of June 2022. Values shown may not add to this total due to rounding.

2 This business case scope is limited to the Adelaide Business Area (**ABA**) which is the geographic region shown in Section 5.1 **Error! Reference source not found.**. The ABA is the service standard region as for which the Commission publishes the target that form the identified need that case seeks to address. For the purpose of this document ABA and CBD are used interchangeably.

3 These topology changes form part of automation solutions.

4 ESCoSA, Electricity Distribution Code review - Final Decision - June 2023, pg26.

- considering outage frequency (SAIFI) as well as duration (SAIDI) in the design of the program.

However, we recognise that some of the assumptions that we applied, and the options analysis that we conducted, in our original business case can be improved and made more complete. Therefore, this addendum reflects several revisions to address each specific concern identified in the Draft Decision, as follows:

- **baseline level of service:** recognising the AER's view that an averaging period that is too long (we originally proposed 7 years) will not capture latest practices, we instead applied a shorter averaging period consistent with AER expectations. We have used a 5-year average from 2019/20 to 2023/24, which also aligns to the period the AER uses for setting STPIS targets – this change materially reduced our forecast expenditure due to a reduction in required SAIDI by 2.8 minutes;
- **likelihood of outage assumptions:** we recalibrated the Probability of Failure (**PoF**) for CBD cables using only CBD cable failures that resulted in outages, rendering the Likelihood / Probability of Consequence metric redundant;
- **outage duration and network characteristics:** we updated the average outage duration for 11kV CBD cables to 115 minutes, as this reflects actual data over the 5 year period (2019/20 to 2023/24);
- **options analysis:** we undertook an extensive and location-specific analysis to consider the potential for various network topology solutions alongside cable replacement and feeder automation; and
- **performance measures:** our analysis has now considered SAIDI and SAIFI, ensuring that the forecast expenditure met targets for both metrics.

The revisions that we have made to address the Draft Decision have resulted in our Revised Proposal forecasting capex being $25.2 million lower (32% lower) than our Original Proposal. Our revised forecast of $53.1 million in capex represents a prudent and efficient level of expenditure to address the identified need, on the basis that:

- **achieves compliant target service level –** expenditure on the proposed solutions enables the reliability of the CBD to be brought into line with jurisdictional service standards by the end of the 2025-30 RCP;
- **target service level is aligned to customer preferences** – the forecast expenditure will improve CBD reliability to standard, consistent with the recommendation of our customers given the importance of this network to South Australians;
- **optimised selection of credible solutions –** the investment option recommended in this addendum, selects the most efficient / least cost combination of all credible network solutions to address the identified need, and recommends an optimised mix of: cable replacement (augex), automation (augex), and topology changes (augex);
- **highest NPV of the credible options –** the recommended investment option achieves the least negative result in Net Present Value (**NPV**) terms, noting this is a compliance driven case; and
- **measured approach to address the underlying cause** – the recommended investment option, while it does not overly rely on repex, ensures a reasonable level of repex in order to take measured progress on addressing the key underlying cause of the reliability problem in the CBD, being the need to retire cable assets that are in poor condition.

3 Our Original Proposal

The business case in our Original Proposal recommended $78 million ($2022) in capex comprised of replacing CBD high voltage cable assets ($55 million repex) and installing automated load switches ($23 million augex). This was pursuant to an identified need of improving CBD performance to bring it into compliance with ESCoSA's reliability service standards, and consistent with the preferences of our customers as recommended through our engagement program. Table 1 provides a further breakdown of the options considered in the original business case.

Table 1: Summary of options considered in the original business case

Option	Description
The base case	The base case was a Business-As-Usual (or do-nothing materially different) scenario of keeping expenditure to the level of our expected actual expenditure over the 2020-25 RCP. • Replace 3.1km of cable in the CBD at a cost of $7.5 million • Install 5 automated switches for $3 million. If we continue with this expenditure level; the reliability of the CBD will continue to decrease resulting in failure to meet the network reliability standard targets. For this reason, the base case is not considered credible.
Alternative Options	
Option 1: Cable Replacement	Option 1 was to undertake planned cable replacements to meet the reliability target of 15 SAIDI minutes by 2030. • Replace 33.2km of 11kV cable in the CBD at a cost of $79.6 million • Replace 2km of 33kV cable in the CBD at a cost of $4.8 million.
Option 2: Combined	Option 2 was to undertake planned cable replacement and install automated switches to meet the reliability target of 15 SAIDI minutes by 2030. • Replace 20.9km of 11kV cable in the CBD at a cost of $50.1 million. • Replace 2km of 33kV cable in the CBD at a cost of $4.8 million. • Install 39 automated switches at a cost of $23.4 million.
Option 3: Feeder Automation	Option 3 was to install automated switches to meet the reliability target of 15 SAIDI minutes by 2030. • Install 121 automated switches at a cost of $72.6 million.

The NPV of benefits and costs were calculated for each of the options as shown in Table 2. Option 2 had the highest benefits on a NPV basis (i.e. least negative NPV)[5] and was therefore chosen as the preferred option.

Table 2: Costs, benefits and risks of alternative options over the 40-year period, $m.

Option	Ranking	Costs		Benefits	NPV	Reliability level to be met by 2030
		Capex	Opex			
Option 0 (Base Case)	Not credible	$10.500	-	$11.434	-$5.243	26.6 SAIDI minutes
Option 1 Repex	3	$84.410	-	$64.030	-$55.301	15 SAIDI minutes
Option 2 Combined	1	$78.315	-	$52.575	-$52.664	15 SAIDI minutes
Option 3 Automation	2	$72.606	-	$28.020	-$53.985	15 SAIDI minutes

[5] Consistent with AER guidelines and practice, the choice of least negative NPV is expected for cases pertaining to identified needs that are based on regulatory compliance.

4 How we have revised our approach

The Draft Decision substituted our proposal with an expenditure forecast of $10.5 million, which was $67.5m lower (87% lower) than our initial proposal. The AER accepted the identified need for the program, but its lower substitute forecast was to serve only as a 'placeholder' forecast pending the concerns identified in its Draft Decision being addressed in our Revised Proposal.

This addendum now implements several revisions in response to, and addressing each specific concern identified in the Draft Decision, as summarised in Table 3 and detailed throughout this addendum.

Table 3: Summary of AER considerations and our response in this Revised Proposal.

AER considerations[6]	How we responded
Baseline level of service	
Calculating the baseline reliability performance using a 7-year average (22.1 minute SAIDI) is insufficiently explained, and likely overstates reliability – a 5 year average baseline would likely be a more accurate assessment of performance.	Revised to calculate baseline performance using a 5-year average of the most recent performance from 2019/20 to 2023/24, also aligning to the STPIS target measurement period. This materially reduced the assumed current risk on the network by 2.8 SAIDI and 0.025 SAIFI and therefore also reduced the expenditure forecast.
Likelihood of outage assumptions	
The assumption of a 100% chance of outage in event of a cable failure likely overstates risk and is not supported by actual data which indicates a 64% likelihood.	Re-calibrated our cable PoF rates, using actual data, and only on historical failures that caused a SAIDI and SAIFI impact, negating the need for a likelihood of consequence metric.
Outage duration	
There is a discrepancy in the assumed restoration time for CBD cables (296.82 minutes) compared to the five-year historic average of 112.	Updated the average outage duration for 11kV CBD cables to the most recent 5-year average restoration times for 11kV cables in the CBD from 2019/20 to 2023/24, which resulted in an average of 115 minutes.
Analysis of additional options	
Need to consider additional options by taking a broader system planning perspective and not assuming that the network topology is fixed – topology changes such as additional feeder ties or feeder sections should be considered alongside other options (repex, automation) to demonstrate the most efficient and effective solutions to addressing the need.	Considered options that do not hold the topology of the network as fixed, via a detailed bottom-up analysis, which allowed us to optimise between feeder ties, new feeders, feeder automation and cable replacement solutions. However, in the majority of cases, topology changes necessitated investment in a new substation and this largely rendered these options to not be comparatively cost effective as this addendum demonstrates. Some topology changes are included in automation solutions and some of these are included in the preferred option.
Performance measures	
In addition to the identified SAIDI need, SAIFI performance should also be considered in the options analysis.	Considered both SAIFI and SAIDI performance to ensure both reliability targets are met. When optimising investments to achieve the required SAIDI improvement at least cost, we found no additional investments were required to achieve SAIFI.

6 AER, Draft Decision - Attachment 5 Capital Expenditure, September 2024, pp. 21, 24-25.

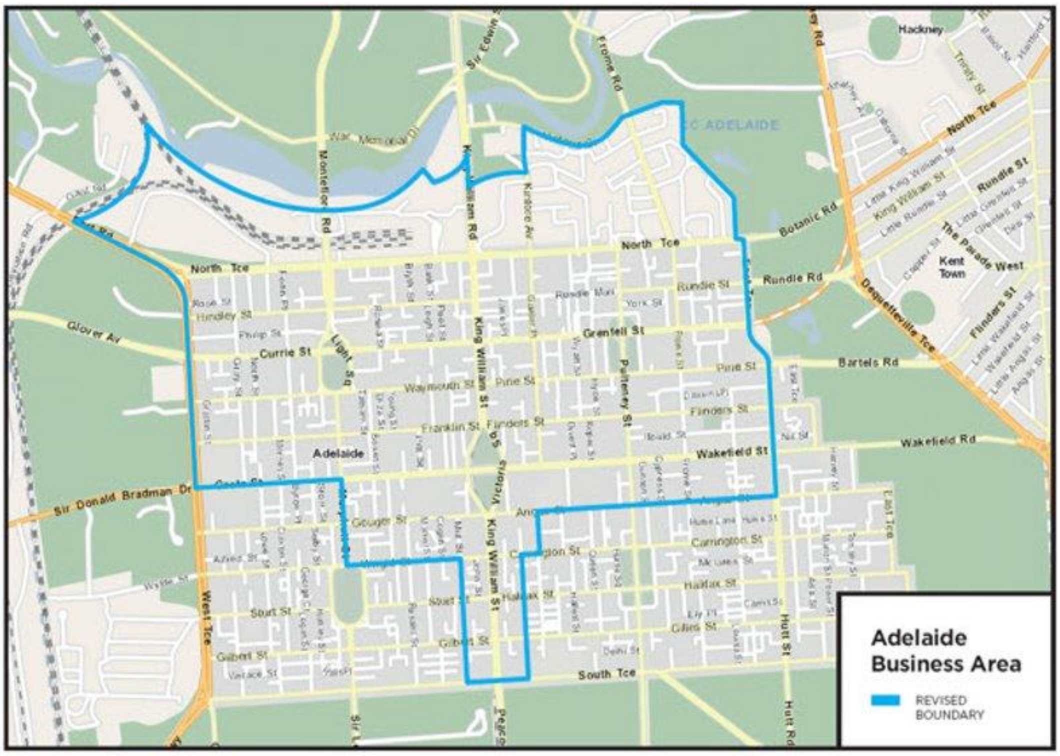
5 The context to the investment need

5.1 The configuration and topology of the Adelaide CBD network

This scope of the CBD reliability program is limited to the Adelaide Business Area (**ABA**) which is the geographic region shown in Figure 1. The ABA is the service standard region for which ESCoSA publishes the target that forms the identified need for this program. Key information on this network is as follows:

- it comprises 33kV, 11kV and Low Voltage networks supplied via four zone substations: Coromandel Place, East Terrace, Hindley Street and Whitmore Square. The 33kV network is supplied via Hindley Street and East Terrace Substations, with one and two 66/33kV transformers at each site respectively;
- the network supplies a total of 12 distribution substations with secondary voltages of 11kV and LV;
- due to their age, the cables on the 33kV network are typically less reliable than 11kV feeders, however, the configuration of the 33kV network ensures that majority of customers are simultaneously connected to at least two 33kV cables, **providing continuous N-1 feeder and transformer redundancy.** As such, although the individual assets on the 33kV network may be less reliable than assets on the 11kV network, the resulting level of network security is significantly higher than the 11kV network. **For this reason, this revised business case focusses on 11kV cables**;
- the 11kV network is supplied via the four CBD zone substation and comprises 111 powerline feeders. Due to physical spatial constraints within the substations and finite space for 11kV circuit breakers, many 11kV feeders are double banked to the same circuit breaker, that is, two independent 11kV feeders are connected to a shared circuit breaker. If a fault occurs on one feeder, the shared circuit breaker will operate to isolate the fault, resulting in both double banked feeders experiencing an outage; and
- regardless, **every 11kV CBD feeder has non-continuous feeder N-1 redundant capacity.** Once a fault is located, switching occurs to isolate the fault and restore supply, ensuring sufficient flexibility in the network so that the fault does not have to be repaired prior to customers' supply being restored.

Figure 1: Adelaide Business Area



5.2 Our performance to date

We have obligations to maintain the safety and reliability of the network. The network reliability standard targets are set by ESCoSA who affirmed the following targets in its EDC Review Final Decision (June 2023) for the 2025-2030 period:

- the Unplanned System Average Interruption Frequency Index **(USAIFI)** target of 0.15 interruptions.
- The Unplanned System Average Interruption Duration Index **(USAIDI)** target of 15 minutes[7].

Figure 2 shows that the SAIFI target of 0.15 interruptions was not met in the 2017/18, 2019/20, 2020/21, 2021/22, and 2022/23 reporting periods. Based on 4 months of performance from 1 July 2024 to 31 October 2024, with 0.144 interruptions recorded, it is very likely the target will also be exceeded in the 2024/25 reporting period.

7 For the purpose of this document, when referring to USAIDI and USAIFI, the terms SAIDI and SAIFI are used.

Figure 2: SAIFI performance in CBD

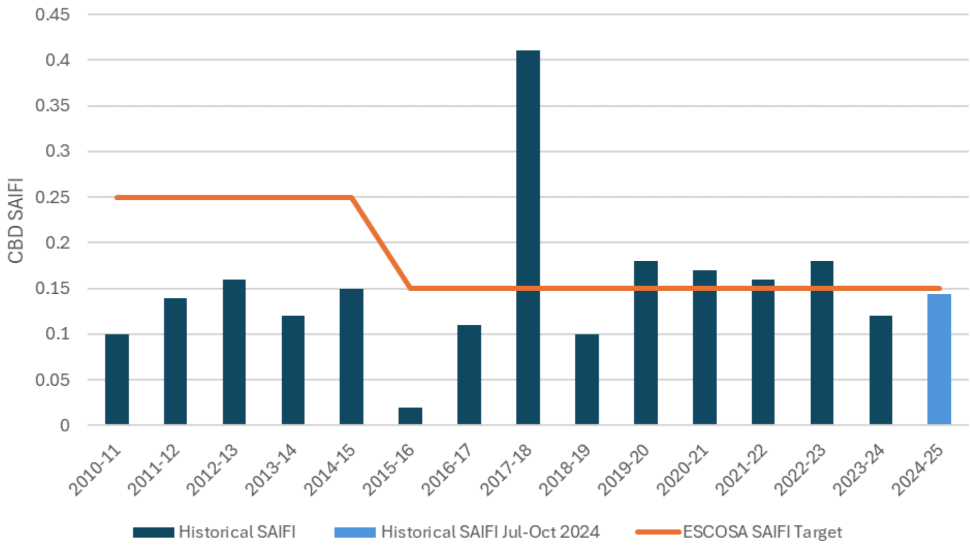
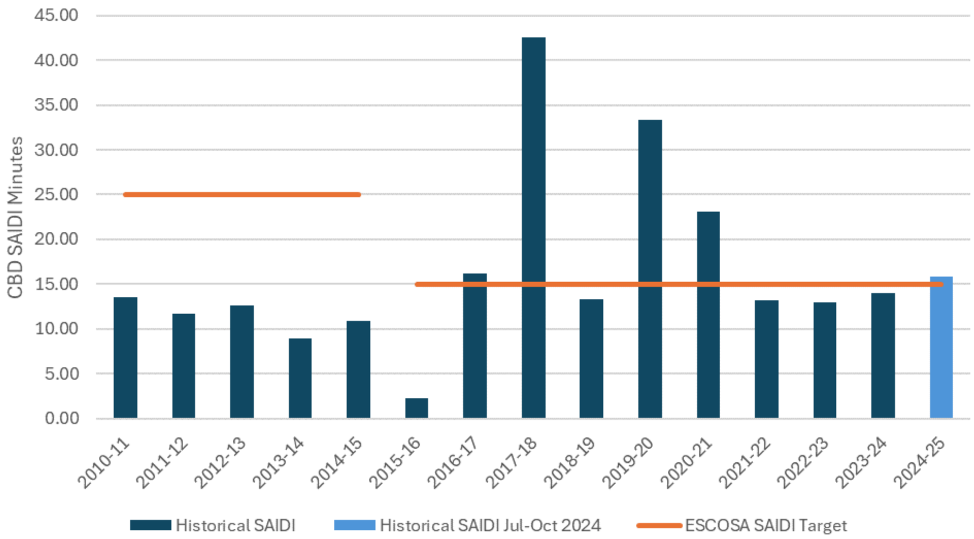


Figure 3 shows that the SAIDI target of 15 minutes was not met in the 2016/17, 2017/18, 2019/20, and 2020/21 regulatory years. The target has already been exceeded in the current 2024/25 reporting period, with 15.9 minutes recorded in the 4 months from 1 July 2024 to 31 October 2024.

Figure 3: SAIDI performance in CBD



5.3 The drivers for change

The driver for change in the CBD is the failure to meet SAIFI and SAIDI reliability targets, caused by the ongoing degradation in performance. A significant driver behind the degradation in the performance of the CBD network is the occurrence of cable faults on aged, poor-condition high voltage cables. This is evident in the contribution to SAIDI and SAIFI performance over the 2019/24 periods, as shown in Figure 4 and Figure 5 below.

Figure 4: Contribution to SAIDI by outage cause (from July 2019 – June 2024)

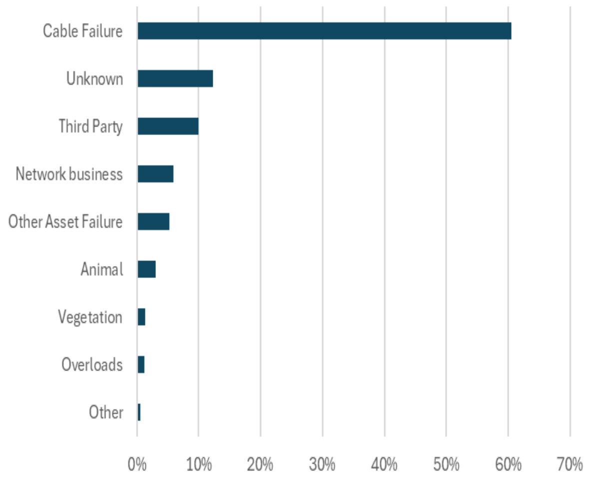
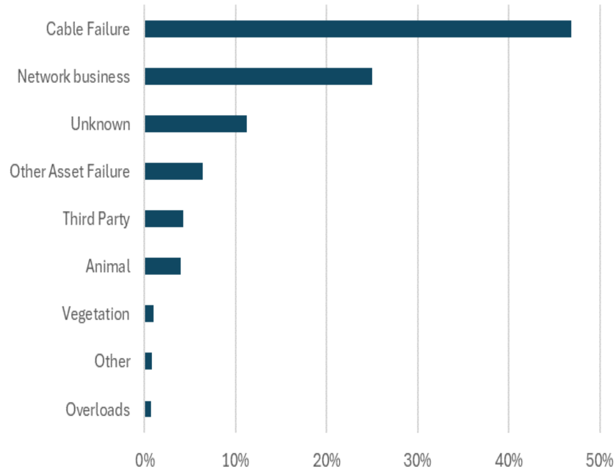


Figure 5: Contribution to SAIFI by outage cause (from July 2019 – June 2024)



The condition of the CBD HV cable network is deteriorating

We operate one of the oldest electricity distribution networks in Australia, with much of the infrastructure constructed in the 1950s and 1960s. **Error! Reference source not found.** illustrates the age profile of CBD cables, showing that most of the 33kV cables have been in service for over 60 years. The 11kV cables, which make up the majority of the network, have largely been in service between 40 and 70 years. With a technical design life of 30-40 years, a significant proportion of these cables have now exceeded their intended lifespan

Figure 6: CBD Cable Age (as of 2023)

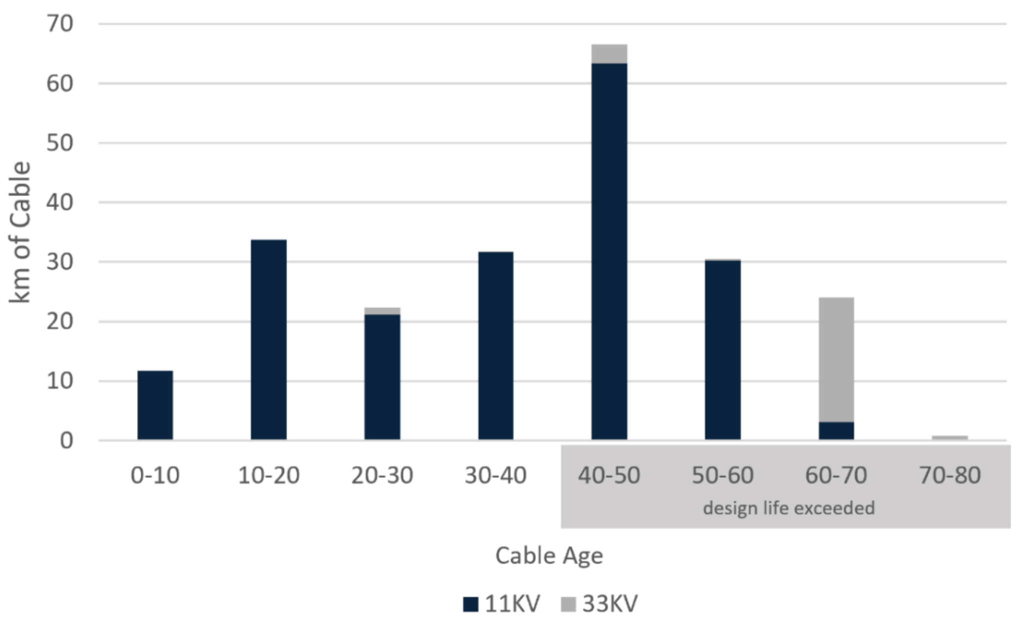
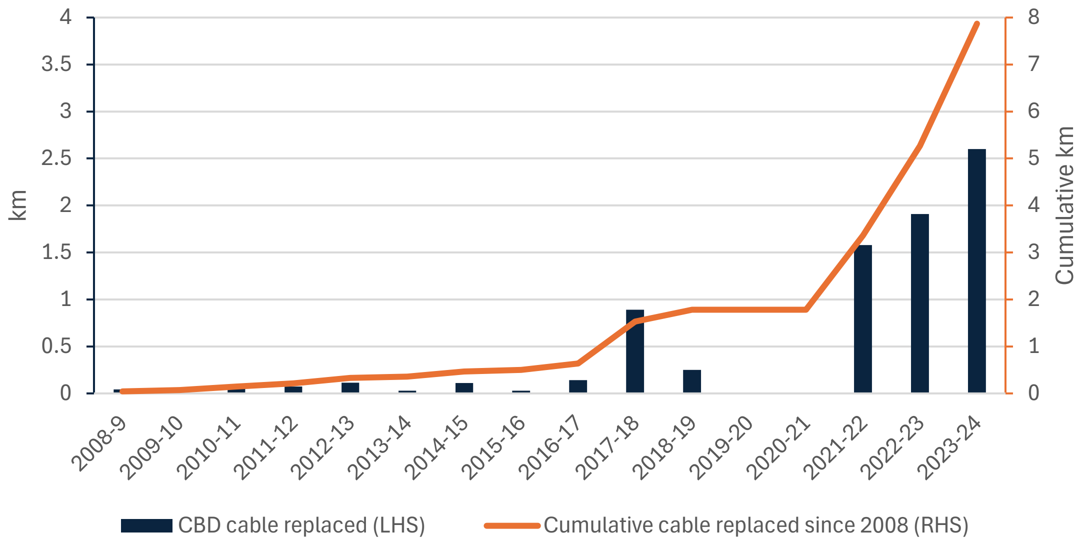


Figure 7 shows the historical HV cable replacement for the CBD, where only 7.9km (~4.5 percent) of cable has been replaced between 2008 to 2024. The replacement rate over the past 15 years is insufficient to maintain the network's condition in the long term; at this pace, it would take over 350 years to replace all cables.

Figure 7: Historical CBD cable replacement rates



The current service level performance of the CBD network does not comply with jurisdictional standards

ESCoSA has set specific reliability performance targets for the Adelaide CBD feeders. In recognition of the significant commercial, residential, cultural and entertainment developments within the CBD, targets for CBD feeders require better reliability than targets for other parts of the network. Table 4 summarises the targets.

Table 4: Electricity Distribution Code reliability targets

	CBD feeders	Urban feeders	Rural Short feeders	Rural long feeders
SAIDI Targets (average minutes off supply per customer per annum)	**15**	110	200	290
SAIFI Targets (average number of supply interruptions per customer per annum)	**0.15**	1.15	1.65	1.75

ESCoSA reviewed the current EDC and made a Final Decision in June 2023 on changes that will apply from 1 July 2025. The Final Decision retained reliability performance targets for CBD feeders at their current levels. ESCoSA stated the following in its EDC Review, final decision June 2023:

> *"The Commission expects SA Power Networks to make sufficient investment to deliver minimum network performance standards for CBD feeders, and that the efficient expenditure required to do so will be included in SA Power Networks' regulatory proposal….*
>
> *…If a case arises where minimum network performance standards are not satisfied, the Commission will consider regulatory intervention having regard to matters such as the statutory framework, relevant licence and code conditions, the circumstances of the event and the actions taken by SA Power Networks (see the terms of the Commission's Enforcement Policy for further information)."*[8]

[8] ESCoSA, *Electricity Distribution Code review - Final Decision*, June 2023, p. 26

The gap in required service levels will worsen over the regulatory period if action is not taken

As shown previously in Figure 2 and Figure 3, we have consistently failed to meet the EDC SAIFI and SAIDI targets for the CBD. We forecast that unless targeted investment in the CBD is undertaken, that the gap between service performance and our target service level (to comply with standards) will continue to widen over the 2025-30 RCP. This is despite the fact that the separate augex program of 'Maintaining Underlying Reliability Performance' will aim to contain the drivers affecting CBD reliability performance that do not arise from asset condition (e.g. third-party interference, animals inference, weather).

To forecast changes in reliability for the 2025-30 RCP, we used our 'Risk Cost Model' that is the basis of our modelled network asset repex, which highlights the impact of continued cable aging in the CBD.

Our forecasts indicate that, without additional intervention, SAIDI performance will degrade to 20.88 minutes and SAIFI to 0.18 by the end of the 2025-30 RCP, as described in Section 6.4.3 of this document. Figure 8 and Figure 9 illustrate these projections.

Figure 8: CBD SAIDI Forecast

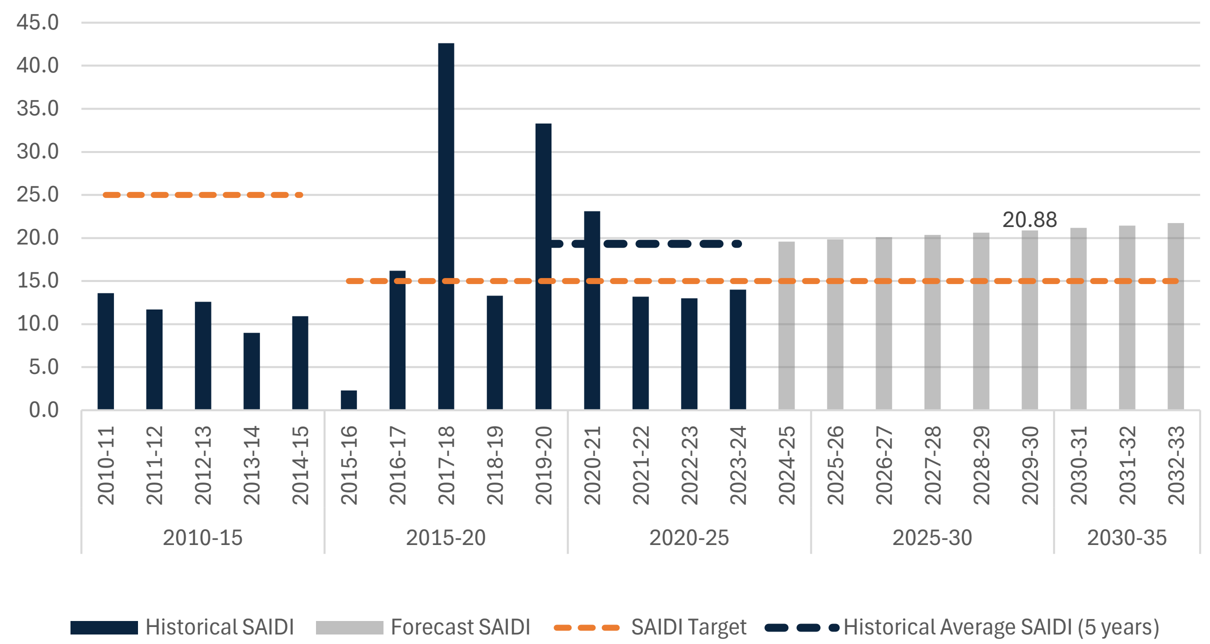
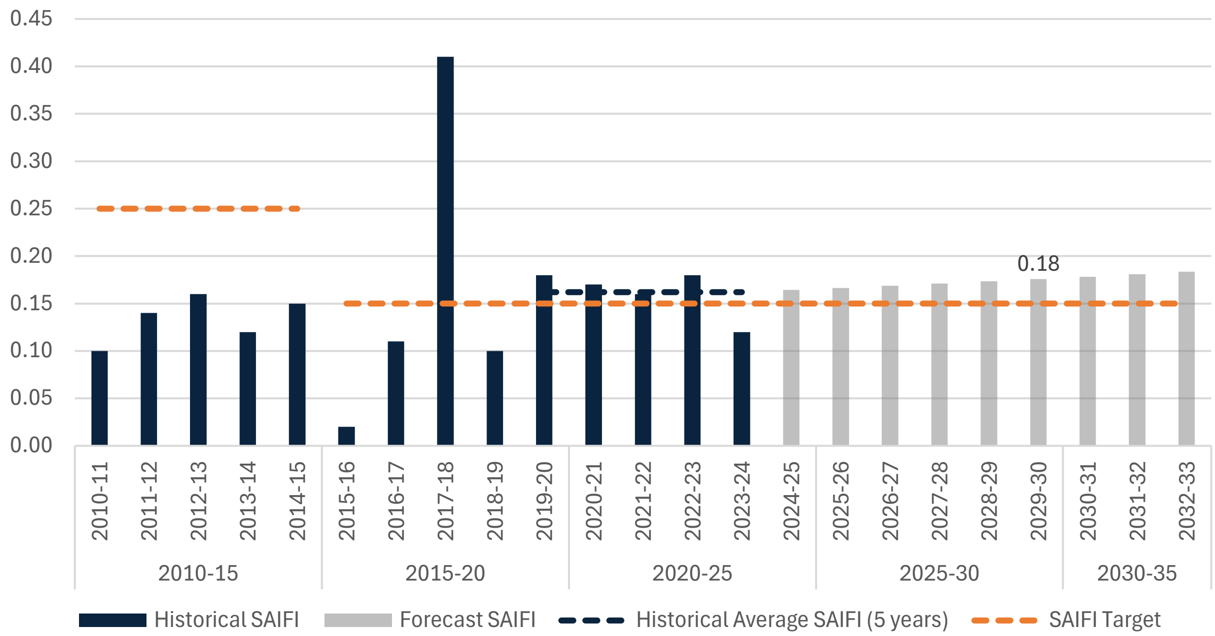


Figure 9: CBD SAIFI Forecast



5.4 The identified need

This program responds to an identified need that the Draft Decision has accepted and therefore remains unchanged from our original business case. That is, the program responds to the need to:

- prudently and efficiently comply with applicable regulatory obligations / requirements,[9] in this case with specific reference to the service standard target set by ESCoSA in the EDC in relation to Adelaide CBD feeders;[10] and
- respond to customers' concerns,[11] identified through our consumer and stakeholder engagement process, regarding their explicit service level recommendation that we invest sufficiently to bring reliability performance in the Adelaide CBD into line with our network reliability service standard target over the 2025-30 RCP.

5.5 The preferences of our customers

We have continued our ongoing engagement with our Community Advisory Forum (**CAF**) and Reset Advisory Group (**RAG**) which is a sub-group of our CAF, subsequent to our Original Proposal and the Draft Decision. No new information has been identified to suggest any change in the preferences of our customers with respect to the need that the CBD reliability program responds to. That is, the service outcome preferences of our customers are to ensure that:

- the reliability of the CBD can be improved to bring it into line / compliant with the jurisdictional service standard; and
- to ensure that the forecast expenditure to achieve this outcome is efficient.

9 This is pursuant to Clause 6.5.7(a)(2) of the NER, which requires expenditure in order to comply with all appliable regulatory obligations or requirements associated with the provision of Standard Control Services

10 SA Power Networks is required by the EDC to use its best endeavours to achieve minimum network reliability targets during each and every regulatory year. For the Adelaide CBD feeders, the target has been set at 15 minutes (average minutes off supply per customer per annum) in relation to the duration of unplanned supply interruptions (excluding Major Event Days). ESCOSA, Electricity Distribution Code (EDC), Version EDC/14, 1 July 2025, p.8

11 This is pursuant to Clause 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.

6 Revised proposal

6.1 We have developed an optimised option

As in section 3, our original business case considered three investment options to meet the identified need:

- **option 1**: **cable replacement only** - forecasting $84.4 million by only replacing ageing cables;
- **option 2**: **cable replacement and automation** - (previously recommended) forecasting $54.9m in cable replacement and $23.4m of automated switch installation; and
- **option 3**: **automation only** - forecasting $72.6m to install automated switches to defer cable replacements.

In this business case addendum, we have applied a detailed, location-specific analysis that does not hold the topology of the network as fixed and incorporates the AER's feedback on modelling inputs and assumptions. This has enabled us to provide an option which considers, cable replacement, automation and topology changes and optimises these investments to achieve least cost to compliance. As a result of this refined analysis, we present two options:

- **option 1 –** an optimised suite of investments which includes cable replacement, automation and topology changes; and
- **option 2** - which includes constructing a new substation in the CBD to enable new feeder topology solutions, along with cable replacement, feeder automation, and feeder ties.

6.2 We have revised key underlying assumptions to address AER concerns

In this section, we outline and address each concern identified in the Draft Decision regarding the CBD reliability case. We also explain how this feedback has been incorporated into risk-cost modelling and location specific analysis to develop our updated options.

6.2.1 Assumed outage duration times

The Draft Decision identified concerns with our assumed outage duration within the risk-cost model, particularly as it pertained to CBD reliability. We accept that our outage duration assumptions could be improved to more reasonably reflect actual data. Therefore, in response to the Draft Decision we have:

- accepted that assumptions on outage duration better reflect customer experience, and incorporate more recent practices on the network, when calibrated using the most recent five years of performance data and segmented by voltage characteristics within the CBD;
- re-assessed the average outage duration experienced by customers due to failures on the 11kV network in the CBD; and
- using a five-year average from 2019/20 to 2023/24, we calculated an updated average outage duration of 115 minutes which we have used within our updated modelling.

6.2.2 Assumed probability of failure and likelihood of consequence

The Draft Decision identified concerns with our assumption on the likelihood of an outage upon the failure of a CBD cable asset (likelihood of consequence) used in the risk-cost model were overstated, particularly the reliability risk assessment for HV underground cables in the CBD.

We accept that our likelihood of consequence should be better calibrated to our historic data. Therefore, in response to the Draft Decision we have:

- analysed cable failures over the five-year period from 2019/20 to 2023/24, as this suitably reflects current practices and data reasonable as a basis for forecasting needs and shows a consistent approach to data usage across our network expenditures; and
- recalibrated our PoF for cables based solely on failures that led to an outage in our historical STPIS performance data. This adjustment effectively embeds the likelihood of consequence (i.e outages) within a lower PoF assigned to the cables.

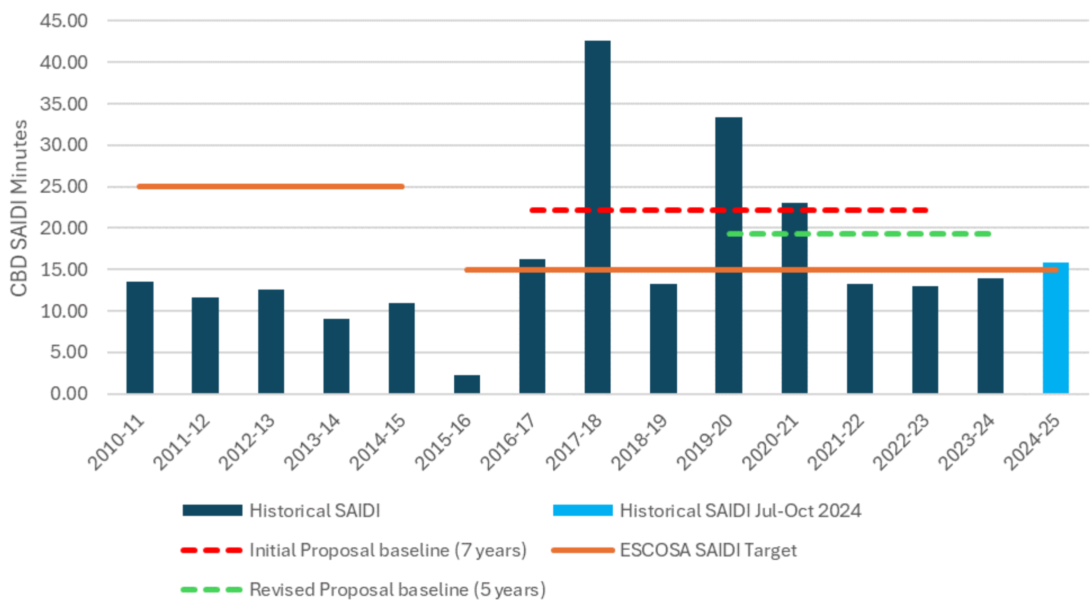
6.3 The baseline level of service has been aligned to more recent performance

The Draft Decision identified a concern that our calculated baseline level of SAIDI performance was unreasonably high, overstating the gap versus the target level of compliant service performance – mainly by having been based on a 7-year average of SAIDI (yielding 22.1 minutes) rather than a shorter averaging period of 5-years. We accept that our calculated baseline service level can be improved to better reflect recent customer experience. Therefore, in response to the Draft Decision we have undertaken the following:

- we adopted a shorter, 5-year average baseline for SAIDI and SAIFI performance;
- as performance data for 2023/24 is now available, we took account of our most updated data at the time of this Revised Proposal, and adopted a 5-year average over the period 2019/20 to 2023/24 – this yields a baseline of 19.3 minutes per year;
- this most recent 5-year averaging period takes reasonable account of needing to:
  - reflect the practices that we have been recently employing to manage the CBD network;
  - align consistently to the period over which the AER sets the STPIS targets;
  - align to period which our model was calibrated for PoF and outage duration; and
  - align to the service performance measurement period we are now using elsewhere in other business case addendums for our Revised Proposal (e.g. in relation to the ‘5.9.3 Maintain Underlying Reliability Program’ and the ‘5.3.1 network asset replacement expenditure’).

The initial and revised baselines are shown in Figure 10 along with historical SAIDI performance. We consider that our 5-year baseline **reflects a conservative approach that will likely understate the reliability risk** - it excludes the significant contribution to SAIDI that occurred in 2017/18, and excludes the first 4 months of the 2024/25 year which indicate that we are on track to again significantly not comply with the target.

Figure 10: CBD Baseline SAIDI



6.4 We have now assessed new investment options

6.4.1 Our options consider topology-based solutions

The Draft Decision identified a key concern that our options analysis did not sufficiently consider alternatives, principally an additional solution to address the identified need via changes to the CBD network's topology (e.g. additional feeder ties or feeder sections) either as a standalone or a blended approach with other solutions, to determine if this would result in a lower expenditure forecast. We accept that our original business case did not effectively consider this additional solution. Therefore, to address the Draft Decision's concerns we have implemented significant and more detailed analysis as follows:

- to identify options to change the topology of the CBD network, we undertook a much more granular and location specific analysis of the CBD network to identify the most effective / efficient solutions at each location;
- this location specific analysis, aiming to identify topology change solutions, also resulted in refinement to our existing solutions of cable replacement and feeder automation, as we gained a greater understanding of the costs and benefits associated with all solutions;
- the additional topology change solutions have been assessed against cable replacement and feeder automation solutions to form investment options that provide the highest SAIDI reduction per dollar spent, and this analysis found that:
    - the majority of topology change solutions depended on the construction of a costly new CBD substation to enable the use of new feeder solutions, which thereby rendered these solutions to not be viable and credible solutions when compared to the effectiveness and efficiency of cable replacement and automation;
    - although there were 2 high efficiency topology change solutions identified that did not depend on a new substation, automation solutions were selected in preference to these because automation removed a larger quantity of SAIDI at a more efficient rate when compared to the less efficient investments that would otherwise need to be selected in other priority cable areas;[12]
    - <u>6 feeder automation solutions chosen include topology changes</u> which involves installing cables (655m) to bring in new feeder ties into the automated switches; and
    - as a comparator, we also considered an additional option which includes the construction of a new CBD substation to enable the use of new feeder solutions together with cable replacement and feeder automation – this is 'option 2' in this addendum.

This addendum **<u>recommends that 'option 1'</u>** is the most prudent and efficient investment option relative to alternatives we considered in this case, comprising of: 'cable replacement', 'feeder automation', and 'limited topology change solutions'.

6.4.2 Our options consider SAIFI performance

The Draft Decision identified a concern that in addition to the identified need for SAIDI, the impact of cable failure on SAIFI performance should also be considered in the options analysis. We accept that our original business case may have provided insufficient information on our consideration of SAIFI. Therefore, in response to the Draft Decision we have:

- explained that when we optimised sets of cable replacement, feeder automation and topology solutions to form our revised investment options, we sought to achieve SAIDI compliance at least cost and also checked if any additional investment was required to achieve the SAIFI target; and
- our analysis found that the SAIFI target was achieved without the need for additional expenditure.

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[12] This is further explained in section 6.4.3 Step 7.

6.4.3 Our method for forecasting expenditure

To forecast the required expenditure to meet the identified need, we undertook the steps summarised in **Error! Reference source not found.**1 and explained in further detail under the headings in this section.

Figure 11: CBD expenditure forecasting process

Step 1 Baseline performance	• Baseline performance is calculated from the past 5 years of SAIDI and SAIFI performance.
Step 2 Forecast Asset risk	• The probability of failure over time for each CBD cable is calculated by analysing failure, attribute and geospatial data.
Step 3 Improvement required	• SAIDI and SAIFI drop required in the year 2029-30 to meet the targets is calculated.
Step 4 Priority areas for analysis	• Priority areas selected for detailed analysis of investment options.
Step 5 Investment options	• Detailed analysis to determine investment options including cable replacement, automation and topology changes.
Step 6 Optimisation of each area	• Benefits and costs calculated for each option and the most cost-efficient option selected.
Step 7 Optimised program	• The minimum number of optimised investment options are chosen to meet the identified need.

Step 1: Understand the baseline SAIFI and SAIDI

The first step required the understanding of current CBD SAIDI and SAIFI performance, referred to throughout this document as baseline SAIDI and SAIFI performance. Baseline SAIDI and SAIFI performance was calculated by measuring average performance in previous years. As discussed in section 6.3, we adopted the AER's feedback and have used a 5-year averaging period across the most recent annual data, which is the 2019/20 to 2023/24 period.

Step 2: Forecast asset risk

With current SAIDI and SAIFI performance established, we sought to understand what sort of SAIDI and SAIFI performance we can expect by the end of the 2025-30 RCP. To do so required understanding how CBD related reliability risks may change over the RCP.

As previously described in section 5.3, a significant driver of the degradation in performance is the occurrence of cable faults on aged, poor-condition high voltage cables. Forecasting the failure rate for cable sections in the CBD is a key input into understanding the escalation of reliability risk in the CBD across the 2025-30 RCP, as these failures contribute to the overall SAIDI and SAIFI performance throughout the period.

We forecast changes in 11kV cable risk using advanced modelling techniques previously developed by Fraser Nash to estimate the failure rate for each cable section.[13] This methodology incorporated available asset information[14], geospatial data, and failure history to determine a set of features representative of failure contributing factors. This was then used to calculate a health index for each cable section. Because asset age

[13] Frazer-Nash, CBD Cable Management Strategy Phase 2 Report (in confidence).

[14] Includes cable type and asset age.

alone has proven to be an unreliable indicator for asset condition, a 'conditional age'[15] was calculated by combining true age and the health index. When 'conditional age' was related to failure data, a failure rate was able to be calculated for each cable section. This is a robust approach and incorporates the AER's feedback on the probability of consequence and asset voltage type as described in section 6.2.2.

Step 3: Calculate the target service level improvement required to achieve compliance

SAIDI and SAIFI from other outage causes besides cable failures were assumed to be held constant throughout the next RCP as a result of the separate augex 'Maintain Underlying Reliability Performance' program. However, that program does not maintain reliability in response to condition related asset failures. The risk-cost models forecasts cable failure rate data to determine how CBD SAIFI and SAIDI performance may alter from baseline performance by the end of the next RCP.

The risk-cost models failure rate data for cables was calibrated to match the 5-year average baseline SAIDI and SAIFI performance across the 2019/20 to 2023/24 period. Using known customer number data and an assumed 115-minute average outage duration the SAIDI and SAIFI forecast was then calculated. The resultant SAIDI and SAIFI forecast is shown in Figure 12 and Figure 13 below.

Figure 12: Historical and forecast SAIFI performance in CBD

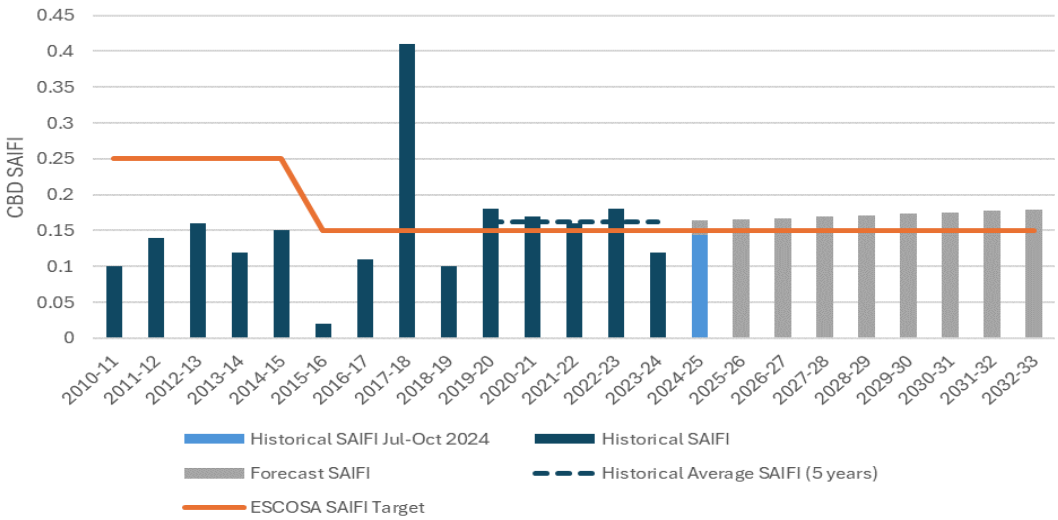
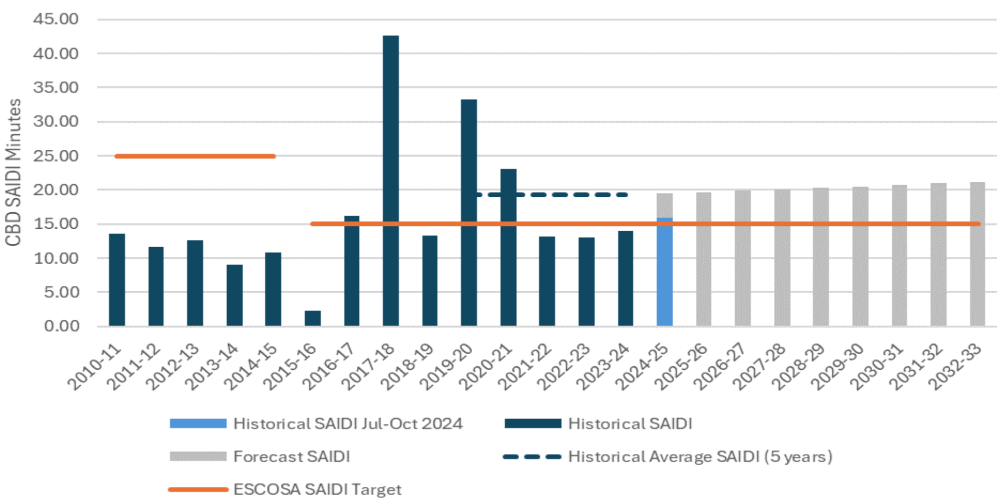


Figure 13: Historical and forecast SAIDI performance in CBD



[15] Conditional age is determined by adjusting the calendar age of an asset to be commensurate with its condition.

A variable that affects the magnitude of this increase in future years is the outage duration value that is used for cable faults. As previously described in section 6.2.1, the most recent 5-year average restoration time from 2019/20 to 2023/24 of 115 minutes has been used.

To calculate the service level improvement required to achieve EDC compliance by the end 2029/30 we assessed the difference between forecast SAIDI and SAIFI performance and the target SAIDI and SAIFI levels and identified the following required improvements to achieve compliance:

- a SAIDI reduction of 5.88 minutes; and
- a SAIFI reduction of 0.0234 interruptions.

As we cannot guarantee that our forecast improvement will eventuate, we have included a small contingency (about 2%) in the required improvement to achieve compliance with the CBD feeder category 15-minute SAIDI target. Consequently, have allowed an improvement of 5.98 minutes instead of 5.88 minutes.

Step 4: Select priority cable areas as candidates for investment solution intervention

This step involved identifying priority high-risk cable areas where investment solutions could be put in place to contribute to the reduction of forecast SAIDI and SAIFI. The locations and topology of the selected high-risk cables are assessed to identify areas that may be addressed collectively, referred to as “priority cable areas” [16].

We identified 59 priority cable areas which represents ~82% of the 11kV feeders in the ABA. To ensure that the analysis was not favouring a particular type of investment, priority cable areas were selected from the following:

- those most likely to give high cable replacement reliability improvement per dollar spent. This was done by choosing areas that had a significant length of cable classified as high SAIDI impact per unit length; and
- those most likely to give high automation or topology reliability improvements per dollar spent. This was done by choosing areas that are forecast to have a high SAIDI impact across the whole area.

Step 5: Identify the credible investment solution to assess

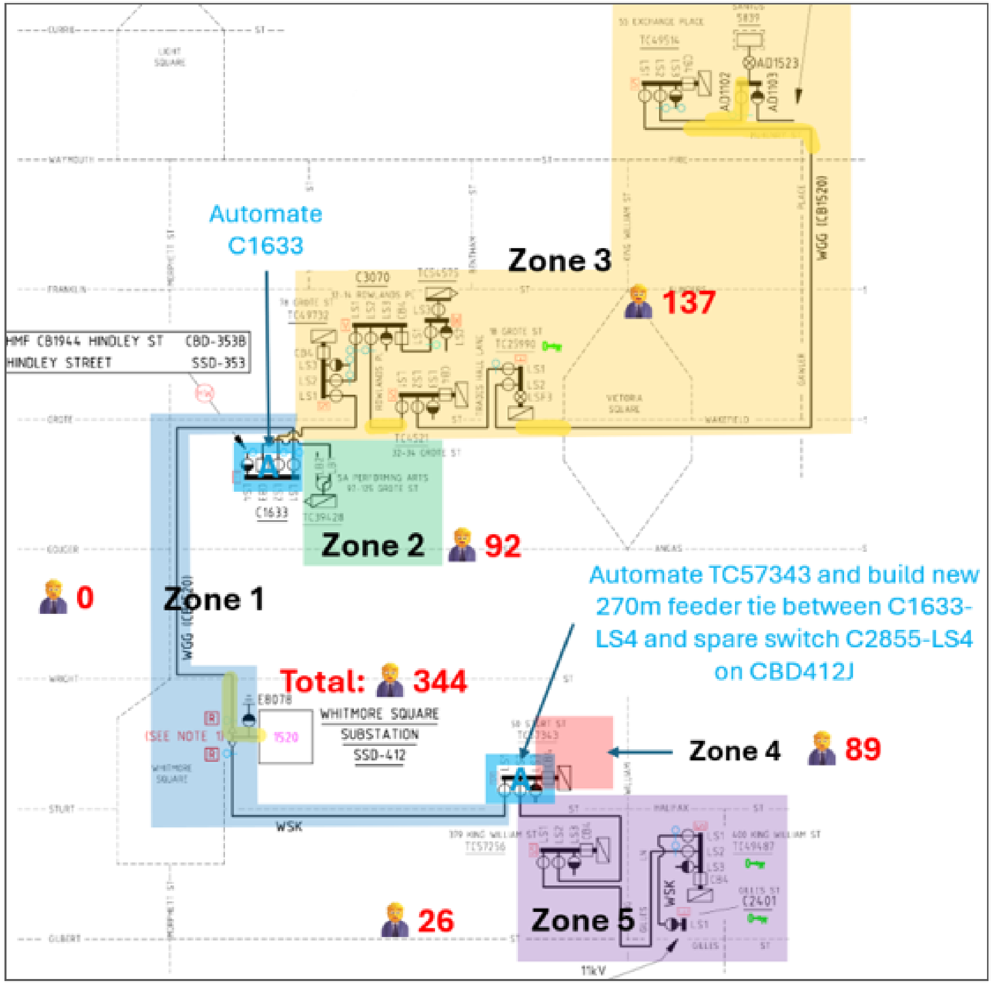
This step identified potential investments other than cable replacement such as feeder automation and topology solutions for each priority cable area to reduce the reliability risk. For each of the priority cable areas identified in step 4, high-risk cables were highlighted on feeder plans which network planning engineers used to undertake detailed desktop analysis of how reliability could be improved by investments other than cable replacement (repex) such as augex via automation and topology change options. This analysis produced the following for each investment option:

- a scope of augmentation works including the number of automation switches, the metres of cable, the feeder tie changes and, in some cases, the installation of a new feeder from a new substation. This information was used to estimate the cost of each investment option;
- a detailed diagram showing how the automation and topology changes would break the priority cable area into the zones and customer numbers in which an outage would impact. With our geospatial information system, this zonal diagram was manually encoded into a database of cables by investment option and zone. This detailed zonal analysis allowed the benefits to be calculated relative to the existing topology of the priority cable area. An example of a zonal diagram for a priority cable area detailing automation and topology investments is shown in Figure 14; and
- a list of transformers in each zone and the customer numbers being supplied by each transformer.

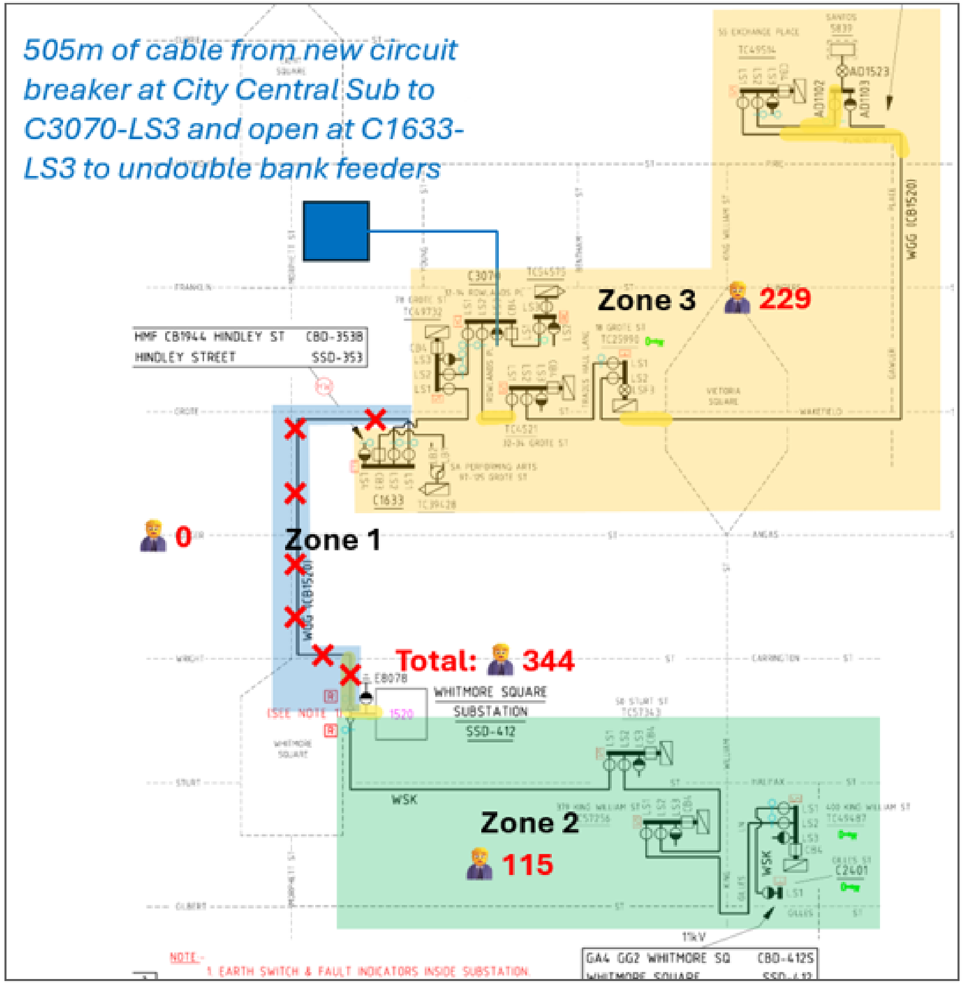
16 Priority cable areas are mostly aligned to feeders.

Figure 14: Priority cable area zonal analysis example

Automation and topology option



Topology option involving a new substation



In undertaking this analysis, the following was considered:

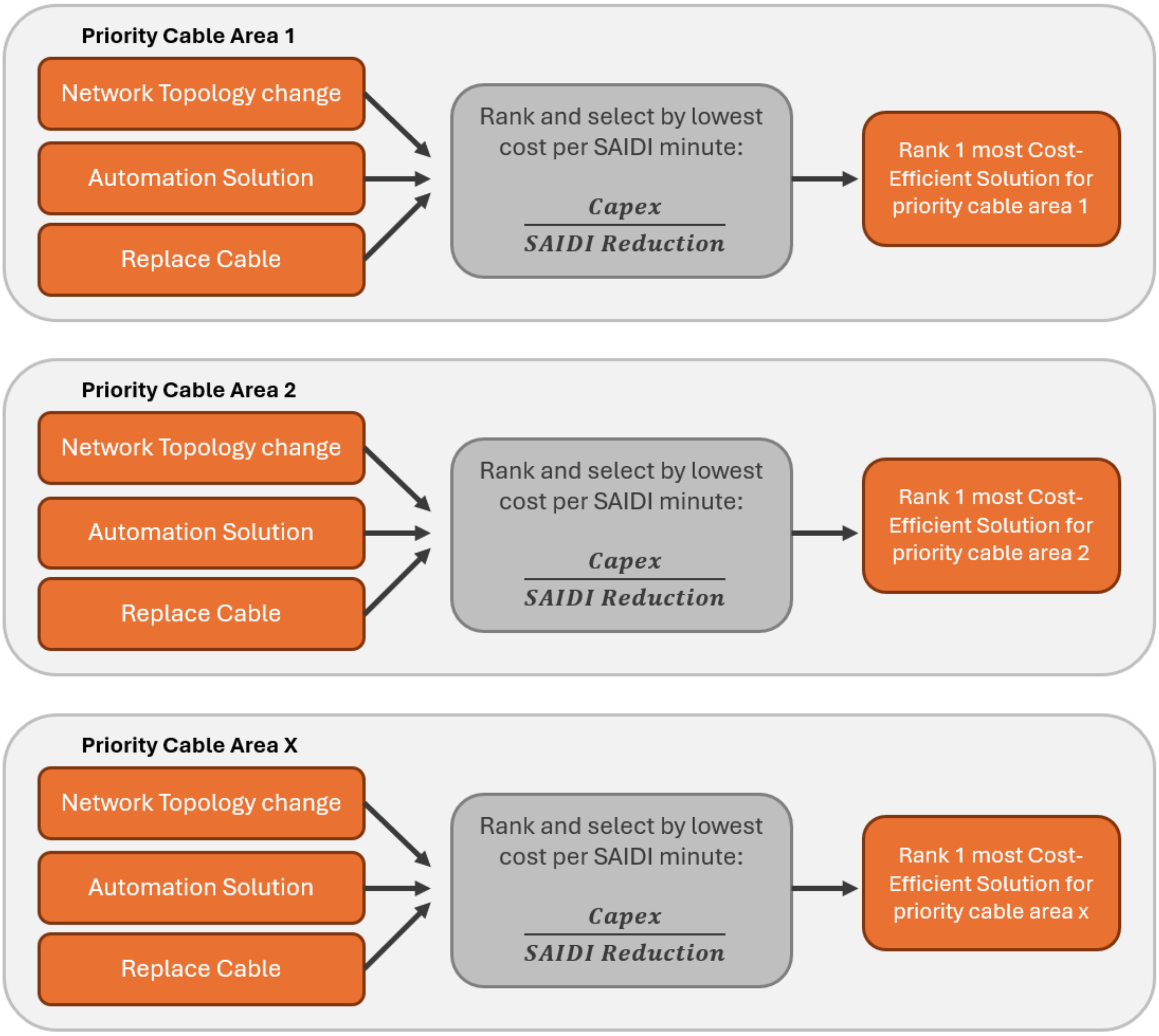
- feeder automation already extant on the network was utilised in developing automation solution;
- running new cable as part of an automation option to bring in a new tie from nearby feeders thereby extending the benefits that can be gained from automation;
- running additional new feeders from existing CBD zone substations was determined to be technically infeasible due to lack of spare circuit breakers and limit physical space to extend 11kV switchboards while maintaining required clearances around switchgear. Additionally, due to finite space, there are civil construction challenges around the ability to get new cables out of existing substations; and
- therefore, to ensure all options were considered, the option of establishing a new CBD substation to accommodate new feeders was explored:
    - a new substation was assumed to be located at Eliza Street - this location was chosen as a land parcel was purchased here in anticipation of a future 5th CBD zone substation and because it is located between three of the four existing zone substations, making it a prime location to build new feeders to become the new primary supply to parts of existing feeders.

Step 6 Optimisation of investments within each priority cable area

This step determined which investment option within a priority cable area was the most cost efficient at providing a SAIDI reduction:

- each priority cable area typically comprised of three potential investments solutions being cable replacement, feeder automation and topology changes;
- investments in cable replacement, topology, and automation are interconnected. Investing in one affects the benefits that may realised from others. For example, the benefits of cable replacement would be reduced if feeder automation was also in place. To avoid overlapping benefits and facilitate a fair comparison of options, we treated solutions for each problem cable area as mutually exclusive. Therefore, for each problem cable area we allowed for the selection of only one investment; and
- the cost per minute of SAIDI benefit for each investment solution was calculated to determine which investment solution reduced the SAIDI in the most cost-efficient manner. This process was applied across all priority cable areas as shown in Figure 15. The result of this process was a ranked set of investment solutions for each priority cable area.

Figure 15: optimisation process for within priority cable areas



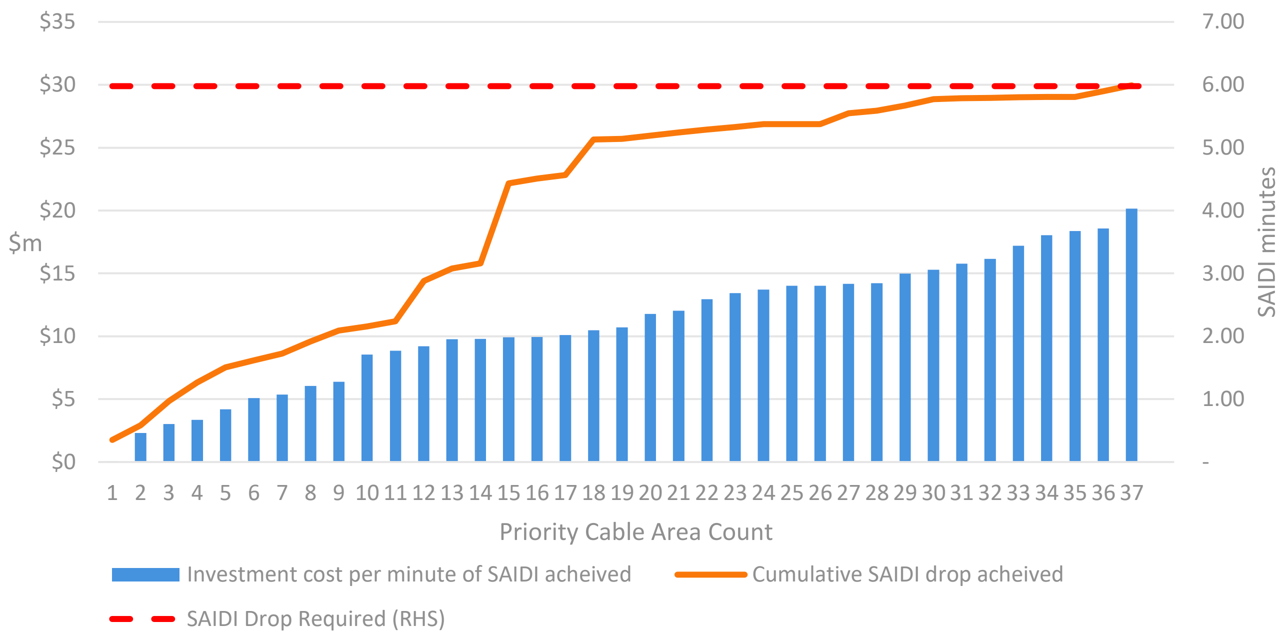
Step 7 Optimise investments across priority cable areas and select required investments to meet the identified need to form business case options.

This step selected an optimal combination of priority cable areas and their associated solutions to reduce forecast SAIDI back to EDC target by the end of the next RCP.

The priority cable areas and their associated solutions were then ranked by their efficiency at providing SAIDI improvements to form an optimised set of investments to meet the identified need. Solutions were sorted in order of least cost per minute of SAIDI provided and added to an investment program until there were enough investments to meet the required 5.98 minute SAIDI reduction in the CBD.

To illustrate this optimisation, Figure 16 shows Option 1's Problem Cable Area solutions costs per minute of SAIDI provided (blue bars), with additional Problem Cable Area solutions added to the option until the SAIDI reduction (orange line) met the required SAIDI reduction (red dotted line).

Figure 16: Option 1 – Priority cable areas solution capex cost per SAIDI minute achieved



While optimising a suite of investment solutions to achieve the required SAIDI reduction, we identified that, in some cases, it was more cost-effective to substitute a rank 1 solution with a rank 2 solution. Although a rank 2 solution may offer slightly lower cost efficiency, it can deliver a greater SAIDI reduction. This approach allowed us to leverage solutions within an options already-included priority cable area rather than bringing in additional solutions from other areas. Additionally, we fine-tuned some of the larger solutions to avoid exceeding the SAIDI target unnecessarily, thereby controlling costs while staying aligned with the target.

A check was then performed to determine if any further investments were required to achieve the SAIFI target and this confirmed that the SAIFI target would be met in all cases where the SAIDI target was met. This process ensured that we selected investments that minimise the cost required to achieve compliance.

This business case addendum therefore presents two options which address the Draft Decision in regard to the required consideration of topology:

- Option 1: Optimised combination of all solutions[17]
- Option 2: Substation with optimised combination of all solutions

6.4.4 Solutions involving standalone topology changes are limited in their efficient applicability

The expenditure forecast process described above included consideration of 2 feeder tie change standalone topology solutions and 22 new feeder standalone topology solutions. None of these standalone topology solutions were utilised in the recommended option 1 list of investment solutions. Topology changes do however form a part of the investments in option 1 in the cases where they are part of an automation solution (i.e. not standalone). In this section, we explain how standalone topology solutions were developed and examined and why these solutions were not found to be effective and efficient and therefore did not comprise a material component of the new fully optimised option 1 recommended in this addendum.

[17] Option 1 includes topology solutions which do not require the construction of a new CBD substation.

The standalone topology solutions considered the following:

1. **new feeders** - added to a network from a new or existing substation to divide an existing high-risk network segment from lower risk segment. By redistributing the load in this way, the network gains more flexibility and resilience as well as a reduction in customer numbers impacted by a fault event on the original feeder. For these new feeder solutions, it was ensured that feeder N-1 redundancy remained capable, as the network currently allows, such that in the event of an outage or fault on the original feeder, once the faulted section is isolated, that switching could occur to resupply healthy sections of the faulted feeder; and
2. **feeder tie** - connections between two separate feeder lines which enhances the reliability of the network by allowing power to be re-routed between feeders in case of an outage. When a fault occurs on one feeder, a feeder tie can help restore service quickly by switching the load to an adjacent feeder. In some cases, feeder tie changes can transfer sections of high-risk cable to feeders that may have a lower consequence of failure although in practice there are limited opportunities to achieve this.

Our assessment of new feeder options found that it was not technically feasible to run additional feeders from the existing CBD substations noting that:

- there is a lack of spare circuit breakers and limited physical space to extend the existing 11kV switchboards within the substation buildings while maintaining required clearances around switchgear; and
- the CBD network currently faces civil construction challenges around the ability to establish new feeder exits to get new cables out of existing substations due to finite space.

We explored the option of establishing a new CBD substation to accommodate the new feeders. Determining the location of the new substation is necessary to evaluate the length of feeders required to assess the associated costs against other potential solutions. SA Power Networks currently owns a land parcel on Eliza Street in the CBD, which is considered an appropriate location for a new “City Central Substation”.

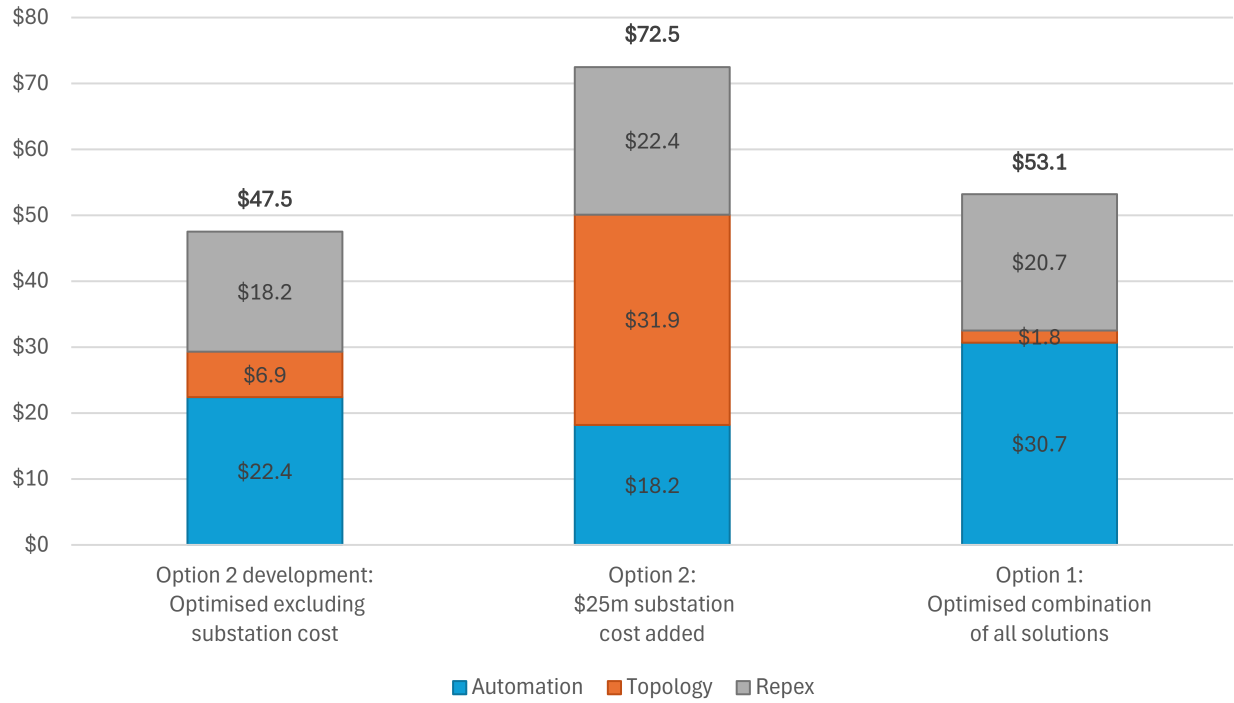
The inclusion of a substation in new feeder solutions introduced the complication of a fixed substation cost which needed to be distributed across new feeder solutions. This presented a challenge because the number of feeders to be used (i.e. not discarded via optimisation) needed to be known to distribute the substation cost across them. To address this challenge, we undertook the following process:

1. an optimised set of solutions (repex, feeder automation and topology changes) to address the identified need assuming no substation costs were incurred. The result was a $47.5 million set of investments which included 7 new feeder solutions requiring the City Central Substation; and
2. when we added a reasonable estimate of $25 million for a substation, the resulting final option costs became $72.5 million; and
3. we compared this against the $53.1 million recommended option which excluded new-feeder topology solutions that required the new substation.

The results of our analysis are shown in Figure 17 below. This analysis establishes that any topology solutions which required investment to establish a new substation would not represent the most comparatively efficient solutions.[18]

[18] For clarity, 'Option 2 Development: Optimised excluding substation cost' is not a credible option. It is presented for illustrative purposes to demonstrate the optimisation process used to derive the 'Option 2: $25m Substation Cost Added' column in the stacked bar chart, which represents the credible Option 2.

Figure 17: Topology capex development and Option 2 Comparison ($ million, June 2022)



6.5 Costs and benefits

6.5.1 Option 1: Optimised combination of all solutions

Option 1 is to undertake planned cable replacement, install automated switches and feeder ties to meet the reliability targets of 15 SAIDI minutes and 0.15 SAIFI interruptions by 2030.

- Replace 11.4km of 11kV cable in the CBD at a cost of $30.7m (repex).
- Install 35 automated switches at a cost of $20.7m (augex).
- Install 655m of cable and undertake feeder tie changes at a cost of $1.8m (augex).

Cost estimation

Table 5 costs by cost type ($ million, June 2022)

Cost Type	2025-26	2026-27	2027-28	2028-29	2029-30	Total 2025-30
Capex	10.626	10.626	10.626	10.626	10.626	**53.129**
Opex	-	-	-	-	-	-
TOTAL COST	10.626	10.626	10.626	10.626	10.626	**53.129**

Benefit estimation

Table 6 Benefits by expenditure type ($ million, June 2022)

Benefit Type	2025-26	2026-27	2027-28	2028-29	2029-30	Total 2025 - 30	Total for analysis period
VCR	0.042	0.050	0.067	0.091	0.115	0.364	2.384
Terminal							23.411
TOTAL	0.042	0.050	0.067	0.091	0.115	0.364	25.795

6.5.2 Option 2: Substation with optimised combination of all solutions

Option 2 is to undertake planned cable replacement, install automated switches, undertake feeder topology changes and install a new substation[19] to meet the reliability targets of 15 SAIDI minutes and 0.15 SAIFI interruptions by 2030.

- Replace 6.7 km of 11kV cable in the CBD at a cost of $18.2m (repex).
- Install 33 automated switches at a cost of $22.4m (augex).
- Install a substation, 3.5km of cable to install new feeders and undertake feeder tie changes at a cost of $31.9m (augex).

Cost estimation

Table 7 Costs by cost type ($ million, June 2022)

Cost Type	2025-26	2026-27	2027-28	2028-29	2029-30	Total 2025-30
Capex	14.496	14.496	14.496	14.496	14.496	72.480
Opex	-	-	-	-	-	-
TOTAL COST	14.496	14.496	14.496	14.496	14.496	72.480

Benefit estimation

Table 8 Benefits by expenditure type ($ million, June 2022)

Benefit Type	2025-26	2026-27	2027-28	2028-29	2029-30	Total 2025 - 30	Total for analysis period
VCR	-	0.043	0.060	0.088	0.120	0.311	2.414
Terminal	-	-	-	-	-	-	37.617
TOTAL	-	0.043	0.061	0.088	0.125	0.17	40.031

19 The new substation facilitates topology options that otherwise would not be possible.

6.6 Options comparison and recommendation

This business case addendum recommends that Option 1 is the most prudent and efficient investment option among those considered in both this case and the original proposal. This option involves:

1. cable replacement,
2. installing automated switches, and
3. a minor amount of topology changes,

to meet the identified need of 15 SAIDI minutes and 0.15 SAIFI interruptions by 2030 in compliance with our jurisdictional standard.

Option 2 is not recommended due to the significantly higher capex needed to achieve the identified need. This is primarily because it includes the cost of a substation. While the new substation enables some high-benefit topology changes, its cost outweighs these benefits to make it overall are more capital-intensive option.

Table 99: Costs, benefits and risks of alternative options over the 5-year period, $m, $ Dec 2022 real.

Option	Costs		Benefits[20]		NPV[21]	2030-31 Reliability [22]	Ranking
	Capex[23]	Opex[24]	Capex	Opex			
Option 1 – Optimised combination of all solutions	$53.129	-	$25.800	-	-$35.838	14.89 SAIDI 0.14 SAIFI	1
Option 2 – Substation with optimised combination of all solutions	$72.480	-	$39.538	-	-$47.158	14.89 SAIDI 0.13 SAIFI	2

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

21 NPV of proposal over 20-year cash flow period from 1 July 2025 to 30 June 2045, based on discount rate of 4.05%.

22 The overall risk level for each option after the proposed are implemented.

23 Represents total capex associated with the proposed option over the 20-year cash flow period from 1 July 2025 to 30 June 2045.

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

Appendix 1: reasonableness of cost and benefit estimates and input assumptions

Cost estimation

Automated switch costs

The cost estimate for automated switches was determined using a unit rate derived from previous similar projects. The unit rate is the same as that used in the original business case and information was provided regarding this in ‘AER Information Request 10’. The number of switches proposed for installation is determined by the steps outlined in section 6.4.3.

Cable replacement

The cost estimate for cable replacement and cable augmentation works was determined using unit rates derived from previous similar projects. The unit rate is the same as that used in the original business case and information was provided regarding this in ‘AER Information Request 10’.

New feeders

For new feeders and feeder tie cables, we undertook desktop estimates in the same manner as the cable replacements proposed in the original business case, taking into account the cable route and informed by similar past projects undertaken in the CBD. These costs include unit estimates for the costs associated with civil works required to establish new duct runs on any proposed new cable paths.

Feeder tie changes

Feeder tie changes are switching operations which involve switching planning, the physical switching operations and updating network records. Feeder tie changes are included in the unit rates for installation of other assets as these always involve switching. In the two cases where the option only involved feeder tie changes we assumed a cost of $5,000 to cover the costs of switching planning, physical switching and updating network records.

Substation

The cost of a substation used a high-level estimation of $25million. We have used a high-level estimate only because it became clear that a substation would not form part of the preferred investment as explained in section 6.4.4.

Benefit estimates

Automated switches

The SAIDI and SAIFI benefits were calculated by conducting a zonal analysis to determine how the duration and customers effected of an outage would change with the implementation of automated switches. This is explained in section 6.4.3. To calculate the reliability benefits for the NPVs in section 6.5, the VCR rates were applied to calculate a monetary value.

Cable replacement

The SAIDI and SAIFI benefits were calculated by determining how many outages could be avoided by the replacement of individual cables. The probability of failure data for cables was used to calculate this along with customer numbers and average outage duration information. This is explained in section 6.4.3. To calculate the reliability benefits for the NPVs in section 6.5, the VCR rates were applied to calculate a monetary value.

The avoided opex benefits from avoided increases in unplanned cable repairs were considered and found to be immaterial.

New feeders

The SAIDI and SAIFI benefits were calculated by conducting a zonal analysis to determine how the duration and customers effected of an outage would change as the topology of the network is modified with a new feeder. This is explained in section 6.4.3. To calculate the reliability benefits for the NPVs in section 6.5, the VCR rates were applied to calculate a monetary value.

Feeder ties

The SAIDI and SAIFI benefits were calculated by conducting a zonal analysis to determine how the duration and customers effected of an outage would change as the topology of the network is modified with a new feeder tie. This is explained in section 6.4.3. To calculate the reliability benefits for the NPVs in section 6.5, the VCR rates were applied to calculate a monetary value.

Cost estimation and NPV analysis template (available on request)

- SAPN - 5.3.12.1 - CBD Reliability - CBA Template - Option 1 – Preferred
- SAPN - 5.3.12.2 - CBD Reliability - CBA Template - Option 2
- SAPN - 5.3.12.3 - CBD Reliability - CBA Model