CASE FOR INVESTMENT (CFI): NPR-000533 132KV OIL-FILLED CABLE CAPACITY CONSTRAINTS 22U, 226, 9J8 (SOUTHERN TRENCH)

August 2022

Endeavour Energy

Version Control and Approvals

Table 1 – Version Control

Version #	Date of Issue	Description
1	Aug22	Initial issue

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Investment Title	**132kV Oil-Filled Cables Southern Trench Capacity Constraints**
<< project # / code >>	NPR-000533
Portfolio	Augex
CFI Date	
Pre RIT-D	☐
Final CFI	☐
Other	☒ Early Phase CFI (Documentation of need, scope and expenditure forecast for inclusion in IDST)

As the highest cost credible solution for this need or opportunity does not exceed $6M, the Regulatory Investment Test process is not required in accordance with the National Electricity Rules.

NPR-000533 was not included within the FY20-24 regulatory submission nor the last published DAPR.

1. Executive Summary

The summary below sets out the key aspects to consider in recommending this investment, including:

- drivers for undertaking the investment,
- investment timing, estimated costs and expected benefits, and
- options considered.

1.1 Recommendation

It is recommended that:

- The project proceeds to preliminary release with preferred Option 3A which recommends capital expenditure of $4.6 Million to install 1 set of SmartValves at Guildford TS by FY30; and
- As an Early Phase CFI, will undergo reviews as more information is confirmed and finalised and a final approval will then be submitted to confirm the scope and recommended timing of investment of the preferred network option.

1.2 Key Drivers

Endeavour Energy's network has 40.5 kilometres of 132kV oil-filled cables installed across six feeders. The six oil-filled cables are installed in two separate trenches and are referred to as the Northern trench and the Southern trench. These cables form part of the 132kV sub-transmission network which supplies the Greater Parramatta area.

There is significant growth expected across the Greater Parramatta area, such as the Parramatta CBD, the Westmead Health Precinct, the North Parramatta Urban Transformation precinct and the Camellia-Rosehill precinct, as well as major customers including the Sydney Metro West, Ausgrid and Equinix Data Centre. With substantial load growth forecast over the next few decades, it has been identified through demand forecasting and load flow modelling that the Southern trench has arising capacity constraints.

A separate project has been raised to replace the Northern trench with XLPE cables under asset renewal needs due to its deteriorating condition. However, this replacement will increase the reactance of the cables in the Northern trench. This will result in more load being shifted onto the already capacity-constrained Southern trench, increasing the potential unserved energy and bringing its need date forward to match the replacement date of the Northern trench of 2030.

As an Early Phase CFI, there is a fair amount of uncertainty around scope, expenditure and timing. The external supplier of the recommended technology option has only recently been engaged and provided high-level technical details and price estimates. In addition, variance in the load forecast up to the next decade within the Greater Parramatta area will likely affect the need date. As such, many details are subject to change. Endeavour Energy will continue engagement with the supplier and monitor load growth to refine and determine the scope, expenditure and timing of this project as the need date approaches.

1.3 Options Considered

Table 2 outlines the options for the total scope of the project.

Table 2: Options for the Total Scope

Option	Description	Solution Type	NPV $M[1]	Assessment Description
1	No proactive intervention	Base case / counterfactual	-	Non-preferred as will lead to unacceptable risk or higher cost for customers if opportunity not captured
2	Augment Feeders 22U, 226 and 9J8 to new XLPE cables	Network solution	5.6	Technically feasible, not economically feasible
3A	**Install 1 set of SmartValves on Feeders 22U and 9J8**	**Network solution**	**30.4**	**Preferred Option (Best NPV)**
3B	Install 2 sets of SmartValves on Feeders 22U and 9J8	Network solution	30.3	Technically feasible, lower net benefits

Notes

1. This represents the "Weighted NPV" as per the parameters in Section 3.6.2

2. Project Proposal

2.1 Identified Need or Opportunity

Endeavour Energy's network has 40.5 kilometres of 132kV oil-filled cables installed across six feeders. These cables form part of the 132kV sub-transmission network which supplies the Parramatta CBD and surrounding area. The six oil-filled cables are installed in two separate trenches, with two cables running side by side in different segments. These two trenches are referred to as the Northern trench and the Southern trench.

The Northern trench consists of feeders:

- 22W Guildford TS to Camellia TS
- 228 Guildford TS to East Parramatta SS
- 223 East Parramatta SS to Camellia TS

The Southern trench consists of feeders:

- 9J8 Guildford TS to Camellia TS
- 22U Guildford TS to Granville ZS
- 226 Granville ZS to Camellia TS

Figure 1 and Figure 2 below show the configuration of these feeders.

The Northern trench has been identified to be replaced under asset renewal needs. The Southern trench has been identified through load flow modelling to have arising capacity constraints.

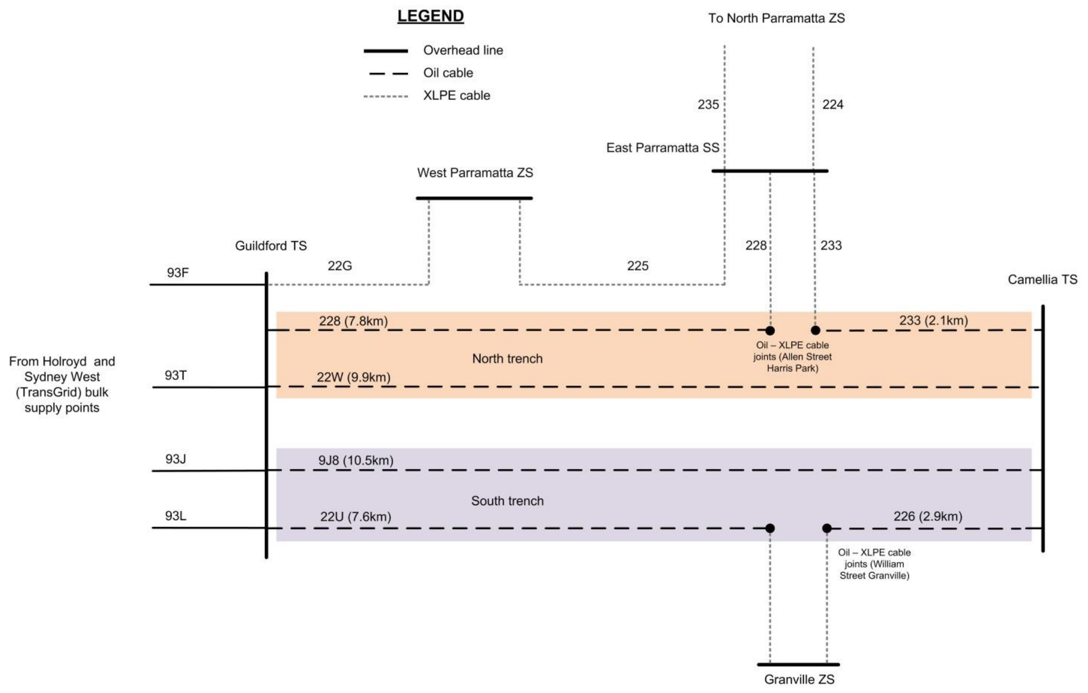

Figure 1 – 132kV Oil-Filled Cable Feeder Schematic

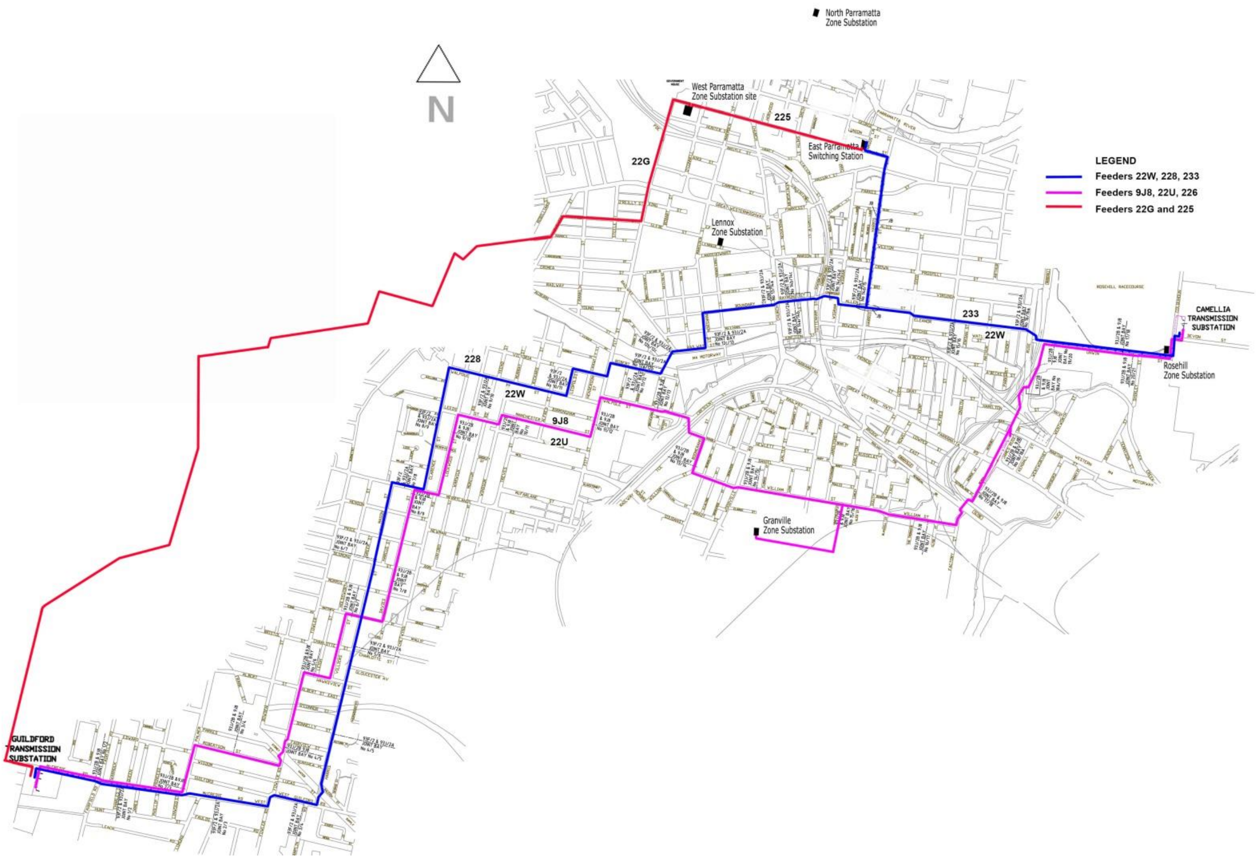

Figure 2 – 132kV Oil-Filled Cable Feeder Geographic

These oil-filled cable feeders form part of the 132kV network that supplies the Greater Parramatta area. This 132kV network supplies the substations and customers in the table below.

Zone Substation/ Customer	Description	10 Yr Load Forecast (MVA)
West Parramatta ZS	Currently providing sole supply to the Parramatta CBD bounded by the Parramatta river on the North and the Great Western Hwy to the South. The Parramatta CBD consists of major residential and commercial developments.	114.1
East Parramatta ZS	Proposed conversion of East Parramatta SS to a zone substation to service continual load growth in the Parramatta CBD. In addition, improves supply security to the CBD.	Covered under West Parramatta.
North Parramatta ZS	Supplies the North Parramatta area located North of the Parramatta River. In the future, this substation will supply the Parramatta North transformation area around the Cumberland Hospital precinct.	35.6
Granville ZS	Supplies suburbs of Granville, Holroyd and Merrylands.	38.4
Westmead ZS	Project in progress to add a third transformer supplied at 132kV at Westmead ZS to supply the Westmead Health Precinct. The Health Precinct is currently undergoing a major expansion.	50.6
Equinix Data Centre	New data centre located in Camellia.	72.0

Rosehill ZS (Supplied from Camellia TS)	Supplies the Rosehill and Camellia areas consisting of residential and industrial loads. This area is planned to undergo redevelopment including a new town centre consisting of 10,000 apartments. In addition, Viva Energy are converting their land into industrial subdivisions.	20.0
Lennox ZS (Supplied from Camellia TS)	Supplies the area South of the Parramatta CBD and North of the M4 Motorway. This area consists of the Auto Alley precinct which has a future vision of being converted into a major commercial precinct.	40.4
Sydney Metro West (Anticipated to be supplied from Camellia TS)	To provide supply to Sydney Metro West, a new Metro running between Westmead and Sydney via Parramatta and Sydney Olympic Park.	44
Ausgrid Loads (Suppled from Camellia TS)	Supply to Ausgrid's Auburn ZS and Lidcombe ZS.	42.5

Table 3: Substations suppled by Greater Parramatta 132kV network

The loads described above were used to model the load flow on the 132kV network using PowerFactory. The modelling carried out normal and contingency scenarios on an annual basis starting from the start of the next Regulatory period ending at FY2032 in which the latest Summer Demand Forecast ends. Load flow results were extrapolated using a 1% growth after FY2032. These results are used to calculate expected unserved energy based on a cable rating of 93MVA which was calculated using Cymcap.

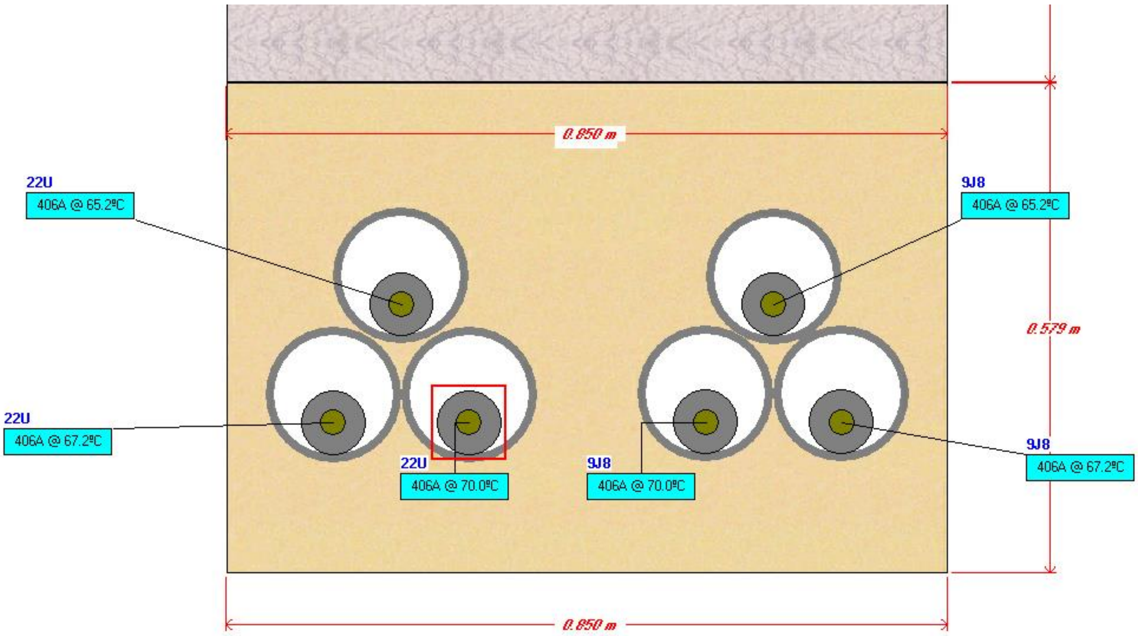

Figure 3 – Cymcap cable rating

The graph below shows the feeders exceeding capacity constraints. These results reflect the loads on the network prior to the Northern trench being renewed.

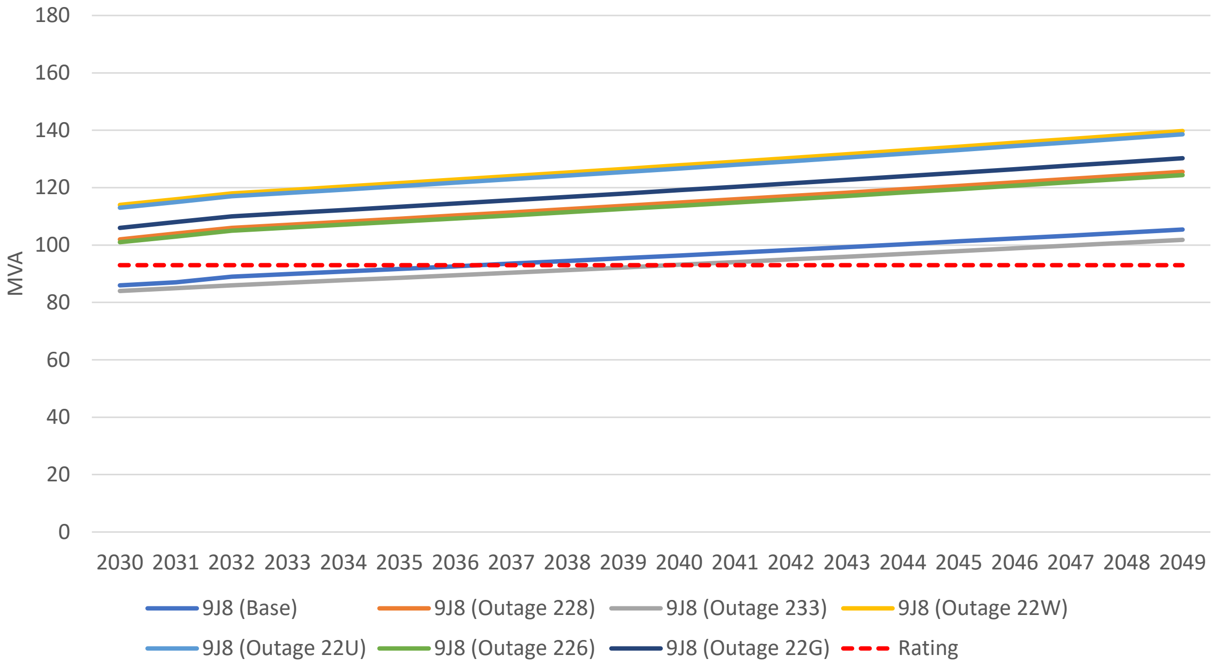

Figure 4 – 9J8 load flow results

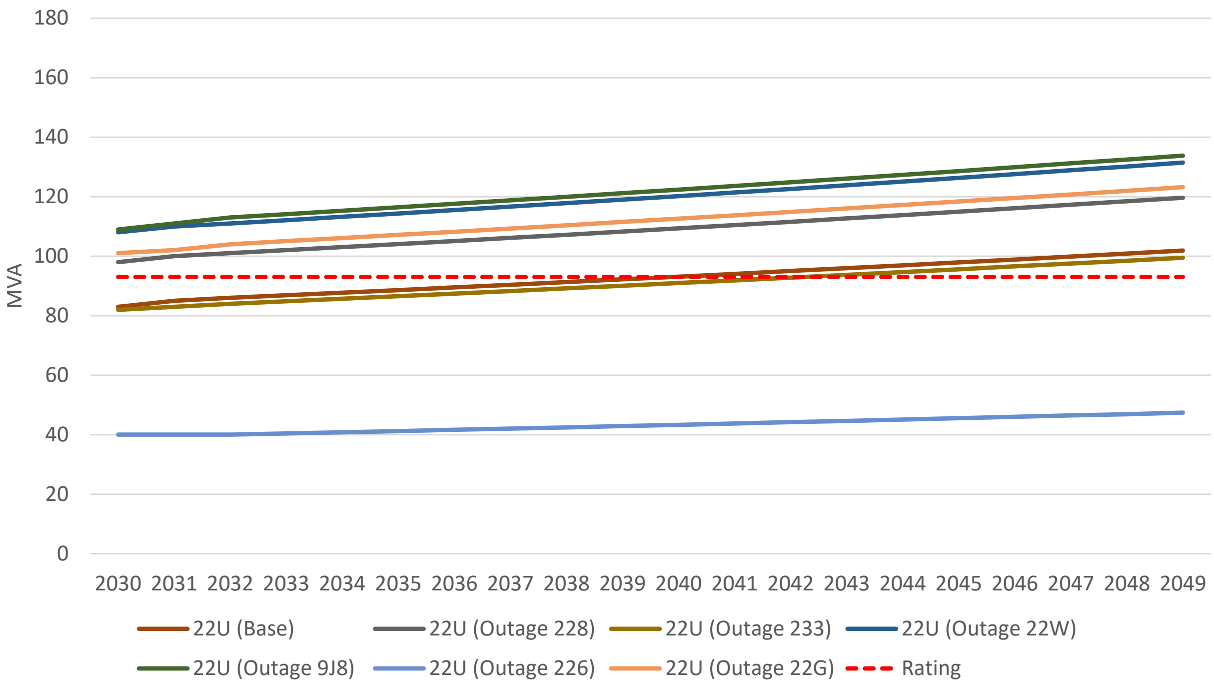

Figure 5 – 22U load flow results

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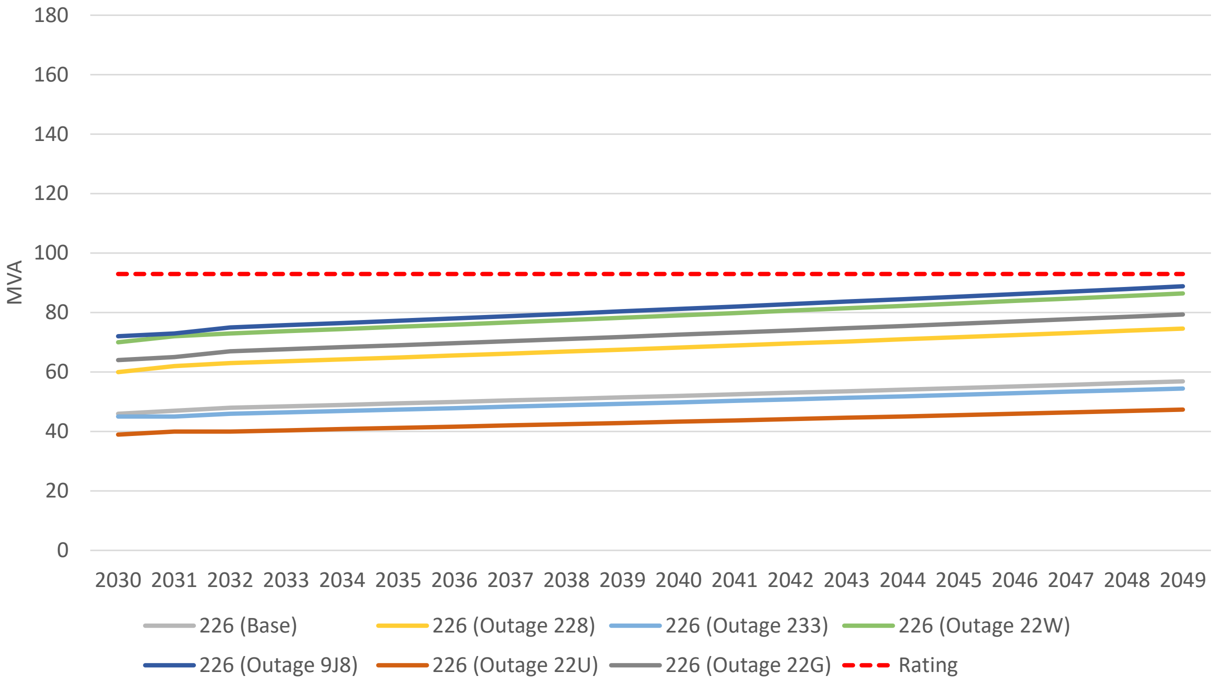


Figure 6 – 226 load flow results

To examine the impact of the replacement of the Northern trench cables, the load flow was modelled again. These results show that as a result of the Northern trench replacement, more load is shifted onto the Southern trench therefore increasing the capacity constraints on the Southern trench. This is due to the newer replaced cables in the Northern trench having a higher reactance than before which is detailed in the table below.

Table 4: Reactance of Northern trench feeders before and after its replacement

Northern trench feeder	Reactance before Replacement of 22W, 228 & 233 (Ohms)	Reactance after Replacement of 22W, 228 & 233 (Ohms)	Percentage increase in reactance
22W	1.220	1.709	40.0%
228	1.227	1.629	32.8%
233	0.561	0.646	15.1%

The graphs below show the load flow as a result of replacing the Northern trench. The financial analysis carried out in this CFI will be based on the assumption that the Northern trench is renewed and completed by the end of the next Regulatory period. As such, results are assessed from after the completion of the Northern trench renewal from FY2030.

It is noted that variance in the load forecast up to the next decade of the substations mentioned above will likely affect the need date. Endeavour Energy will continue to monitor the load growth to confirm the timing of this project as the need date approaches.

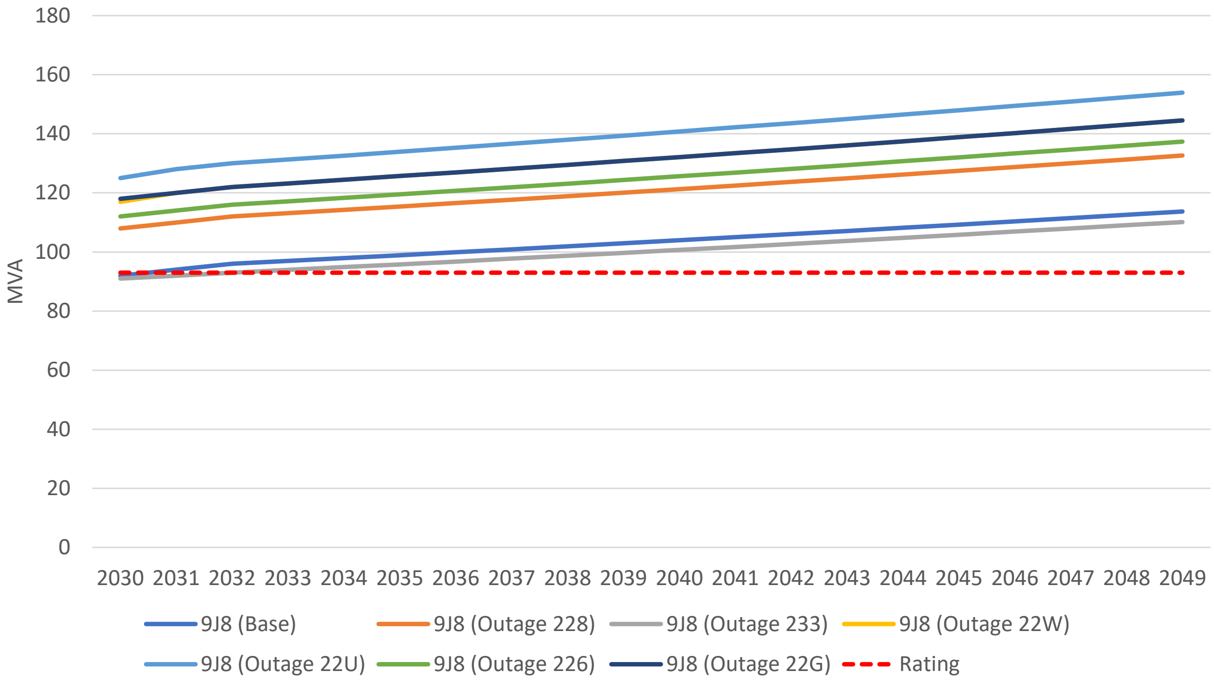


Figure 7 – 9J8 load flow results (after Northern trench replacement)

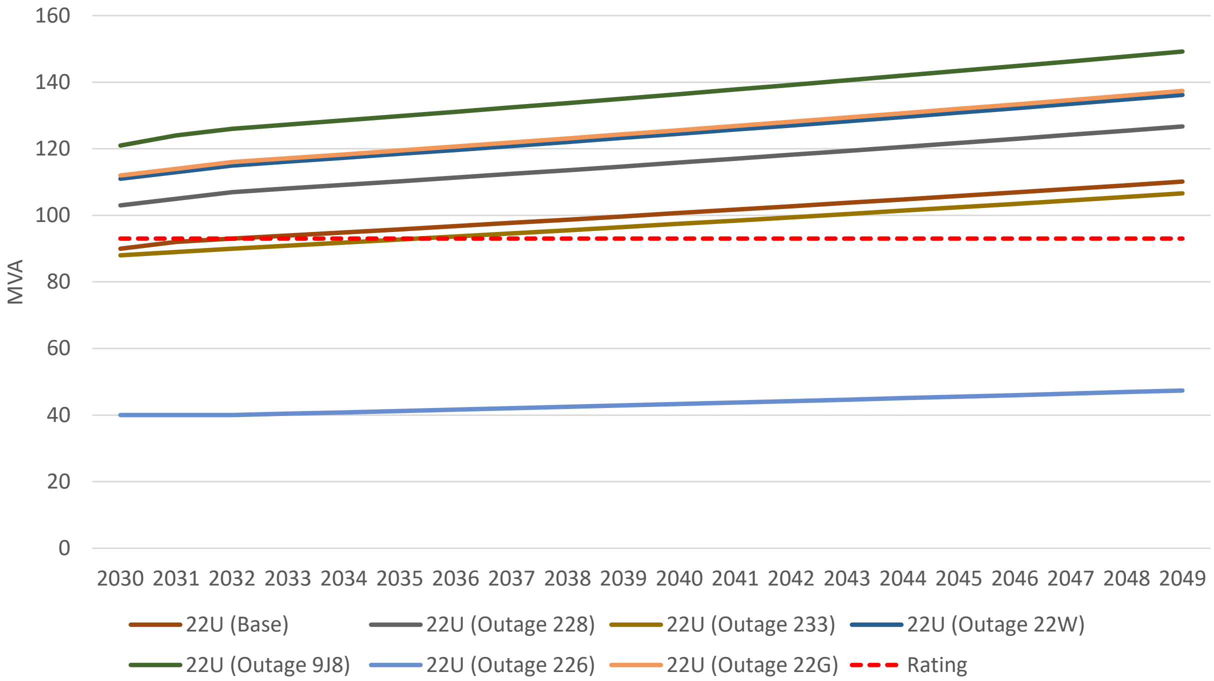


Figure 8 – 22U load flow results (after Northern trench replacement)

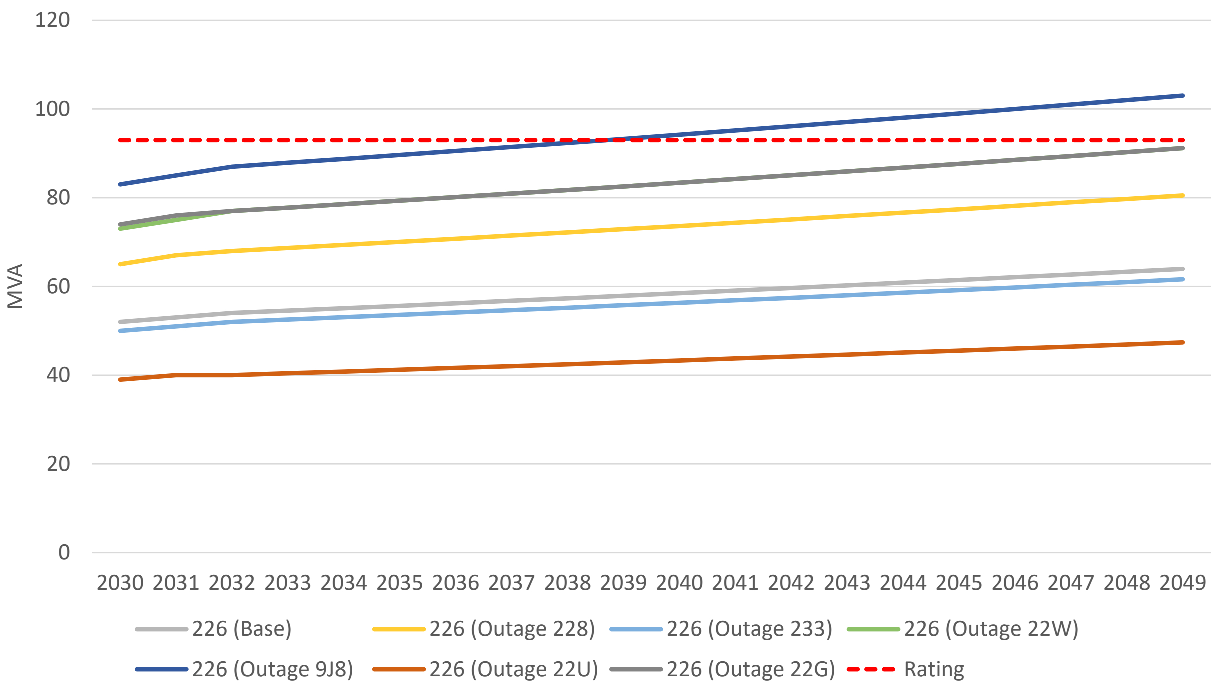


Figure 9 – 226 load flow results (after Northern trench replacement)

2.2 Related Projects

NTM-000535 (PR713) Replace 132kV Oil Cables (North Trench) addresses the renewal needs of the three oil-filled cable feeders 228, 233 and 22W.

2.3 Assumptions

Key assumptions relating to the economic evaluation of the viable options are listed below:

- The 7 January 2022 version of the HK model was used.
- Dollars are given in FY23.
- A study period of 20 years was used – due to conditional asset modelling of the Southern trench oil cables estimating an asset renewal need in approx. 20 years.
- The commercial discount rate was set to 3.26% based on the pre-tax real WACC.
- A VCR of $40,264/MWh was used based on an average of the VCRs of the substations supplied by the 132kV network weighted by load.
- NPV based on the weighted NPV as per the scenario analysis in Section 3.6.2. It was assumed that the unserved energy in the high and low scenarios were 130% and 70% of the central scenario respectively. This adjustment is typically applied to the load forecast but was applied to the total unserved energy instead due to the complexity of modelling the load forecast in every outage scenario listed in Figure 7, Figure 8 and Figure 9.
- Benefits and comparison of options beyond the reliability corrective action period are based on avoided unserved energy.

3. Options Considered

3.1 Summary of Options

The options comparison table below sets out the ***credible options*** that were considered, together with a counterfactual option: "*no proactive intervention"* to assist the overall comparison. These include all substantially differing commercially and technically credible options, including non-network solutions. Credible options (or a group of options) are those that meet the following criteria:

– addresses the identified need

– is (or are) commercially and technically feasible

– can be implemented in sufficient time to meet the identified need

For all options a review period of 20 years has been used with a discount rate of 3.26%.

Refer to Appendix B for details on RIT-D process (if relevant).

To provide a fit-for-purpose response to the growth challenge as well as be consistent with the NER and AER guidelines, Endeavour Energy has segmented the growth investments into two types, greenfield and brownfield. Figure 10 below shows the decision framework used to determine the investment requirements.

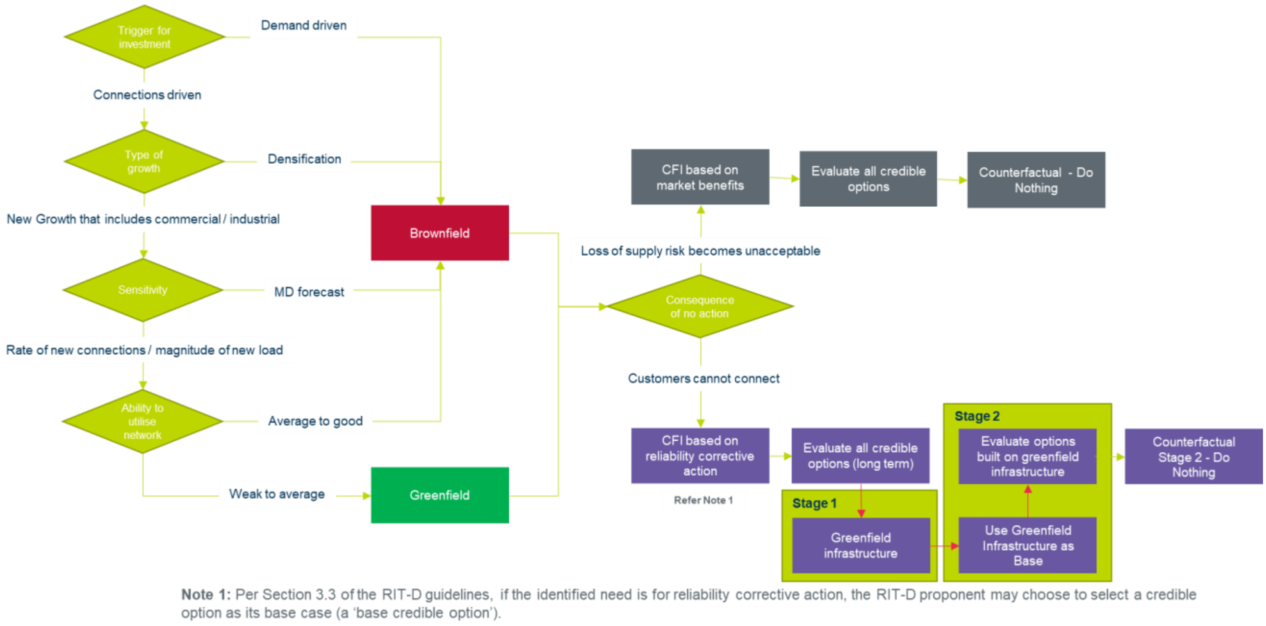


Figure 10 – Investment decision matrix

Based on the decision rule outlined in Figure 10, the following are the characteristics of the area:

- Investment is classified as brownfield**.**
- This CFI is based on market benefits.

Table 5: Option summary table

Option	Description	Solution Type	PV residual risk[1] $M	PV Cost[2] $M	PV Benefits[3]	NPV [4] $M	Rank
1	No proactive intervention	Base case / counterfactual	32.39	-	-	-	4
2	Augment Feeders 22U, 226 and 9J8 to new XLPE cables	Network solution	-	26.8	32.39	5.6	3
3A	**Install 1 set of SmartValves on Feeders 22U and 9J8**	**Network solution**	**0.02**	**1.9**	**32.37**	**30.4**	**1**
3B	Install 2 sets of SmartValves on Feeders 22U and 9J8	Network solution	-	2.1	32.39	30.3	2

Notes:
1: PV residual risk cost (or savings for opportunities) post the investment. Further details on the risks considered can be found in Appendix A.
2: PV of total costs, both Capex and Opex. See Appendix C for further details.
3: PV of total quantified benefits, both risk mitigated and any forecast decrease in Capex or Opex arising as a result of undertaking the investment (opportunities).
4: PV Benefits less PV Investment Costs.
5: The breakdown of PV is based on "Weighted NPV", as per the parameters in Section 3.6.2

3.2 Recommended Network Option

Table 5 shows that Option 3A is the option with the highest value (economic benefit), being NPV positive of $30.4 Million, even with the sensitivity & scenarios considered in Section 3.6. **Hence, Option 3A is the preferred network option.**

It is noted that there is only a small difference in the NPV between Option 3A and Option 3B of $0.1M. Noting this is an Early Phase CFI with uncertainty around scope, expenditure and timing, the recommended option will need to be reviewed as engagement continues with the supplier of the technology option and load growth is monitored.

3.3 Consequence of 'no proactive intervention'

The consequence of not proceeding with the investment in a network option for the study area is significant unserved energy due to the existing supply network being constrained and incapable of supplying the forecast demand for the area.

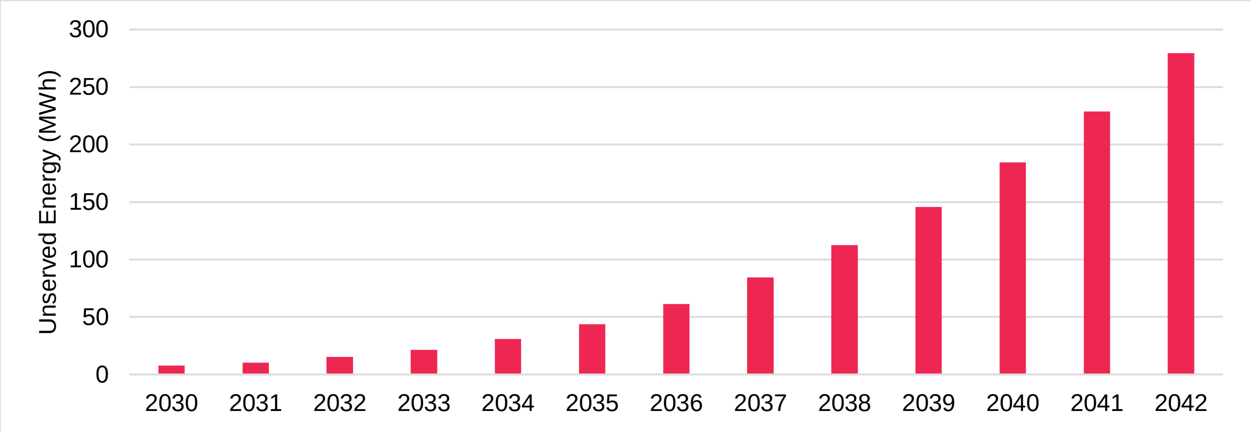


Figure 11: Expected Unserved Energy as a result of "no proactive intervention" based on Central Demand

	2030	2031	2032	2033	2034	2038	2039	2040	2041	2042
Expected Unserved Energy (MWh)	7.6	10.1	15.3	21.3	30.9	112.4	145.6	184.4	228.8	279.5
Value of Unserved Energy ($M)	0.3	0.4	0.6	0.9	1.2	4.5	5.9	7.4	9.2	11.3

Table 6: Value of Expected Unserved Energy as a result of "no proactive intervention"

Figure 11 and Table 6 shows the expected unserved energy and value of the expected unserved energy as a result of No Proactive Intervention.

In terms of Risk Cost assessment, the "No Proactive Intervention" option provides a base case where the risks are valued by applying a Value of Customer Reliability (VCR) to the forecast expected unserved energy. The VCR values used by Endeavour Energy in its modelling are the same as those published by AER. The AER endorsed this approach during the determination process

For a 20-year review period, no proactive intervention equates to a PV cost of $32.4M under the central scenario, which is an unacceptably high-risk position and is therefore non-preferred.

3.4 Option 2: Augment feeders 22U, 226 & 9J8

3.4.1 Scope

This option involves replacing the three oil-filled cable feeders 22U, 226 and 9J8 with new XLPE cables. Approximately 21km of new cable will be required to be laid in mostly the same alignment of the old cables.

3.4.2 Cost

The Houston Kemp model (HK model) was utilised in the economic evaluation of the viable option. Figure 12 provides a summary of the capital cost.

Capital cost				[DON'T INSERT AND DELETE ROWS]
Option	Component	Total amount	Commissioning	Asset life
Replace cables		55,884,000	2030	50

Figure 12: Capital cost input into Houston Kemp model (Option 2)

3.4.3 Benefits & NPV

The NER states that quantifiable economic market benefits (needs) include changes in involuntary load shedding. The costs and benefits analysis described in the following section included this benefit in determining the best option. Endeavour Energy's Unserved Energy Template was used to estimate the involuntary load shedding that can be prevented as a result of proactive action. The HK model utilised the involuntary load shedding along with a Value of Customer Reliability to calculate a market benefit. There were no other identified risks that were included in the costs and benefits analysis.

The assumptions used in the HK model are stated in Section 2.3. The NPV summary is provided in the table below.

Option	PV "Market Benefits" ($M)	PV Costs ($M)	NPV ($M)
2	32.4	26.8	5.6

Table 7: NPV Summary - Option 2

Given that this option provides similar benefits over the review period but has a significantly greater capital cost when compared to Option 3 (refer to Section 3.5), this option has been assessed as economically infeasible and therefore a non-credible option. Thus, it has been excluded from further economic evaluations.

3.5 Option 3: Install SmartValve

3.5.1 Scope

This option involves installing one or two sets of SmartValve devices on two feeders. Each set of SmartValve consists of one unit per phase, i.e. three units per set per feeder.

SmartValve is a single-phase, modular-SSSC (static synchronous series compensator) that injects a leading or lagging voltage in quadrature with the line current. These devices are installed in series with a feeder which requires an adjustment to its reactance. The result is an increase or decrease in reactance that is in series with the feeder. This provides the ability to adjust the load sharing across parallel feeders.

This option involves installing either one (referred to as Option 3A) or two (referred to as Option 3B) sets of SmartValves on feeders 22U and 9J8 to increase their reactance and thus “pushing” load onto the replaced higher rated XLPE feeders in the Northern trench. The installation of these devices would be located at Guildford TS between the 132kV CB and the feeder.

With the need date fairly far off, the SmartValve supplier has only recently been engaged and as such there are many factors still unknown such as detailed pricing, protection requirements and the required construction and maintenance works.

3.5.2 Cost

The Houston Kemp model (HK model) was utilised in the economic evaluation of the viable option.

Capital cost		[DON'T INSERT AND DELETE ROWS]		
Option	Component	Total amount	Commissioning	Asset life
SmartValve (x1)	1 set of SmartValves (3x 1-1800 solution)	2,600,000	2030	50
SmartValve (x1)	Fdr connection works: $1M/fdr * 2fdrs	2,000,000	2030	50
SmartValve (x2)	2 sets of SmartValves (6x 1-1800 solution)	2,950,000	2030	50
SmartValve (x2)	Fdr connection works: $1M/fdr * 2fdrs	2,000,000	2030	50

Figure 13: Capital cost input into Houston Kemp model (Option 3A and 3B)

3.5.3 Benefits & NPV

The NER states that quantifiable economic market benefits (needs) include changes in involuntary load shedding. The costs and benefits analysis described in the following section included this benefit in determining the best option. Endeavour Energy’s Unserved Energy Template was used to estimate the involuntary load shedding that can be prevented as a result of proactive action. The HK model utilised the involuntary load shedding along with a Value of Customer Reliability to calculate a market benefit. There were no other identified risks that were included in the costs and benefits analysis.

The assumptions used in the HK model are stated in Section 2.3. The NPV summary is provided in the table below.

Option	PV “Market Benefits” ($M)	PV Costs ($M)	NPV ($M)
3A	32.37	1.9	30.4
3B	32.39	2.1	30.3

Table 8: NPV Summary - Option 3 (Central Scenario)

3.6 Sensitivity and Scenario Analysis

3.6.1 Sensitivity Analysis

Sensitivity tests have been applied to the economic evaluation of the credible network options and the results are shown below. The results show that Option 3A remains the most favourable option in all sensitivity tests.

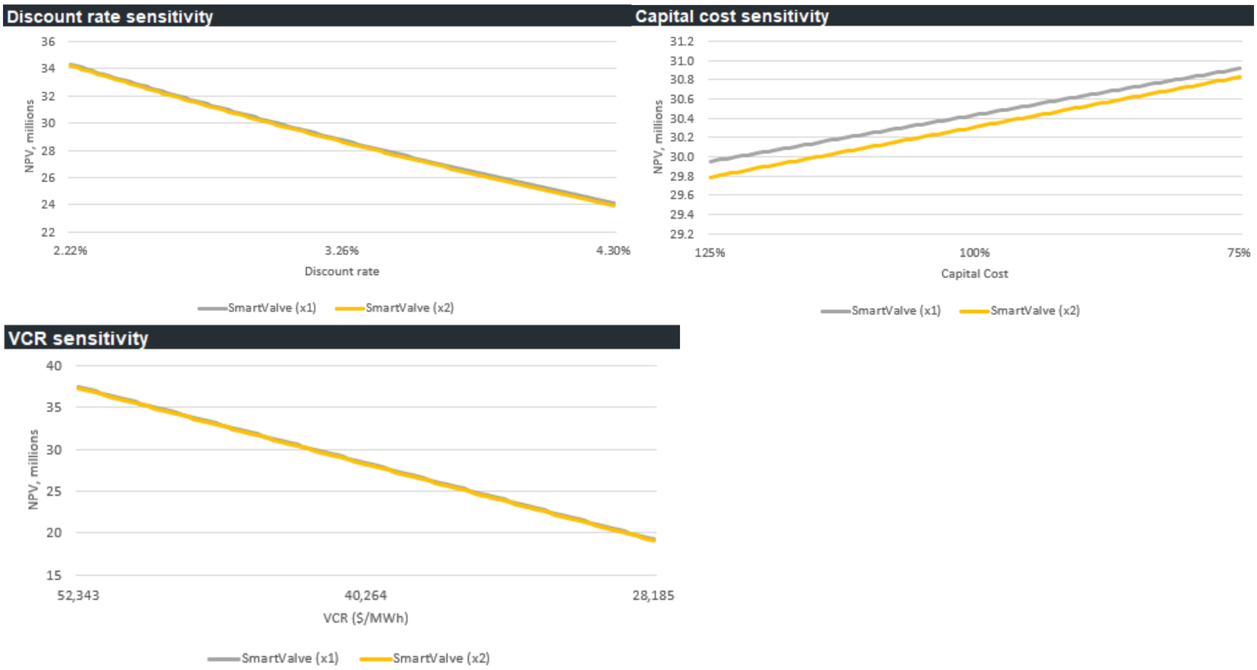


Figure 14 – Sensitivity analysis

3.6.2 Scenario Analysis

Scenario analysis has been carried out by the model. The parameters of the scenario analysis are presented below.

Scenario settings

Parameters		S1	S2	S3
General parameters	**Unit**	**Central**	**High**	**Low**
Commercial discount rate	Percent	3.26%	2.22%	4.30%
VCR for involuntary load shedding	$/MWh	40,264	52,343	28,185
VCR for voluntary load curtailment	$/MWh	40,264	52,343	28,185
Cost parameters	**Unit**	**Central**	**High**	**Low**
Capital cost	Factor	1.00	0.75	1.25
Planned routine maintenance and refurbishment	Factor	1.00	0.75	1.25
Unplanned corrective maintenance	Factor	1.00	1.25	0.75
Decommissioning costs	Factor	1.00	1.25	0.75
NNO proponent charges	Factor	1.00	0.75	1.25
Cost X	Factor	1.00	1.00	1.00
Risk cost parameters	**Unit**	**Central**	**High**	**Low**
Reliability and security risk costs	Factor	1.00	1.30	0.70
Safety and health risk costs	Factor	1.00	1.30	0.70
Environmental risk costs	Factor	1.00	1.30	0.70
Legal/regulatory compliance risk costs	Factor	1.00	1.30	0.70
Financial risk costs	Factor	1.00	1.30	0.70
Benefit parameters	**Unit**	**Central**	**High**	**Low**
Avoided involuntary load shedding	Factor	1.00	1.00	1.00
Avoided voluntary load curtailment	Factor	1.00	1.00	1.00
Avoided costs for non-RIT-D proponent parties	Factor	1.00	1.00	1.00
Differences in the timing of unrelated network expenditure	Factor	1.00	1.00	1.00
Changes in load transfer capacity	Factor	1.00	1.00	1.00
Additional option value	Factor	1.00	1.00	1.00
Changes in electrical energy losses	Factor	1.00	1.00	1.00
Scenario weightings	**Unit**	**Central**	**High**	**Low**
Weightings	%	0.50	0.25	0.25

Table 9 – Summary of scenarios investigated

The scenarios have been weighted as 50% for Scenario 1 being the most likely with Scenarios 2 and 3 being given a weighting of 25%. The weighted NPV for each option is shown below. Table 10 shows that Option 3A still has a higher NPV and is still the preferred option.

Option	Scenario 1 (Central) NPV ($M)	Scenario 2 (High) NPV ($M)	Scenario 3 (Low) NPV ($M)	Weighted NPV ($M)	Option ranking
Option 3A	**27.4**	**57.1**	**9.7**	**30.4**	**1**
Option 3B	27.3	57.0	9.5	30.3	2

Table 10 – Weighted net present value of options

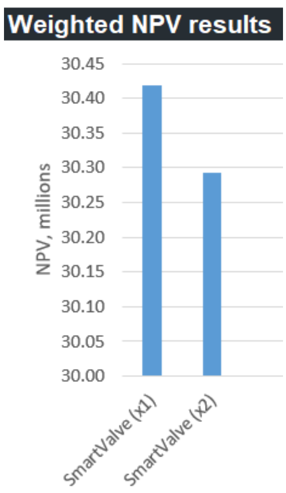


Figure 15 – HK scenario analysis output

Proposed Investment Timing

The optimal timing where the value of unserved energy from the 'No Proactive Intervention' scenario exceeds investment costs is 2030 as per Figure 16.

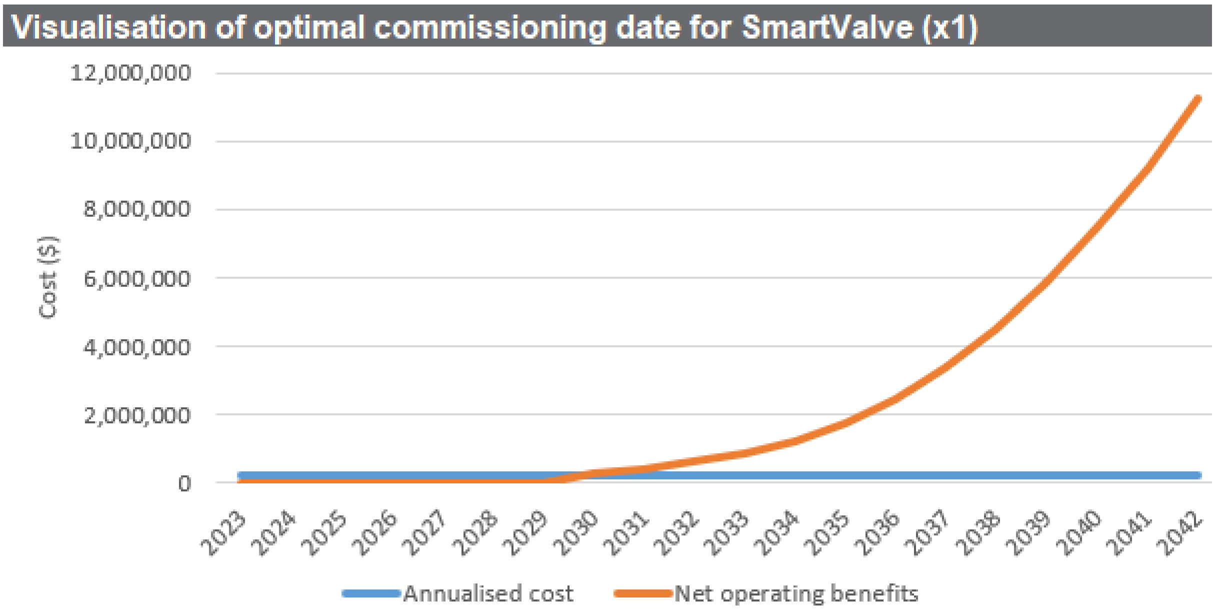


Figure 16 - Houston Kemp optimal timing output

3.7 Option 4: Non-Network Options

Electricity Distributors in NSW operate under the licence requirement (under the NSW Electricity Supply Act 1995) to investigate non-network alternatives to network augmentation for specific capital expenditure projects. The National Electricity Rules (NER) requires Distribution Network Service Providers (DNSP) to investigate non-network (demand management) options by utilising a thorough consultation process as part of planning for major network upgrades.

The NER calls for a regulatory investment test for distributors (RIT-D) process to be used in identifying the solution delivering the highest net market benefit in removing the network limitation. A “screening test” is performed for all network limitations where the most expensive credible option is greater than $6 Million. As the highest cost credible option for NPR-000533 is less than the $6 Million threshold, a screening test is not required.

4. Detailed description and costs of preferred option

The preferred option proposes to install one set of SmartValves on Feeders 22U and 9J8.

The works include:

- Installing SmartValve devices on each phase on Feeders 22U and 9J8 at Guildford TS.
- Laying cables from the oil cable sealing ends to the SmartValves.
- Laying cables from SmartValves to the circuit breakers.
- Installing SCADA monitoring devices.

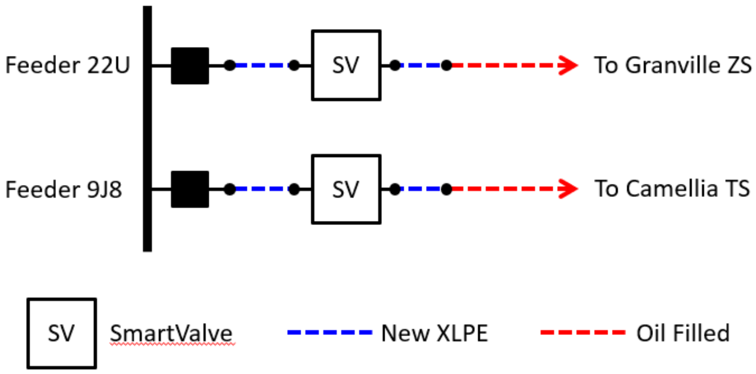


Figure 17 – Proposed Guildford TS single line diagram

The SmartValve product cost is $2.6 Million for 3x 1MVAR unit (1 for each phase). An estimate of $1 Million per feeder has been included for associated installation costs. Detailed cost estimates for connection works will require further investigation.

The nominal project cost is estimated to be $4.6M. The forecast expenditure will occur in FY29 as shown in the table below.

Estimated Cost	2028/29
SmartValve product cost (nominal) ($)	2,600,000
Zone substation works (nominal) ($)	2,000,000
Total ($)	**4,600,000**

Table 11 – Project expenditure spread

5. Recommendations and Next Steps

It is recommended that:

- The project proceeds to preliminary release with preferred Option 3A which recommends capital expenditure to install 1 set of SmartValves at Guildford TS. Preliminary release enables development of project definitions, detailed design, environmental assessment and preliminary market engagement activities in accordance with Company Procedure GRM0051.
- As an Early Phase CFI, will undergo reviews as more information is confirmed and finalised and a final approval will then be submitted to confirm the scope and recommended timing of investment of the preferred network option.

Appendices

A. Listing of benefits, risks, and residual risks considered

The NER states that quantifiable economic market benefits (needs) include changes in involuntary load shedding. The costs and benefits analysis described in the previous section included this benefit in determining the best option. Endeavour Energy's Unserved Energy Template was used to estimate the involuntary load shedding that can be prevented as a result of proactive action. The involuntary load shedding was utilised by the HK model along with a Value of Customer Reliability to calculate a market benefit. The captured benefit is listed in the table below.

Benefit	Description	Model	Option 2 PV $M	Option 3A PV $M	Option 3B PV $M
Value of avoided unserved energy	The NER states that quantifiable economic market benefits (needs) include changes in involuntary load shedding.	Endeavour Energy's Unserved Energy Template was used to estimate the involuntary load shedding that can be prevented as a result of proactive action. The involuntary load shedding was utilised by the HK model along with a Value of Customer Reliability to calculate a market benefit.	32.39	32.37	32.39

Table 12 – Benefits

There were no other identified risks that were included in the costs and benefits analysis.

8.1 Safety Considerations

The constraints analysed in this CFI are capacity related and there are no known safety issues with the existing network assets. In analysing expected unserved energy for the constraint we have considered the impact of potential widespread outages. The proposed investment solutions will be designed to current network standards to ensure safe operation of the network for our staff and general public. The proposed solution reduces the expected unserved energy and is considered SFAIRP.

B. RIT-D / market engagement process

Electricity Distributors in NSW operate under the licence requirement (under the NSW Electricity Supply Act 1995) to investigate non-network alternatives to network augmentation for specific capital expenditure projects. The National Electricity Rules (NER) requires Distribution Network Service Providers (DNSP) to investigate non-network (demand management) options by utilising a thorough consultation process as part of planning for major network upgrades.

The NER calls for a regulatory investment test for distributors (RIT-D) process to be used in identifying the solution delivering the highest net market benefit in removing the network limitation. A “screening test” is performed for all network limitations where the most expensive credible option is greater than $6 Million. As the highest cost credible option for NPR-000533 is less than the $6 Million threshold, a screening test is not required.

C. Detailed costs and benefits analysis

The Houston Kemp model (HK model) was utilised in the economic evaluation of the viable options. Endeavour Energy's Unserved Energy Template was used to calculate the expected unserved energy that was used as an input to the HK model.

The assumptions used in the HK model are:

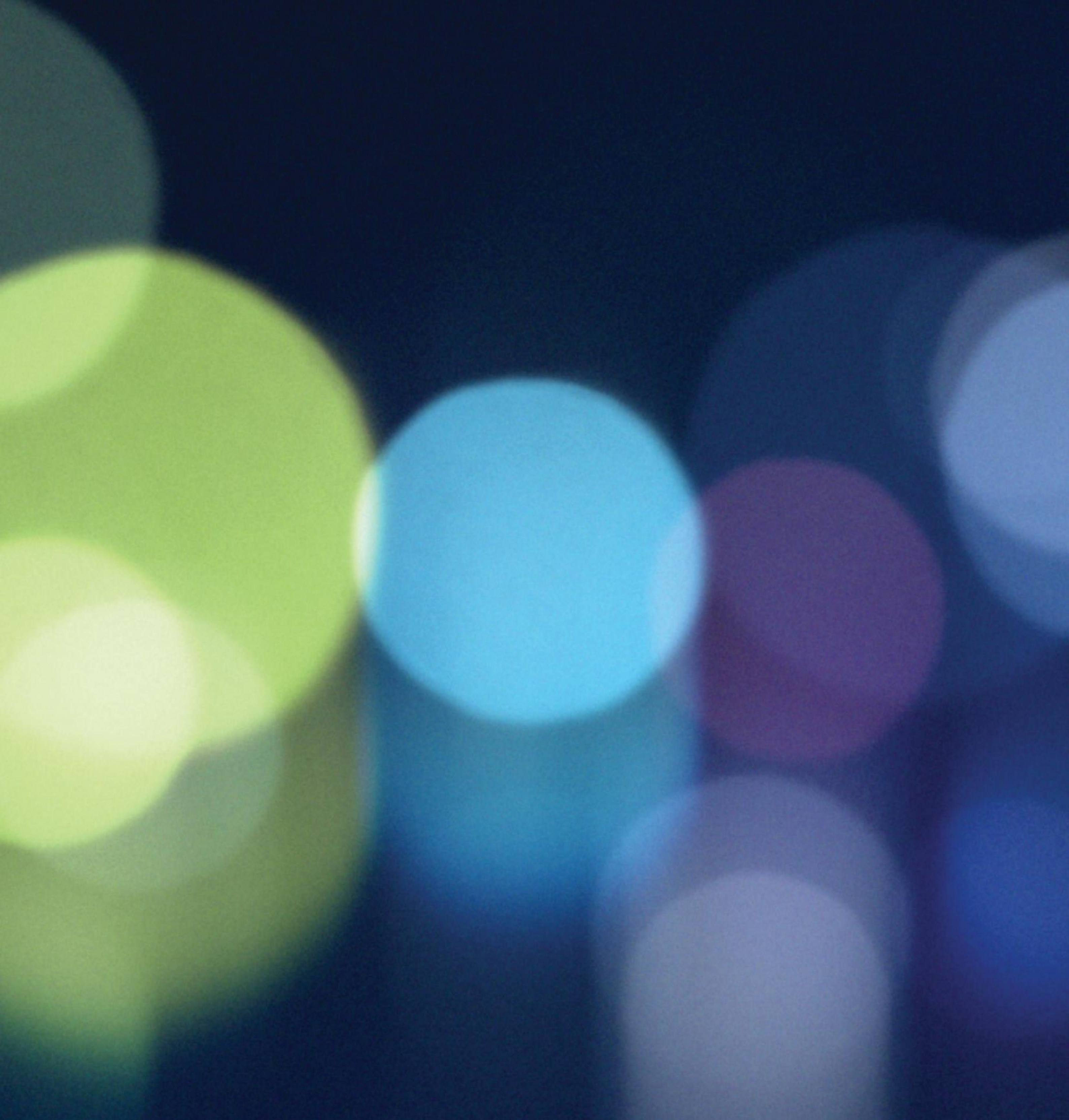
- A study period of 20 years;
- The commercial discount rate was set to 3.26% based on the final 2021 IASR [1]. For sensitivity analysis, this is adjusted to:
  - For high benefits: 2.22% based on the latest final AER DNSP determination pre-tax real WACC for high benefits
  - For low benefits: 4.33% based on a symmetrical adjustment upwards.
- A VCR of $40,264/MWh was used based on an average of the VCRs of the substations supplied by the 132kV network weighted by load.
- NPV based on the weighted NPV as per the scenario analysis in Section 3.6.2. It was assumed that the unserved energy in the high and low scenarios were 130% and 70% of the central scenario respectively. This adjustment is typically applied to the load forecast but was applied to the total unserved energy instead due to the complexity of modelling the load forecast in every outage scenario listed in Figure 9, Figure 10 and Figure 11.
- The benefits of options are based on the avoided unserved energy.

Capital cost				[DON'T INSERT AND DELETE ROWS]
Option	Component	Total amount	Commissioning	Asset life
Replace cables		55,884,000	2030	50
SmartValve (x1)	1 set of SmartValves (3x 1-1800 solution)	2,600,000	2030	50
SmartValve (x1)	Fdr connection works: $1M/fdr * 2fdrs	2,000,000	2030	50
SmartValve (x2)	2 sets of SmartValves (6x 1-1800 solution)	2,950,000	2030	50
SmartValve (x2)	Fdr connection works: $1M/fdr * 2fdrs	2,000,000	2030	50

Figure 18 – Capital cost input into Houston Kemp model

D. Referenced documents and appendices

[1] AEMO, *2021 Inputs, Assumptions and Scenarios Report*. AEMO, 2021.



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