Unplanned Reliability Distribution Augmentation

Business Case

January 2024

energex

Part of Energy Queensland

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DOCUMENT VERSION

Version Number	Change Detail	Date	Updated by
1	Initial Version	17/2/2023	Manager Distribution Planning
2	Update following feedback	6/11/2023	Manager Distribution Planning
3	Update following feedback	29/11/2023	Manager Distribution Planning
4	Approval	20/12/2023	General Manager Grid Planning

RELATED DOCUMENTS

Document Date	Document Name	Document Type
Dec 2019	Value of Customer Reliability - Final report on VCR values	Report
03/10/2019	Distribution Authority No. D07/98, Energex	PDF

1 SUMMARY

<table>
<tr><th>Title</th><th>Unplanned Reliability Distribution Augmentation</th></tr>
<tr><td>DNSP</td><td>Energex</td></tr>
<tr><td>Expenditure category</td><td>☐ Replacement ☒ Augmentation ☐ Connections ☐ Tools and Equipment
☐ ICT ☐ Property ☐ Fleet</td></tr>
<tr><td>Identified need
(select all applicable)</td><td>☐ Legislation ☒ Regulatory compliance
☒ Reliability ☒ CECV ☐ Safety ☐ Environment ☐ Financial
Augment the Distribution Network (11kV, 22kV, 33kV, LV and SWER) as required to meet customer expectations in terms of network reliability.</td></tr>
<tr><td>Summary of preferred option</td><td>The Preferred Option is to provide funding as detailed in this business case such that customer reliability expectations as can be justified by Value of Customer Reliability are met.</td></tr>
<tr><td>Expenditure</td><td>
<table>
<tr><th>Year</th><th>2025-26</th><th>2026-27</th><th>2027-28</th><th>2028-29</th><th>2029-30</th><th>2025-30</th></tr>
<tr><td>$m, direct 2022-23</td><td>1.83</td><td>1.86</td><td>1.99</td><td>2.14</td><td>2.26</td><td>10.09</td></tr>
</table>
</td></tr>
<tr><td>Benefits</td><td>Compliance with Regulatory and Legislative obligations regarding network capacity and associated network clearance as well as network voltage performance.
Network Reliability performance in regard to Unplanned outages will be maintained as can be justified by CECV and VCR analysis.</td></tr>
</table>

2 PURPOSE AND SCOPE

This business case is for Distribution Augmentation Unplanned Reliability driven works as can be justified by the AER's Value of Customer Reliability Guidelines and as detailed in Distribution Authority No. D07/98, Energex "must plan and develop its supply network in accordance with good electricity industry practice, having regard to the value that end users of electricity place on the quality and reliability of electricity services". The purpose of this business case is to justify feeder reliability improvement based on VCR analysis to meet customers reliability expectations. It is focussed on network reliability performance relating to unplanned outages.

3 BACKGROUND

Energex operates medium voltage distribution networks at 11kV and 33kV. The distribution network is made up of approximately 56,000km of overhead powerline and 21,000km of underground cable, with about 703,000 power poles and over to 52,000 distribution transformers.

As detailed in the "Energex Planned Distribution Augmentation Capacity and Voltage" business case the threshold for feeder capacity constraints was to apply a 90% utilisation based on the 10 POE forecast using 30-minute averaged data. It is recognised that this is an extremely conservative approach and at these utilisation levels, network reliability is expected to deteriorate. Feeder utilisation needs to be maintained well below 100% to maintain supply reliability at a reasonable level during network contingencies. This business case is targeted to address reliability performance where justified based on Value of Customer Reliability (VCR) and Customer Export Curtailment Value (CECV). This augmentation program is designed to maintain reliability at existing levels. The program is aimed at planned higher complexity reliability projects on the Medium Voltage Network. A separate "Energex Reactive Distribution Augmentation" business case has a reliability component which is more directed at the Low Voltage (LV) network and the unexpected more reactive reliability issues that might emerge associated with customer complaints.

For proposed unplanned reliability expenditure, Value of Customer Reliability (VCR) analysis has been performed to ensure the proposed work can be Net Present Value (NPV) justified. VCR rates ($/kwh) of unserved energy that have been applied are based on the Australian Energy Regulator's VCR guidelines. Individual feeder level consumption data for agriculture, commercial, residential, and Industrial customer types has also been applied to determine the accurate VCR rates with the applicable customer mix at a feeder level.

This Distribution Augmentation business case seeks to continue to deliver sustainable outcomes for customers and the business, with no compromise to safety and legislative compliance. The objective is to provide an affordable, safe, resilient, reliable, and secure quality of supply to meet the changing needs of our customers. Without Energex's proposed Distribution Augmentation expenditure, Energex would not be able to meet the expected reliability performance associated with standard control services and unplanned outages over the regulatory control period 2025-30.

3.1 Planned Distribution Augmentation – Unplanned Reliability

As detailed in AEMOs Electricity Statement of Opportunity 2021(ESSO) which provides an insight into the next 10 years, demand for electricity is expected to increase as part of the energy transformation to Net Zero. Consumers will transition to electric vehicles, and households and business will move from carbon-based fuels to electricity. This transition will not only drive increase demand, but also create increased dependency on the reliability of supply to customers and the community.

As detailed in Distribution Authority No. D07/98, Energex "must plan and develop its supply network in accordance with good electricity industry practice, having regard to the value that end users of electricity place on the quality and reliability of electricity services". This reliability program focuses on maintaining network reliability performance by targeting the feeders that have the most positive NPV outcomes. A conservative approach has been taken as part of this analysis in terms of the assumptions applied to derive the proposed volumes of work included in this business case. Solutions typically involve installing new reclosers, remote controlled gas switches, installing covered conductors, or installing ties to other feeders to improve operability of the network. Table 1 details the volume of reliability projects proposed to address unplanned outages. The methodology to determine the number of projects is detailed in section 4.5 of this business case and corresponds to projects where there is a VCR impact of greater than approximately $300,000. The timing of the work has been balanced across the regulatory period to ensure a deliverable program.

Description	25/26	26/27	27/28	28/29	29/30
Unplanned Feeder Reliability Constraints	7	7	7	8	8

Table 1 Volume of projects with a VCR impact greater than $300,000.

4 IDENTIFIED NEED

Unplanned Reliability expenditure is required based on customer expectations regarding network performance and is justified by a positive cost/benefit analysis. Table 2 details the drivers that make up this planned distribution augmentation reliability business case.

Program	Sub Program	Justification	Justification Detail
Planned Augmentation	Reliability	Cost Benefit Analysis	Value of Customer Reliability (VCR) Export - Customer Export Curtailment Value (CECV) Electricity Act 1994/Distribution Authority D07/98

Table 2 Distribution Augmentation Justification Matrix

4.1 Problem Statement

A significant number of Energex's distribution feeders have experienced a level of unplanned reliability performance that results in significant unserved energy to customers. This business case is focussed on addressing this reliability performance and is justified through VCR analysis. Feeders with an annual historic unserved energy resulting in an annual potential VCR impact of greater than $300,000 have been targeted in this business case.

4.2 Compliance

Energex has an obligation to comply with Electricity Act 1994 and the associated Distribution Authority D07/98 section 8.1 which details that Energex must have regard to the value that end users place of the reliability, and as such the approach to justification taken in this business case is to apply Cost Benefit Analysis. This methodology is detailed in section 4.4 of this report.

4.3 Discussions with customers

On 18 December 2019 the AER released its final decision on the Value of Customer Reliability (VCR) with the aim of establishing and investment framework to ensure “consumers pay no more than necessary for safe and reliably energy, helping energy businesses identify the right level of investment to deliver reliable energy services to customers”. In order to determine this investment methodology, the AER engaged with over 9,000 residential, small business and industrial energy customers. This business case applies the Value of Customer Methodology as detailed by the AER which was determined through extensive consultation and was updated further in 2021 and 2022.

4.4 Counterfactual analysis (Base case)

4.4.1 Summary

Energex broadly considers five value streams for investment. These are shown in Figure 1.

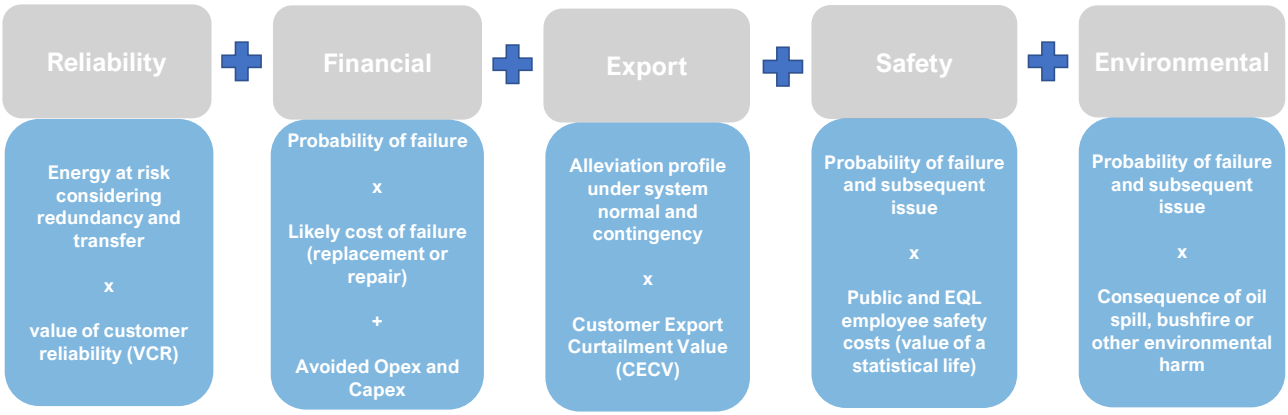

Figure 1– Value Streams for Investment

Table 3 details the value streams that are applicable to this business case is *Reliability and Export.*

Program	Sub Program	Value Stream
Planned Augmentation	Reliability	Reliability - Value of Customer Reliability (VCR)
	Export	Export - Customer Export Curtailment Value (CECV)

Table 3 Program and value stream relationship

The counterfactual arrangement is to not do this reliability program.

4.4.2 Risks

By doing nothing this will result in progressively decreasing reliability performance of the network, and an unaddressed VCR and CECV risk of approximately $17 million.

By doing nothing, Energex will fail to meet its obligations to the community to balance the reliability performance of the network with customer expectations. This will result in a significant economic cost to the community based on measures detailed in the AER's Value of Customer reliability guidelines. This will result in progressively decreasing reliability performance of the network, and a cumulated unaddressed VCR and CECV risk of approximately $17 million.

Feeder	Annual Average Unserved Energy MWh	Minimum Reliability benefit/Annual VCR Impact $
KCY4	21.5	$1,162,407
KCY3	15.7	$963,735
MGP13A	21.5	$795,877
APLLYT10A	12.2	$748,620
TGW3	17.1	$721,822
BDBCAL2A	11.2	$687,605
PWC3	16.1	$679,507
GCAKRA6	15.7	$670,899
CSEWCS13	15.4	$657,754
GYS6A	11.4	$530,578
WSE3A	15.6	$523,546
KBR1A	13.2	$503,753
TLFTR2A	11.4	$476,625
NBR3B	10.4	$464,556
GHM1	6.9	$423,782
MCWWTP6A	6.8	$415,177
PWC4	11.0	$379,950
MTB15A	9.8	$375,833
PWC2	9.9	$375,725
KBN5A	10.3	$372,084
CLD18A	7.7	$357,671
MLB8A	8.5	$339,582
PWC5	10.0	$339,268
LBH5A	8.3	$330,543
TCB2	8.8	$329,199
WMD8B	7.9	$325,947
BBSRDL12	8.7	$319,451
YTA43A	7.9	$314,003
CBW6	10.2	$303,312
YDA1B	2.0	$302,226
446E	7.1	$295,934
CBT8A	9.5	$294,639

LGV2B	6.5	$290,580
MLY3	8.0	$283,787
HWD2B	6.1	$278,545
BTN1	4.5	$276,681
CPL2A	5.4	$276,363
Total	**389.8 MWh**	**$17,187,567**

4.5 Assumptions/ Methodology

This category of Distribution Augmentation is to specifically target distribution feeders that have significant customer minute contribution to Energex's reliability performance. The following methodology has been applied to justify this program:

- The 5-year average annual customer minutes for each feeder was calculated based on historic reliability performance. This was determined simply by summating the customer minutes per feeder over the last five years and dividing by 5.
- The average energy per customer minute was then calculated based on RIN data. The total kwh consumption per feeder was divided by the metered days (total number of days customers were metered on the feeder over the year) to provide this figure.
- The average annual customer minutes observed on each feeder was then multiplied by the average energy per customer minute to determine the average energy lost on the feeder over the last 5 years.
- The VCR rate was then individually calculated per feeder based on the customer-mix across Agriculture, Commercial, Industrial and residential categories and multiplying by the AER published VCR rates as detailed in AER - Values of customer reliability update summary - December 2022.pdf.

QLD Rates	$/kwh $2022
Agriculture	42.14
Commercial	49.54
Industrial	70.97
Residential	26.44

- By Multiplying the VCR rate by the average annual energy lost at a feeder level with adjustment for self-consumed solar, the maximum annual potential VCR investment amount per feeder was calculated.
- A reliability improvement hurdle/benefit of 10% was applied to determine a lower bound of improvement investment benefit that could be achieved and justified per feeder. A reliability improvement of 10% was selected as it is the minimum reliability performance improvement that can be expected based on historic reliability projects and Energex's Standard for Sub-transmission and Distribution Planning.
- A final potential investment value was then determined by applying the WACC and assuming a project reliability benefit of 10% would be realised over a 10-year life. A 10-year life was conservatively selected as this is based on a worst case bare minimum life Energex would expect out of some assets installed to address reliability constraints (for example a recloser). With a potential investment value per feeder now determined,

provided that the project cost per feeder is less than this value, the outcome will be NPV positive.

- Based on the above, a selection of NPV positive potential feeders were then selected to formulate this program, and the proposed expenditure in this category.

In addition to the above justification, maintaining reliability performance of the network will also provide safety benefits and improve the operability of the network as more ties, remotely operable recloses and switches will be installed on the network as part of this program.

5 OPTIONS ANALYSIS

As part of this analysis only one option has been explored which involves creating a low risk conservative unplanned network reliability program of work, including the most NPV positive feeders as determined through VCR and CECV analysis.

5.1 Economic Analysis

5.1.1 Cost summary 2025-30

The counterfactual is to not have an unplanned reliability program that specifically targets unplanned outages, resulting in zero expenditure across the regulator period. A cost summary of the proposed expenditure compared with the counterfactual is provided in Table 4 below.

Table 4 Cost summary 2025-30 ($m, real 2022-23)

Option	2025-26	2026-27	2027-28	2028-29	2029-30	Total 2025-30
Counterfactual (Base)	-	-	-	-	-	-
Option 1	1.83	1.86	1.99	2.14	2.26	10.09

5.1.2 NPV analysis

NPV analysis has been performed based on a number of conservative assumptions. Further to this sensitivity analysis applying monte Carlo simulation has also then been performed around these assumptions. Assumptions and sensitivity considerations are detailed in the following points:

1) Each project will deliver an ongoing benefit for 10 years. Sensitivity Analysis was performed over a 7-13 year benefit period.
2) Reliability Improvement benefit achieved per project is 10%. A deviation of +-2% was applied as part of sensitivity analysis. As detailed previously reliability improvement of 10% was selected as it is the minimum reliability performance improvement that can be expected based on historic reliability projects.
3) The average cost per project is $268 705 which is based on the cost of similar historic network reliability projects undertaking in the 2020-2025 regulatory period. A sensitivity was applied using cost from $228,705 to $308,705.

Table 5 details NPV sensitivity analysis performed with the variables of the expected years of benefit the project is expected to deliver and the percentage reliability improvement expected from the project.

Table 5 NPV Sensitivity Analysis with Benefit Years and % reliability Improvement

		% Reliability Improvement due to Reliability Project				
Benefit (years)		12.0%	11.0%	10.0%	9.0%	8.0%
	13	$12,041,511	$10,161,041	$8,280,571	$6,400,101	$4,519,631
	12	$10,755,860	$8,992,095	$7,228,330	$5,464,565	$3,700,800
	11	$9,425,213	$7,782,237	$6,139,262	$4,496,286	$2,853,311
	10	$8,047,992	$6,530,034	**$5,012,075**	$3,494,117	$1,976,159
	9	$6,622,569	$5,234,003	$3,845,438	$2,456,872	$1,068,307
	8	$5,147,255	$3,892,612	$2,637,968	$1,383,324	$128,680
	7	$3,620,306	$2,504,271	$1,388,236	$272,201	**-$843,834**

NPV analysis based on a 10-year benefit, and an expected 10% reliability improvement has been undertaken for the proposed program. This analysis details the program is expected to deliver a $4.9 million positive NPV outcome as shown in bold in Table 5.

When applying sensitivity analysis and monte Carlo simulation on the NPV results, a 95.8% confidence level that a positive NPV outcome was achieved. These results can be seen in Figure 2.

NPV Result	Random Output	Mean	Standard Deviation	Probability of Greater Than	$0
	$6,330,876	$4,361,174	$2,513,635	95.80%	
	95% Confidence Level Interval	Upper Limit	Lower Limit	Minimum	Maximum
	$220,326	$6,551,201	$6,110,550	-$2,355,732	$11,978,039

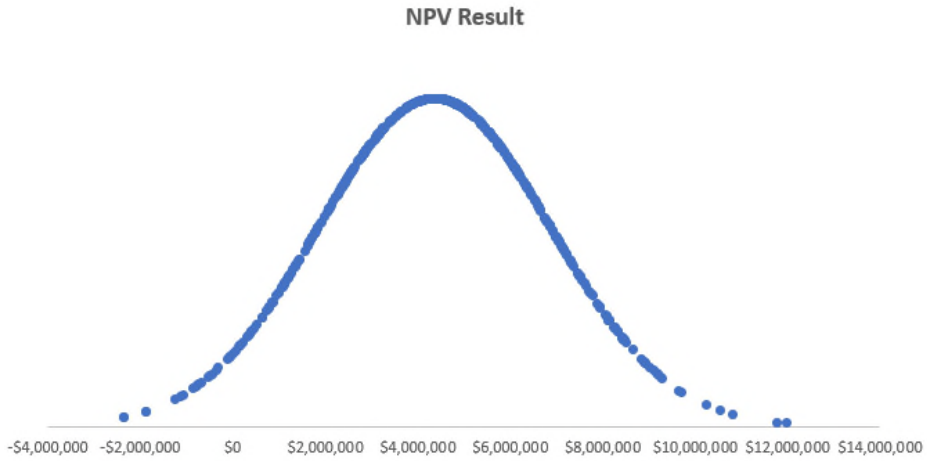

Figure 2 Monte Carlo simulation output of NPV outcomes

5.2 Optimal Timing

The individual projects that make up the Distribution Augmentation program are typically shorter duration projects of two years and under. Operating on a relatively short duration ensures projects can proceed efficiently with minimal risk of timing inaccuracy. The project timing is created to meet the associated timing of constraints and associated regulatory obligations. Reliability expenditure is based on VCR and CECV modelling, and the predicted network performance. Expenditure in this area increases over the regulatory period to allow for delivery resources to be incremented to achieve the delivery of this work. Expenditure also increases to align with expected network growth and expected increasing customer dependence on network performance associated with increased reliance on the network.

The program of work presented in this business case is formed by a large number of smaller projects. A prudent level of investment is assured by prioritising the timing and need for projects that make up this program based on risks, ensuring a range of viable alternative options are considered to minimise the cost and optimise the timing of any investments made within the network. Each individual investment that forms part of this program will be approved via an individual stand-alone business case with financial delegate approval before funding is released.

6 RECOMMENDATION

It is recommended to establish the program of work, and breakdown as detailed in this business case. Table 6 summarises the key components of this program.

Table 6 Options Analysis Scorecard

Criteria	Detail
Net Present Value	Individual Planned Augmentation Reliability projects are issued based on positive NPV outcomes
Investment cost (TCO)	$10.09m
Investment Risk	Medium
Benefits	Meet Regulatory Obligations in terms of Distribution Authority requirement. Meet customer reliability expectations
Delivery time	This business based is for a rolling program made up of numerous individual projects that typically have a life cycle of less than 24 months
Detailed analysis – Benefits	Network reliability performance will also be addressed by economically justifiable (with Net Present Value positive) investments.
Detailed analysis – Risks	Conservative assumptions have been applied to the analysis in this business case and hence the funding requested is low in comparison to the amount that could otherwise be justified. This business case does not consider constraints in the 2020-2025 regulatory period that may not have been addressed during this period or associated work/investment that carry over from the 2020-2025 period into the 2025-2030 period which is expected to be significant.
Detailed analysis - Advantages	This option results in a distribution network where network reliability performance does not deteriorate and is justified by cost benefit analysis.

APPENDICES

Appendix 1: Alignment with the National Electricity Rules

Table 7 Recommended Option's Alignment with the National Electricity Rules

NER capital expenditure objectives	Rationale
A building block proposal must include the total forecast capital expenditure which the DNSP considers is required in order to achieve each of the following (the capital expenditure objectives):	
6.5.7 (a) (1) meet or manage the expected demand for standard control services over that period	See Section 3.1 of this Business Case
6.5.7 (a) (2) comply with all applicable regulatory obligations or requirements associated with the provision of standard control services;	See Section 4 of this Business Case
6.5.7 (a) (3) to the extent that there is no applicable regulatory obligation or requirement in relation to: (i) the quality, reliability or security of supply of standard control services; or (ii) the reliability or security of the distribution system through the supply of standard control services, to the relevant extent: (iii) maintain the quality, reliability and security of supply of standard control services; and (iv) maintain the reliability and security of the distribution system through the supply of standard control services	See Section 3.1 and 4 of this Business Case
6.5.7 (a) (4) maintain the safety of the distribution system through the supply of standard control services.	Not Applicable as not Safety Driven
NER capital expenditure criteria	**Rationale**
The AER must be satisfied that the forecast capital expenditure reflects each of the following:	
6.5.7 (c) (1) (i) the efficient costs of achieving the capital expenditure objectives	See Section 4.5 of this Business Case
6.5.7 (c) (1) (ii) the costs that a prudent operator would require to achieve the capital expenditure objectives	See Section 4.5 of this Business Case
6.5.7 (c) (1) (iii) a realistic expectation of the demand forecast and cost inputs required to achieve the capital expenditure objectives	See Section 4.5 of this Business Case

Appendix 2: Reconciliation Table

Table 8 Reconciliation

Expenditure	DNSP	2025-26	2026-27	2027-28	2028-29	2029-30	2025-30
Expenditure in business case $m, direct 2022-23. In combination with Distribution Feeder Augmentation Capacity and Voltage, aligns with the input tab in the Capex model.	Energex	$1.83	$1.86	$1.99	$2.14	$2.26	**$10.09**

Appendix 3: Glossary

The following definitions, abbreviations and acronyms appear in this business case:

Definition, abbreviation, or acronym	Definition
AER	Australian Energy Regulator
CAPEX	Capital Expenditure
CECV	Customer Export Curtailment Value
DA	Distribution Authority
DNSP	Distribution network Service Provider
EQL	Energy Queensland Limited
HV	High Voltage (distribution feeder voltages)
LV	Low Voltage (Typically 230V single phase or 400V three phase)
NEM	National Electricity Market
NPV	Net Present Value
POE	Probability of Exceedance
SWER	Single Wire Earth Return
Unplanned Outage	As outage that occurred on the network that was not initiated by the DNSP (e.g. a branch bringing down a line)
VCR	Value of Customer Reliability