Revised Proposal

Attachment 5.13.M.17

Sub-transmission Towers program CBA summary

January 2019

Attachment 5.13.M.17

Sub-transmission Towers program CBA summary

Introduction

Ausgrid has reviewed the risks associated with Sub-transmission Towers by undertaking a quantitative risk assessment. This document covers the outcomes of cost benefit analysis, and should be reviewed in conjunction with the cost benefit analysis (CBA) modelling methodology report[1].

Scope

This model covers the forecast mapped to the following RIN categories:

- Poles - > 66kV & <= 132kV; Steel

Analysis Outcome

The analysis was completed using historical data up to and including FY18. The CBA models forecast risk from FY19 onwards. The quantities included in FY19 are reflective of Ausgrid's committed program in this year.

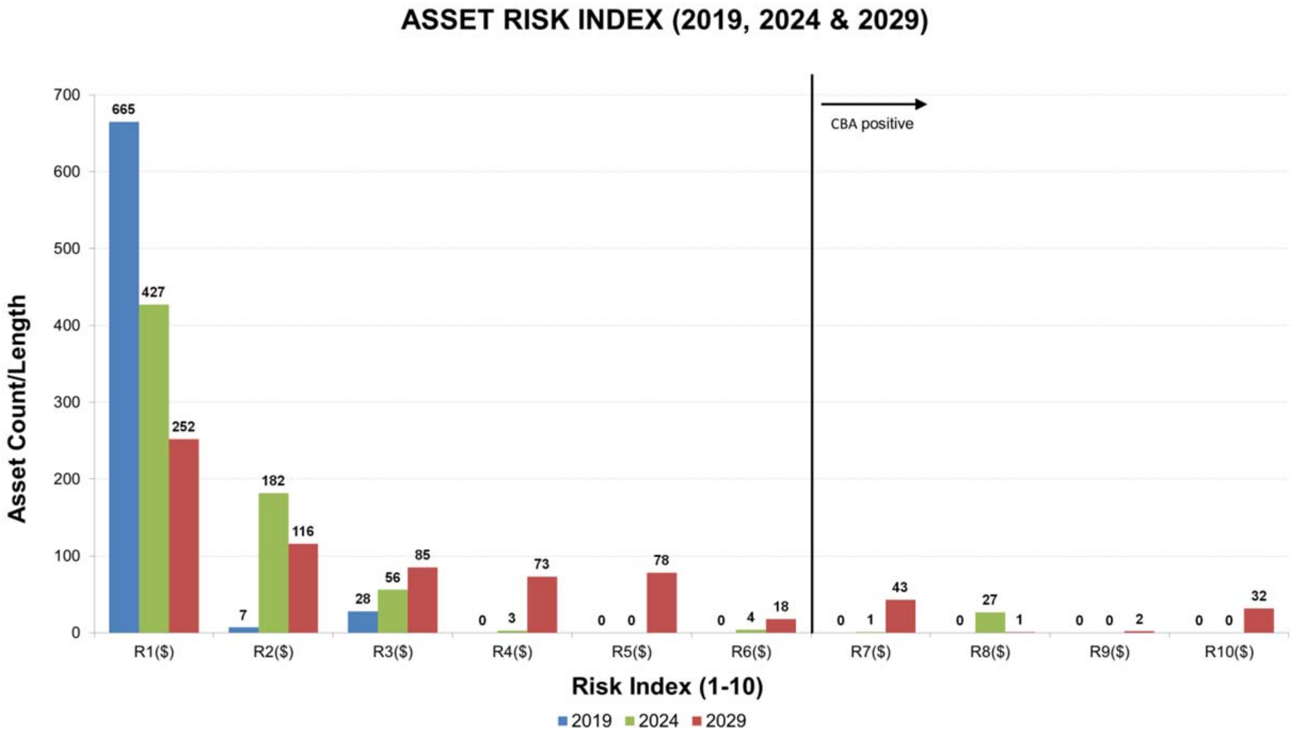
Based on the analysis completed, the model output is supporting the replacement of 28 Sub-transmission Towers by the end of FY24. This includes a total of 4 Sub-transmission Towers which have been committed in FY19 and a total of 24 Towers which are cost benefit positive between FY20 to FY24.

In forming this decision Ausgrid considered three options and performed sensitivity analysis as described in this document. Ausgrid is recommending Option 3 – levelled replacement of all assets cost benefit positive by the end of FY24 for this asset category. This option requires that some replacements are initiated before replacement becomes cost benefit positive so that replacement of all assets which are cost benefit positive can be reasonably achieved by the end of FY24.

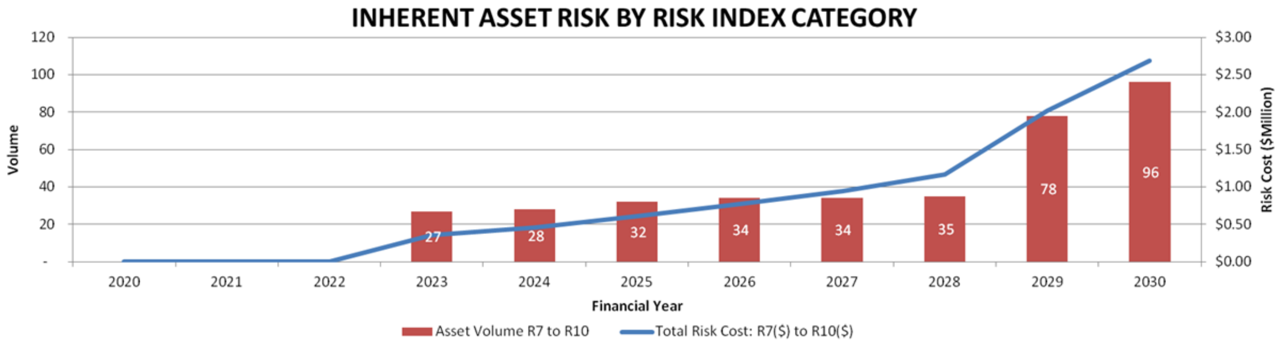
Risk Index

The normalised risk index below considers the probability of failure, consequence of failure and the annualised replacement cost.

[1] Attachment 5.13.M.0 – Repex program CBA modelling methodology



The inherent risk of Sub-transmission Towers that are cost benefit positive is shown in the figure below.

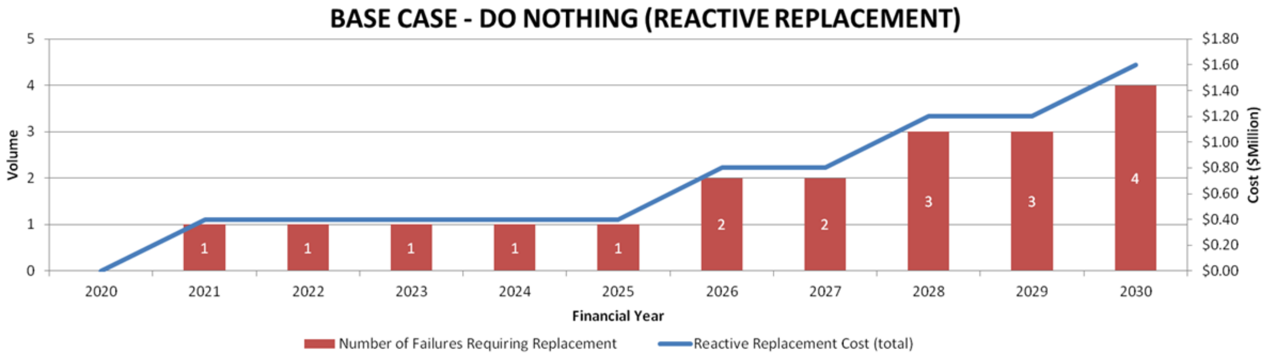


Option One – Base Case (Reactive Replacement)

Under a base case scenario, if Ausgrid were to adopt a reactive replacement strategy, the minimum replacement quantity during FY20 to FY24 is 4 Sub-transmission Towers. The table below shows the quantity of assets which will require reactive replacement in the year that they are forecast to fail.

Financial Year	FY20	FY21	FY22	FY23	FY24
Quantity for replacement	0	1	1	1	1

This quantity represents the minimum required replacement volume with no proactive strategy adopted.

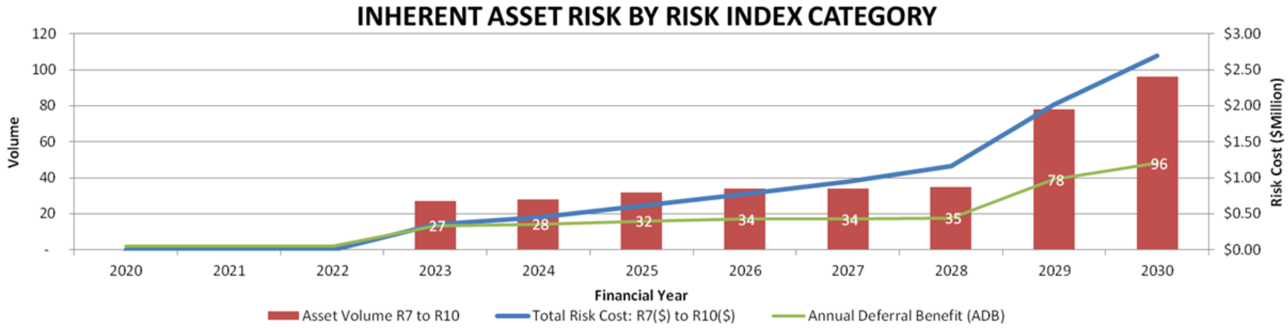


Option Two – Replace where cost benefit positive

Given Ausgrid plans to replace 4 Sub-transmission Towers in FY19, the recommended replacement quantity from the model is 24 Towers. The table below shows the year in which these assets should be replaced based on when the benefit to customers exceeds the annualised deferral benefit:

Financial Year	FY20	FY21	FY22	FY23	FY24
Quantity for replacement	0	0	0	23	1

Based on this replacement quantity, the annual deferral benefit against the inherent risk for all assets included in and above Risk Index 7 is shown in the figure below. The annual deferral benefit remains lower than the total risk as Ausgrid is not targeting any assets that are not cost benefit positive.



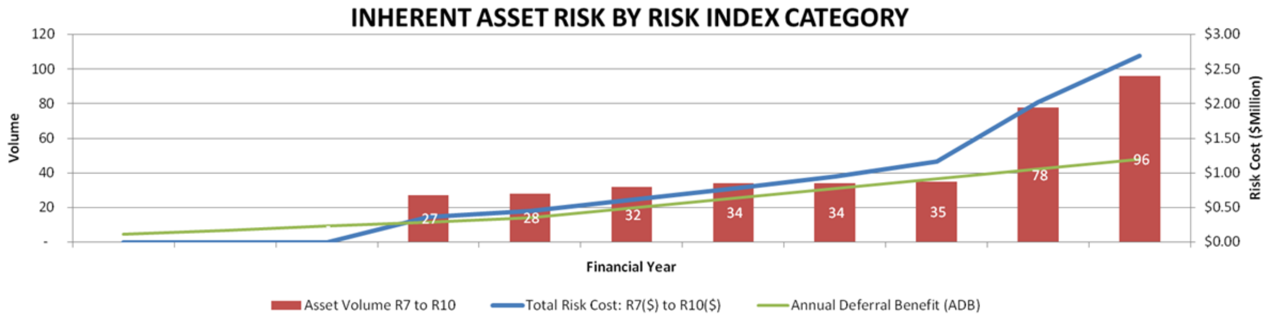
This option provides the maximum benefit to customers as it leads to the avoidance of risk at the point at which the benefits exceed the costs. However, the large delivery requirement in FY23 will not be reasonably achievable due to the constraints on network access, physical access and staff resourcing.

Option Three – Replace all cost benefit positive by the end of the period

Given the delivery constraints, under this option Ausgrid have considered the levelled replacement of all Sub-transmission Towers that are cost benefit positive by the end FY24. This results in 4 Sub-transmission Towers being replaced in the first year and 5 Sub-transmission Towers replaced in the remaining four years.

Financial Year	FY20	FY21	FY22	FY23	FY24
Quantity for replacement	4	5	5	5	5

Based on this replacement quantity, the annual deferral benefit against the inherent risk for all assets above Risk Index 7 is shown in the figure below.



This option balances achieving value for customers with consideration of the constraints associated with efficient delivery.

Data input

		Data Source
Population	700	SAP – Asset Register
Object Types	TOWER – Tower	SAP – Asset Register
Conditional & Functional Failures / Time Period	206 failures 6 years	SAP – Defect Records
Asset standard life	54.5 years	RAB life
WACC	3.90%	Regulated Rate

Planned Cost

Given the variation in annual cost, a weighted average for the period per asset was used in this model.

Cost	Data Source
$333,812	2020-24 Revised Regulatory Proposal (FY19 real direct costs +25% of indirect costs)

Weibull parameters

Developed by applying asset age to failure correlation using Ausgrid historical failure and asset data.

β_{good}	13.8898	$\beta_{average}$	14.2780	β_{poor}	14.6662
η_{good}	70.0718	$\eta_{average}$	62.4268	η_{poor}	55.9571

b (intercept)	-59.0252

Adjustments factors

Probability of Failure (PoF)	• Actual Failure Data • Age • Equipment construction type (DS4 style) • Structural Utilisation • Proximity to saltwater • Degree of refurbishment completed
Probability of Consequence (PoC)	• Feeder criticality • Traffic route • Bushfire area

Model calculated failures

	2020	2021	2022	2023	2024
Failures	45	56	71	88	109

Sensitivity

Ausgrid tested the sensitivity of the applied grossly disproportionate factor by applying a factor of 6, for all safety and fire severities. The impact of these changes is a no change to the overall recommended replacement quantities within the FY20 to FY24 period.

Modelled inherent incident consequences

In determining the probability of severity, Ausgrid has utilised available information to determine the rate of occurrence of an event by each severity. These values were then tested for sensitivity. Common mode failure of critical feeders was also reviewed to determine if the loss of a tower could result in total loss of supply to an area.

Safety

Worker Safety ICR – 0.00% (Ausgrid's recorded ICR)

Public Safety ICR – 0.00% (Ausgrid's recorded ICR)

Severity	Cost of Consequence	Probability of Consequence	Grossly DF	Probability of Severity	Years until event
Severe	$ 4,469,292	n/a	10	n/a	n/a
Major	$ 446,929	n/a	8	n/a	n/a
Moderate	$ 44,693	n/a	6	n/a	n/a
Minor	$ 4,469	n/a	4	n/a	n/a
Insignificant	$ 447	n/a	2	n/a	n/a

Average **safety** consequence per asset: $n/a.

There is no recent history of tower failures resulting in safety incidents for workers or the general public, as such there are negligible consequences modelled.

Fire

ICR – 0% (Industry recorded ICR)

Severity	Cost of Consequence	Probability of Consequence	Grossly DF	Probability of Severity	Years until event
Severe	$ 66,000,000	n/a	10	n/a	n/a
Major	$ 6,600,000	n/a	8	n/a	n/a
Moderate	$ 660,000	n/a	6	n/a	n/a
Minor	$ 66,000	n/a	4	n/a	n/a
Insignificant	$ 6,600	n/a	2	n/a	n/a

Average **fire** consequence per asset: $n/a.

There is no recent history of towers failures resulting in fire incidents, as such there are negligible consequences modelled.

Environment

ICR – 0% (Ausgrid's recorded ICR)

Severity	Cost of Consequence	Probability of Consequence	Grossly DF	Probability of Severity	Years until event
Severe	$ 10,193,119	n/a	1	n/a	n/a
Major	$ 4,558,501	n/a	1	n/a	n/a
Moderate	$ 1,019,312	n/a	1	n/a	n/a
Minor	$ 101,931	n/a	1	n/a	n/a
Insignificant	$ 10,193	n/a	1	n/a	n/a

Average **environment** consequence per asset: $n/a.

There is no recent history of towers failures resulting in environmental incidents, as such there are negligible consequences modelled.

Loss of supply

Ausgrid's failure data has been reviewed to determine the proportion of failures resulting in unserved energy, with consideration of the number of outages recorded using data from Ausgrid's outage management system (OMS). Common mode failure of redundant critical feeders has only been considered as part of the loss of supply considerations.

Outage Type	Feeder	Data Source
Proportion of failures resulting in unserved	0.015%	Estimated

Outage Type	Feeder	Data Source
energy		
VCR	$40.73/kWh	AEMO / AER
Average interruption duration	24.0 hrs	Estimated
Time without supply	0.004 hrs	Calculated

Average **loss of supply** consequence per asset: $5,216 per event.

The proportion of failures resulting in unserved energy at the current failure rate would result in a loss of supply event approximately every 187 years. As the proportion of failures resulting in unserved energy and the associated average interruption duration are only able to be built from estimates due to no events within the observation period (noting that Ausgrid have previously recorded one outside the observation period), the sensitivity of removing the loss of supply consequence was tested. This would result in no cost benefit positive tower replacements until the end of FY24 however is not considered a reasonable scenario.

Finance

		Data Source
Annual deferral benefit of reactive	$15,036	20% increase on planned replacement cost applied at the WACC
Repair cost	$9,616	FY13-FY18 actuals per repair
Proportion replaced	1%	Estimated from structural component models including coatings
Weighted replacement/repair cost	**$9,670**	Calculated
Maintenance original asset per annum	$200	FY13-FY18 actuals
Maintenance replacement asset per annum	$40	Estimate based on concrete pole inspection cost and no costs in first 15 years for two poles
Maintenance benefit per asset per annum	**$160**	Calculated

Average **financial** consequence/benefit per asset: $9,830 per event.

AVERAGE TOTAL CONSEQUENCE per asset: $15,046 (including POC x C($))