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Review of the ElectraNet Capital Expenditure Economic Assessment Framework and its Application

A report prepared for ElectraNet in the context of the regulatory determination for the 2019 to 2023 period

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Introduction

During the course of 2015, ElectraNet developed an improved economic assessment framework with the assistance of HoustonKemp to ensure that such assessments were conducted consistently across the organisation, both in terms of the economic principles applied as well as the criteria, techniques and assumptions used. Applying a consistent framework assists in demonstrating that any specific assessment undertaken is robust, both internally (eg, to senior management) as well as externally (eg, to the Australian Energy Regulator and other stakeholders).

The ElectraNet economic assessment framework developed is comprised of the following:

- Guidelines for Undertaking Cost Benefit Analyses;
- a procedural guideline regarding how to undertake cost-benefit modelling for asset management purposes;
- a procedural guideline outlining how to undertake cost-benefit modelling for corporate (or 'non-network'[1]) purposes; and
- separate Excel model templates for undertaking economic assessments in the context of incurring expenditure for asset management and corporate (or 'non-network') purposes, respectively.

ElectraNet has most recently applied this framework in the context of its regulatory proposal for the forthcoming 2019 to 2023 regulatory control period. Specifically, ElectraNet has applied the framework to a number of cases where it considers capital expenditure (capex) is required to address a certain need and, in doing so, has sought to identify the most efficient option to meet this need.

HoustonKemp has been engaged by ElectraNet to review the application of the economic assessment framework developed. Specifically, ElectraNet has requested that HoustonKemp review 61 capex assessments undertaken by ElectraNet and provide assurance that:

- the economic assessment framework developed has been applied correctly; and
- that calculations and formulae contained in the assessments are correct.

We understand that the 61 capex assessments represent approximately 84 per cent[2] of ElectraNet's capex proposal for the 2019 to 2023 regulatory control period.

This report is structured in two primary sections, ie:

- section 1 – provides a summary of the ElectraNet economic assessment framework and why we consider it to be consistent with best practice; and
- section 2 – sets out our approach to reviewing ElectraNet's economic assessments and the process we undertook in assisting ElectraNet. Key findings and conclusion from our review are also presented in this section.

A summary of the 61 individual capex economic assessments reviewed by HoustonKemp is provided in Appendix A1.

Appendix A2 summarises the key inputs and assumptions employed by ElectraNet in undertaking these assessments.

[1] We note that the use of the term 'non-network' in this report and the ElectraNet economic assessment framework is distinct from the traditional definition of 'non-network' (eg, demand management, storage, generation support etc). Throughout this report and the ElectraNet economic assessment framework 'non-network' refers to activities that are not directly relevant to the transmission network nature of ElectraNet's core business, eg, corporate, IT, communications, payroll systems etc.

[2] We understand that this percentage excludes 'work in progress' (WIP) projects, ie, projects that are currently underway but have continuing expenditure into the 2019 to 2023 regulatory control period.

1. Review of the ElectraNet economic assessment framework

In our opinion, the framework developed jointly by ElectraNet and HoustonKemp for undertaking economic assessments is consistent with best practice for such assessments.

Specifically, the framework includes the prerequisites that an economic assessment requires in order to robustly identify the most efficient decision – such as:

- the requirement for more than one project option to be considered;
- requiring that costs and benefits are measured relative to a 'business as usual' base case;
- allowing for risk and uncertainty to be accommodated; and
- assessing the robustness of results.

The framework also includes a number of characteristics we consider are best practice when undertaking such assessments. These include:

- the requirement to comprehensively document all sources and assumptions;
- standardisation of common approaches to input estimates, general parameters and modelling techniques; and
- a number of design features and modelling conventions that should be adhered to when developing such models.

The economic assessment framework developed is also broadly consistent with, and reflective of, accepted industry practice, eg, the AER's Regulatory Investment Test for Transmission and Regulatory Investment Test for Distribution Application guidelines and Grid Australia's Regulatory Investment Test for Transmission (RIT-T) Cost Benefit Analysis Handbook.[3]

The sections below outline how the framework prescribes each of these elements and why we consider them to be important in the context of undertaking economic assessments.

1.1 A range of options are required to be considered

The explicit inclusion of more than one credible option is consistent with best practice when undertaking economic assessments. Doing so demonstrates to third parties (ie, senior management and external stakeholders) that the analysis has taken into account a range of options and that the option identified as preferred can be considered to be the most efficient.

The ElectraNet framework specifies typical types of options that should be considered, eg:

- do nothing (continuation of the status quo);
- undertaking the investment or expenditure now;
- staging the investment or expenditure over time;
- deferring the investment or expenditure to a later point in time;
- including different technical specifications that meets the need for investment or expenditure; and
- any non-network options (alternatives for network investments).

[3] See: AER, *Better Regulation – Regulatory investment test for distribution Application Guidelines*, 23 August 2013; and Grid Australia, *RIT-T Cost Benefit Analysis Grid Australia Handbook*, July 2011; AER, *Regulatory Investment Test for Transmission Application Guidelines*, June 2010.

The framework also specifies that options identified for consideration in the economic assessment should be 'credible', ie, that they are technically and economically feasible within the same order of magnitude relative to other options (ie, they have a similar cost for similar benefits).

1.2 Costs and benefits are measured relative to a 'business as usual' base case

A 'business as usual' base case should be included in a cost benefit analysis, which is typically a 'do nothing' option, ie, the continuation of the status quo. Structuring the analysis in this manner minimises the complexity of the modelling required as only changes relative to the base case need to be considered. It also allows every option considered to be compared on an equivalent basis, ie, relative to the base case.

1.3 Risk and uncertainty can be accommodated

The ElectraNet economic assessment framework has been developed to cater for the risk of transmission equipment failures. The failure of transmission equipment is inherently uncertain and, when they do fail, there can be a significant cost imposed on the network, as well as downstream customers.

Reductions in the expected cost arising from equipment failures ('risk cost reductions') are accommodated in the economic assessment framework. In particular, the probability of failure (PoF), the likelihood of consequence (LoC) and the cost of consequence (CoC) can be estimated exogenously for various options (as well as the base case) and simply entered in as a category of benefit – the product of these three variables for an option (or the base case) provides an estimate of the expected cost arising from equipment failures.

In this way, if an option decreases the expected cost arising from equipment failures relative to the base case, then it will result in a benefit in the assessment.

The ElectraNet economic assessment framework also allows risk and uncertainty to be investigated and accommodated through the use of sensitivity and scenario testing as well as threshold analyses. These tests allow a variety of assumptions to be investigated and ensures that the robustness of the assessment results to the underlying assumptions is tested, ie, it minimises the risk that a suboptimal decision is made by relying only on the base set of assumptions. The way in which these various tests feature in the economic assessment framework is outlined in the section below.

1.4 The robustness of assessment results is tested

A well-executed and documented testing of a cost-benefit analysis' underlying assumptions demonstrates that the preferred option has been considered against different conditions and therefore strengthens the robustness of a preferred option being recommended.

ElectraNet's framework outlines three different types of tests relevant to assessing the robustness of a preferred option, being:

- sensitivity testing – changing key modelling parameters or estimates one at a time to demonstrate the consistency (or inconsistency) of option ranking in light of those changes;
- scenario testing – scenarios should be developed based on sensitivities that change the selection of the preferred option, ie, if sensitivity analysis suggests a change in a parameter or input estimate would result in a different preferred option then the parameter or input estimate should be used to construct scenarios; and
- threshold analysis – which can be applied to test what value (eg, minimum or maximum) a particular assumption would need to take in order for the preferred option to change.

The ElectraNet framework outlines a range of typical sensitivity tests that should be conducted – both generally and for asset management and corporate ('non-network') applications, respectively. Specifically, the framework suggests investigating the following sensitivities:

- general sensitivities:
  - costs – capex;
  - Value of Customer Reliability (VCR) estimates;
  - discount rates; and
  - load forecasts
- asset management sensitivities:
  - costs – capex
  - VCR estimates;
  - USE estimates;
  - discount rates; and
  - load forecasts.
- corporate ('non-network') sensitivities:
  - costs – capex and/or opex; and
  - discount rates.

The framework also provides guidance on the general process in developing different scenarios to assess a preferred option for robustness, as well as an example of how to conduct threshold analyses.

1.5 All sources and assumptions are comprehensively documented

The framework developed stipulates that all sources, inputs and assumptions be clearly documented and referenced. Specifically, the framework allows for a specific input section in the assessment models for all parameters and more specific inputs to be listed and sourced.

Developing economic assessment models in this manner is best practice as it ensures that the assessment model is an all-encompassing 'one stop shop' for the analysis, which means that a third party reviewing a model has sources and assumptions located in one place.

1.6 Standard approaches and parameters

The economic assessment framework sets out as a guiding principle that models should be designed to be as simple as possible while retaining sufficient capacity to rank options in order to identify the preferred option. To this end, the framework specifies a number of key elements of a simple but sufficient modelling framework that should be applied by ElectraNet staff in undertaking such assessments, ie:

- the use of financial years;
- using real dollars;
- applying real, pre-tax discount rates;
- using a terminal value approach to including capex;
- estimating opex as simply as possible for capital-intensive applications (eg, network investments);
- that the first year of the analysis should be the year in which expenditure is first incurred under any of the options; and

- ensuring that the time horizon for the analysis is the same for all options and of sufficient length to assess each option on a like-for-like basis (and of appropriate length in order to adequately assess the impact of the alternate options on future market benefits).

The framework also standardises the approach to be taken for estimating a number of benefit categories – generally as well as for each of the asset management and corporate ('non-network' applications). The framework provides an overview of the common benefit categories to the network applications, as well as the unique benefit categories across each of these applications – namely:

- benefit categories relevant for asset management:
  - involuntary load shedding; and
  - timing and amount of TNSP expenditure.
- benefit categories for corporate ('non-network'):
  - decreased expenditure (reduced opex budgets, labour cost savings and reduced expenditure on contractors);
  - increased revenues; and
  - improved service outcomes.

The framework defines each of these benefit categories and outlines how they should be estimated. This ensures all models are constructed in a consistent manner.

1.7 Applies best practice economic assessment modelling conventions

The economic assessment framework sets out a number of design features that should be adhered to when developing assessment models. These features ensure that the model is well organised and easy to understand and use, ie:

- set up the model and its elements in a clear and logical manner;
- models should be constructed and presented with sufficient clarity so that new users are able to quickly understand the model and view its input and outputs;
- automation of the model should be utilised wherever possible, especially in the case of key modelling output tables/charts;
- models need to incorporate flexibility to enable the users to test the robustness of the analysis (sensitivity/scenario testing and threshold analysis), and to adapt the basic framework to accommodate different options; and
- models should adopt common Excel conventions.

The framework provides guidance on each of these conventions as well as Excel template models that demonstrate how to apply each convention.

Specifically, HoustonKemp developed Excel template models for both network asset management and corporate ('non-network') applications, which embody the principles and conventions listed above. These models serve as a starting point for network asset management and corporate ('non-network') cost benefit assessments.

These Excel templates complement the procedural documents and aim to harmonise the look and feel of each cost benefit assessment through standardising the way inputs are entered. For example, the two procedural documents and accompanying Excel templates provide staff preparing cost benefit assessments with practical guidance on how inputs should be entered into the model and a number of worked examples are included in each procedure document.

2. Application of the economic assessment framework to the 2019 to 2023 Regulatory Proposal

ElectraNet has applied the economic assessment framework developed during 2015 in the context of its regulatory proposal for the forthcoming 2019 to 2023 regulatory control period. Specifically, the framework has been applied to a number of instances where ElectraNet considers capex is required to address a certain need in order to identify the most efficient option to meet this need.

HoustonKemp has been engaged by ElectraNet to undertake a review of ElectraNet's application of its assessment framework to a number of projects. Specifically, HoustonKemp has reviewed ElectraNet's application of the economic assessment framework to 61 capex assessments. We understand that the capex projects represent approximately 84 per cent[4] of ElectraNet's capex proposal for the 2019 to 2023 regulatory control period.

The capex projects reviewed are comprised of:

- 27 projects involving the replacement and/or refurbishment of transmission lines – totalling $158.6 million in capex;
- 26 projects for non-lines asset management purposes – totalling $148.7 million in capex; and
- 8 projects for corporate (or 'non-network') purposes – totalling $38 million in capex.

This section describes our approach and the process we have adopted to review these assessments, provides a summary of the key findings from our review and our overall conclusion from the review process. Appendix A1 presents a summary of the 61 cost benefit assessments reviewed and the outcomes of each. Appendix A.2 summarises the key inputs and assumptions adopted by ElectraNet in undertaking these assessments.

2.1 Our approach to reviewing ElectraNet's cost benefit assessments

We adopted a systematic approach in reviewing each cost benefit assessment, which focuses on the following three areas:

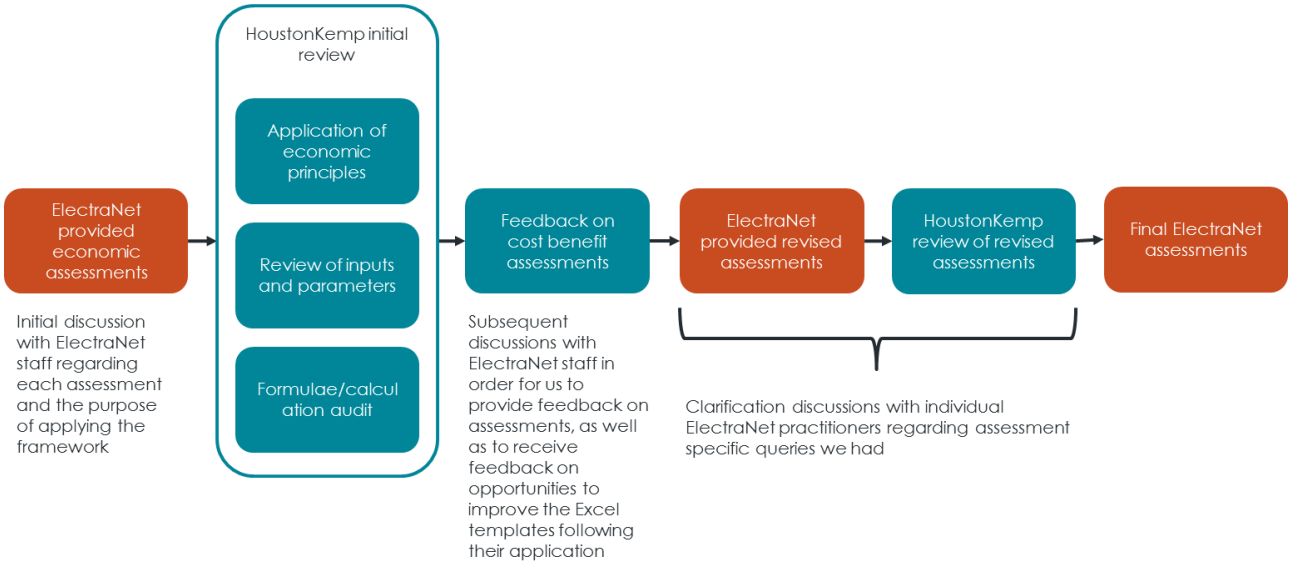
1. the application of economic principles;
2. a review of input parameters; and
3. an audit of all formulae and calculations.

Throughout the review process we worked closely with ElectraNet staff to ensure that each assessment was correctly understood from our end and that how the framework was to applied to each assessment was made clear to ElectraNet practitioners.

Our approach to reviewing the application of the framework by ElectraNet is summarised in Figure 2.1 below.

[4] We understand that this percentage excludes 'work in progress' (WIP) projects, ie, projects that are currently underway but have continuing expenditure into the 2019 to 2023 regulatory control period.

Figure 2.1: Approach to reviewing cost and benefit assessments



In reviewing the application of economic principles, we focused on ensuring that each application includes the prerequisites that an economic assessment requires in order to robustly identify the most efficient decision. These include the best practices set out in the Guideline for Undertaking Cost Benefit Analyses, as well as the procedural documents for network asset management and corporate (or 'non-network') applications, ie:

- that multiple project options have been identified and assessed;
- that each assessment includes an appropriate 'business as usual' base case; and
- ensuring the robustness of the results from each assessment have been explored, by way of sensitivity analysis, applying different scenarios and/or threshold analyses (where relevant).

In undertaking a review of inputs and parameters, we evaluated four primary components – namely:

- whether the assessments undertaken by ElectraNet have correctly applied the standardised parameters and approaches as set out in the two procedural documents for network asset management and corporate ('non-network') investments. Where cost benefit assessments departed from standardised parameters, we ensured that an explanation has been provided;
- whether estimated cost and benefit inputs made sense in terms of how inputs varied over time and in magnitude;[5]
- whether costs have been appropriately allocated and entered as capital expenditure (where depreciation and terminal values need to be accounted for) or operating cost; and
- whether sources and assumptions have been appropriately documented.

We have also undertaken a thorough audit of all formulae and calculations to ensure the two Excel templates for network asset management and corporate ('non-network') applications have been applied accurately to calculate net present values for each assessment. In undertaking this audit, we also looked for opportunities to improve the Excel templates so that the templates are able to accommodate a wide range of project proposals as simply as possible.

[5] We reviewed the appropriateness of inputs and parameters to the extent that those inputs did not exhibit unusual or unexpected trends and that their absolute magnitude appeared reasonable. However, our review of inputs and parameters does not provide assurance as to the validity of calculations and amounts that are technical in nature.

2.2 Our key findings and overall conclusion

Having undertaken our initial review of the assessments undertaken by ElectraNet, we provided the following feedback:

- the majority of assessments only included one project option (in addition to the base case);
- the base case had been entered as a project option – the majority of assessments included the base case as its own project option, in addition to everything being measured relative to the base case, which is unnecessary and increases the risk of human error;
- an error was identified in the discounting formula – the discounting formula did not adjust for the start year of the analysis relative to the base year of the analysis correctly; and
- sources and assumptions could be more fulsomely referenced – documentation of sources and assumptions were not comprehensively referenced and still required a third party to track down original sources.

In addition, we identified that the Excel templates had limitations that prevented input of complicated capex profiles. Specifically, the Excel template could not easily accommodate options made up of multiple capital assets over time with different asset lives.

We amended the Excel templates so that capital inputs could be entered on an individual asset basis and provided ElectraNet with updated templates. This modification ensured that the capital cost of options made up of multiple capital assets over time with different asset lives were correctly included in the models. These updated templates have been provided to ElectraNet, who took on board our feedback from the initial review and applied the updated Excel model templates and provided us with revised economic assessments.

The revised assessments provided by ElectraNet addressed our initial feedback via:

- including at least two project options (in addition to the base case);
- removing the base case from being an explicit project option (but retained estimating all costs and benefits relative to the base case);
- correcting the discounting error identified; and
- comprehensively documented all sources and assumptions in the Excel models.

Having reviewed the revised set of economic assessments undertaken by ElectraNet, we are satisfied that each has been undertaken consistent with the economic assessment framework developed in 2015. We therefore conclude that the revised cost benefit assessments are consistent with best practice in undertaking cost benefit assessments.

A summary of cost benefit assessments projects reviewed by HoustonKemp are listed in Appendix A1.

A1. List of project assessments reviewed by HoustonKemp

Tables in this appendix lists the network asset management projects reviewed by HoustonKemp. Details of the options under each project, their respective capital expenditure, 'central' NPV, and rankings are presented for each project. Table 2.1 sets out details for the 27 line projects reviewed, in descending order of the capital expenditure associated with each preferred option (ie, the option with the highest NPV).

Table 2.1: Lines replacement/refurbishment project assessments ($m)

	Project	Option	Capital expenditure	NPV[6]	Ranking[4]
1	Eyre Peninsula reinforcement project	Live reconductoring	73.6	88.1	3
		Live reconductoring (deferred by five years)	73.6	83.3	4
		132 kV double circuit[7]	**188.0**	**123.4**	**1**
		132 kV double circuit (deferred by five years)	188.0	103.6	2
2	14151 NWB - Monash No1 F1820 132 kV Line Insulator Systems Refurbishment	**Starting in 2018**	**11.1**	**14.8**	**1**
		Starting in 2023	11.1	8.7	2
3	14152 Keith - Kincraig F1828 132 kV Line Insulator Systems Refurbishment	**Starting in 2018**	**9.3**	**13.2**	**1**
		Starting in 2023	9.3	7.9	2
4	14076 Line Support Systems Refurbishment	**Starting in 2018**	**8.8**	**77.4**	**1**
		Starting in 2023	8.8	45.3	2
5	14158 TIPS - Cherry Gardens F1903 275kV Line Insulator Systems Refurbishment	**Starting in 2018**	**6.2**	**131.6**	**1**
		Starting in 2023	6.2	86.7	2
6	14154 Kincraig - Penola West F1831 132 kV Line Insulator Systems Refurbishment	**Starting in 2018**	**5.5**	**9.7**	**1**
		Starting in 2023	5.5	5.8	2
7	14159 TIPS - Magill F1912 275 kV Line Insulator Systems Refurbishment	**Starting in 2018**	**5.1**	**85.4**	**1**
		Starting in 2023	5.1	53.1	2
8	14141 MWPS2 – MWPS1 F1853 132 kV Line Conductor and Earthwire Refurbishment	**Starting in 2018**	**4.2**	**99.5**	**1**
		Starting in 2023	4.2	82.4	2
9	14139 MWPS3 – MWPS2 F1849 132 kV Line Conductor and Earthwire Refurbishment	**Starting in 2018**	**4.2**	**82.5**	**1**
		Starting in 2023	4.2	68.6	2

[6] Ranking and NPV results have been presented using the 'central' set of assumptions of costs, benefits, discount rates and 'risk costs'. As noted in the body of the report, ElectraNet has also tested the robustness of these results to certain high and low scenarios.

[7] While a 132 kV double circuit full-rebuild was found to be the preferred option in this assessment, we understand that ElectraNet has included the lowest cost replacement option (ie, the live-line reconductoring option) in its ex ante capex forecast, since it is found to deliver positive net benefits in-itself, and will be commencing a formal Regulatory Investment Test for Transmission (RIT-T) to investigate all options for delivering reliable electricity supply to the Eyre Peninsula, including augmenting the network to 275kV capacity. Consequently, we understand ElectraNet has included a contingent project associated with reinforcing the Eyre Peninsula, where the trigger for investment is an option passing this RIT-T – we further understand that ElectraNet is proposing to recover only the capital costs associated with the preferred option over and above the amount included in the ex ante capex proposal for the live-line reconductoring option.

	Project	Option	Capital expenditure	NPV[6]	Ranking[4]
10	14160 Para - Tungkillo F1921 275 kV Line Insulator Systems Refurbishment	**Starting in 2018**	**3.9**	**24.3**	**1**
		Starting in 2023	3.9	15.1	2
11	14157 TIPS - Para No4 F1902 275 kV Line Insulator Systems Refurbishment	**Starting in 2018**	**3.0**	**93.2**	**1**
		Starting in 2023	3.0	62.3	2
12	14144 Waterloo East - MWPS4 F1888 132 kV Line Conductor and Earthwire Refurbishment	**Starting in 2018**	**2.7**	**13.5**	**1**
		Starting in 2023	2.7	11.9	2
13	14149 Waterloo – Mintaro F1805 132 kV Line Insulator Systems Refurbishment	**Starting in 2018**	**2.5**	**3.3**	**1**
		Starting in 2023	2.5	1.8	2
14	14161 PGW - Para F1940 275 kV Line Insulator Systems Refurbishment	**Starting in 2018**	**2.3**	**47.0**	**1**
		Starting in 2023	2.3	30.9	2
15	14153 South East - Mount Gambier F1829 132 kV Line Insulator Systems Refurbishment	**Starting in 2018**	**1.8**	**2.5**	**1**
		Starting in 2023	1.8	1.5	2
16	14143 Waterloo – Waterloo East F1806 132 kV Line Conductor and Earthwire	**Starting in 2021**	**1.7**	**1.5**	**2**
		Starting in 2026	1.7	1.3	1
17	14140 MWPS4 - Robertstown F1855 132 kV Line Conductor and Earthwire Refurbishment	**Starting in 2018**	**1.7**	**17.7**	**1**
		Starting in 2023	1.7	15.5	2
18	14142 Robertstown – MWPS3 F1847 132 kV Line Conductor and Earthwire Refurbishment	**Starting in 2018**	**1.7**	**13.5**	**1**
		Starting in 2023	1.7	11.3	2
19	14138 MWPS1 – NWB F1854 132 kV Line Conductor and Earthwire Refurbishment	**Starting in 2018**	**1.6**	**6.0**	**1**
		Starting in 2023	1.6	5.2	2
20	14150 Davenport - Leigh Creek F1813 132 kV Line Insulator Systems Refurbishment	**Starting in 2018**	**1.5**	**0.6**	**1**
		Starting in 2023	1.5	0.3	2
21	14156 Pelican Point – PGW F1901 275 kV Line Insulator Systems Refurbishment	**Starting in 2018**	**1.3**	**13.7**	**1**
		Starting in 2023	1.3	8.7	2
22	14146 Cherry Gardens - Happy Valley F1906 275 kV Line Insulator Systems Refurbishment	**Starting in 2018**	**1.3**	**12.6**	**1**
		Starting in 2023	1.3	8.9	2
23	14155 MBHPS3-Kanmantoo-Back Callington F1850 132 kV Line Insulator Systems	**Starting in 2018**	**0.8**	**1.4**	**1**
		Starting in 2023	0.8	0.9	2
24	14162 Para – Robertstown F1945 275 kV Line Insulator Systems Refurbishment	**Starting in 2018**	**0.8**	**1.6**	**1**
		Starting in 2023	0.8	1.0	2
25	14147 TIPS - New Osborne No3 F1714 66 kV Line Insulator Systems Refurbishment	**Starting in 2018**	**0.7**	**10.3**	**1**
		Starting in 2023	0.7	6.8	2
26	14148 TIPS - New Osborne No4 F1715 66 kV Line Insulator Systems Refurbishment	**Starting in 2018**	**0.7**	**10.0**	**1**
		Starting in 2023	0.7	6.6	2

	Project	Option	Capital expenditure	NPV[6]	Ranking[4]
27	14163 Para – Munno Para F1956 275 kV Line Insulator Systems Refurbishment	**Starting in 2018**	**0.6**	**4.3**	**1**
		Starting in 2023	0.6	2.8	2

Table 2.2 sets out capital expenditure, 'central' NPV, and rankings are presented for 26 non-lines asset management projects that have been reviewed. Projects are presented in descending order of the capital expenditure associated with each preferred option (ie, the option with the highest NPV).

Table 2.2: Non-lines asset management project assessments ($m)

	Project	Option	Capital expenditure	NPV[8]	Ranking[6]
1	14031 Protection Systems Unit Asset Replacement	**Starting in 2019**	**29.3**	**11.1**	**1**
		Starting in 2024	25.8	8.6	2
2	14085 Gawler East Connection Point[9]	**132/11kV Zone Substation**	**16.0**	**33.0**	**1**
		66/11kV Zone Substation	19.0	30.8	2
		33/11kV Zone Substation	34.0	19.4	3
3	14105 Brinkworth-Waterloo Bearer Replacement	**OPGW starting in 2022**	**11.1**	**1.1**	**1**
		Buried fibre	9.5	0.9	2
		OPGW starting in 2030	15.0	0.3	3
4	14034 Isolator Unit Asset Replacement	**Starting in 2019**	**11.0**	**2.5**	**1**
		Starting in 2028	5.6	1.9	2
5	14209 Substation Improvements for System Black Conditions	**Starting in 2019**	**7.5**	**4.5**	**1**
		Starting in 2024	7.5	2.6	2
6	14047 Transformer Bushing Unit Asset Replacement	**Starting in 2019**	**6.9**	**43.7**	**1**
		Starting in 2024	6.9	26.6	2
7	12115 Telco Asset Replacement	**Planned replacement starting in 2019**	**6.8**	**1.4**	**1**
		Planned replacement starting in 2024	8.0	0.4	2
8	14071 Robertstown Circuit Breaker Arrangement Upgrade	**Expansion**	**6.6**	**4.0**	**1**
		Without expansion	3.2	3.3	2
9	14033 Circuit Breaker Unit Asset Replacement	**Starting in 2019**	**4.9**	**108.3**	**1**
		Starting in 2024	4.9	90.9	2

[8] Ranking and NPV results have been presented using the 'central' set of assumptions of costs, benefits, discount rates and 'risk costs'. As noted in the body of the report, ElectraNet has also tested the robustness of these results to certain high and low scenarios.

[9] Capital expenditure for 14085 Gawler East Connection Point includes a joint project cost with SA Power Networks.

Project	Option	Capital expenditure	NPV[8]	Ranking[6]
10 14056 Templers West 275 kV Reactor	**New reactor**	**4.8**	**1.5**	**1**
	SVC	11.0	(0.6)	2
11 14182 South East SVC Computer Control System Replacement	**SVC Control System**	**4.5**	**3.3**	**1**
	Complete SVC Secondary Systems	17.0	(6.1)	2
	New South East Substation SVC's	30.0	(15.9)	3
12 14216 Blyth West 275 kV 50 Mvar Reactor	**New Reactor**	**4.4**	**(0.2)**	**1**
	SVC	11.0	(3.6)	2
13 14215 Para 275 kV 50 Mvar Reactor	**New Reactor**	**4.4**	**(1.4)**	**1**
	SVC	11.0	(6.5)	2
14 14080 Substation Security Fencing	**Starting in 2019**	**4.1**	**2.1**	**1**
	Starting in 2024	4.1	1.2	2
15 14180 Pimba Telecoms Bearer	**Starting in 2018**	**3.8**	**2.9**	**1**
	Starting in 2023	3.8	0.8	2
16 14214 Transmission Line Access Track Upgrade	**Starting in 2019**	**3.6**	**5.8**	**1**
	Starting in 2024	3.6	5.2	2
17 14070 Substation LAN Replacement	**Starting in 2019**	**3.4**	**11.1**	**1**
	Starting in 2024	3.3	5.7	2
18 14077 Mannum Transformer 1 and 2 Replacement	**Starting in 2022**	**2.7**	**1.0**	**1**
	Starting in 2027	2.7	0.1	2
19 14176 Surge Arrestor Unit Asset Replacement	**Starting in 2019**	**2.5**	**0.1**	**1**
	Starting in 2024	2.5	(0.3)	2
20 14090 Mount Gambier Transformer 1 Replacement	**Starting in 2021**	**2.1**	**0.2**	**1**
	Starting in 2026	2.1	0.2	2
21 14014 Energy Management System Technical Refresh 2021-23	**Starting in 2021**	**1.6**	**0.7**	**1**
	Starting in 2026	1.6	0.2	2
22 14042 Canowie Circuit Breaker Arrangement Upgrade	**Starting in 2020**	**1.6**	**0.2**	**1**
	Starting in 2025	1.6	0.1	2
23 14055 Torrens Island North Substation Tie Bus Installation	**Starting in 2019**	**1.4**	**11.1**	**1**
	Starting in 2024	1.4	6.2	2
24 14066 Telecommunications Tower Capacity Increase	**Starting in 2019**	**1.4**	**0.0**	**1**
	Starting in 2024	1.4	0.0	2
25 14075 Substation Air Conditioning Systems Unit Asset Replacement	**Starting in 2022**	**1.2**	**0.1**	**1**
	Starting in 2024	1.2	0.0	2

Project		Option	Capital expenditure	NPV[8]	Ranking[6]
26	14045 Battery Charger Unit Asset Replacement	**Starting in 2019**	**1.1**	**2.1**	**1**
		Starting in 2024	1.1	1.6	2

Table 2.3 lists the eight corporate ('non-network') projects reviewed by HoustonKemp. Details of the options under each project, their respective capital expenditure, 'central' NPV, and rankings are presented for eight corporate ('non-network') project in descending order of the capital expenditure associated with each preferred option (ie, the option with the highest NPV).

Table 2.3: Corporate ('non-network') project assessments ($m)

Project		Option	Capital expenditure	NPV[10]	Ranking[7]
1	12330 One IP Substation Network - Stage 2[11]	Native IP network	36.0	(15.6)	2
		Overlay IP Network	**16.0**	**1.7**	**1**
2	12071 Licenses, Maintenance, Minor Software 19-20 12403 Licenses, Maintenance, Minor Software 21-22 12021 Licenses, Maintenance, Minor Software 22-23	**Rolling project**	**5.7**	**1.6**	**1**
		Capital project	15.0	(6.8)	2
3	14091 Online Asset Condition Assessment Equipment Replacement	**Starting in 2019**	**3.8**	**2.9**	**1**
		Starting in 2024	3.8	1.7	2
4	12010 ERP Systems Refresh	Replace SAP	3.0	1.4	2
		Upgrade SAP	**2.3**	**3.5**	**1**
5	11661 Substation Computer Based Local Control Facilities Replacement	**Starting in 2019**	**3.0**	**0.4**	**1**
		Starting in 2024	3.0	0.1	2
6	14118 Database Platform Refresh 19-20	**SAP Hana platform**	**2.9**	**0.5**	**1**
		Exadata	5.1	(1.3)	2
7	12005 IT Storage and Compute Hardware Refresh 2019-20	**Refresh infrastructure**	**2.4**	**0.3**	**1**
		Cloud infrastructure	4.9	(10.1)	3
		Hybrid	3.5	(2.6)	2
8	12002 Local Area Network Equipment Refresh 21-22	**Refresh hardware**	**1.9**	**0.1**	**1**
		Replace all hardware	2.2	(0.1)	2

In addition, to the projects outlined above we have also reviewed ElectraNet's economic assessment of the Dalrymple ESCRI-SA Energy Storage project. We understand that the identified need for the ESCRI project is a proof of concept demonstration that utility scale battery storage can support the integration of renewable energy by helping to address the system security challenges that result from a high penetration of intermittent renewable energy on an interconnected power system.

[10] Ranking and NPV results have been presented using the 'central' set of assumptions of costs, benefits, discount rates and 'risk costs'. As noted in the body of the report, ElectraNet has also tested the robustness of these results to certain high and low scenarios.

[11] Capital expenditure for 12330 One IP Substation Network - Stage 2 includes work in progress from when the project started in 2014.

The ESCRI project is to be only partially funded by regulated revenue, which would need to be recovered from electricity consumers through regulated charges, with the remainder of the project costs being sourced from the following two sources: (1) unregulated revenue, by way of a lease contract with AGL consistent with ElectraNet's Cost Allocation Methodology; and (2) an ARENA grant funding contribution.

Our role in reviewing the ESCRI project was to check whether the benefits (based on benefits of reduced unserved energy around Dalrymple and the benefits of reduced Heywood interconnector constraints) can be considered to exceed the value proposed to be included in ElectraNet's regulated asset base, as well as generally reviewing/auditing the model. Overall, we conclude that this can be considered to be the case with benefits expected to flow to regulated consumers exceeding the costs they would face. We note that the costs and benefits have been subjected to sensitivity analyses by ElectraNet that investigate alternate input assumptions in order to ensure the robustness of this result.

A2. Key inputs and assumptions used by ElectraNet

This appendix sets out the key inputs and assumptions applied in the economic evaluations undertaken by ElectraNet. In particular, it summarises the assumptions regarding discount rates, capital and operating costs, VCR values (where applicable) and the 'risk cost' benefits assumed.

A2.1 Discount rates

ElectraNet has applied a central discount rate of 6 per cent (real, pre-tax) to assess the various costs and benefits associated with each of the economic evaluations undertaken, which has been estimated to be reflective of a current commercial discount rate. ElectraNet has also tested the sensitivity of different projects' net present value against a lower bound discount rate of 4.5 per cent (to represent the prevailing regulatory rate of return), and an upper bound discount rate of 8.5 per cent.

We consider this consistent with best practice for economic assessments of electricity infrastructure. For example, the RIT-T requires that:[12]

> The present value calculations must use a commercial discount rate appropriate for the analysis of a private enterprise investment in the electricity sector.

The central rate of 6 per cent is lower than the 10 per cent recommended by Grid Australia in its RIT-T Cost Benefit Handbook developed in 2011.[13] This primarily reflects the changing financial conditions, as rates on both risk free and risky assets have fallen considerably since July 2011.

We consider the framework (ie, testing the sensitivity of results against a range of discount rates) and the rates are both consistent with best practice. In particular:

- investigating lower and upper sensitivities ensures that the robustness of the economic assessment results are tested to different discount rate assumptions; and
- the commercial discount rate used in economic assessments should be re-estimated from time-to-time in order to ensure that the rate being used is reflective of prevailing financial conditions.

We note also that the central rate of 6 per cent (real, pre-tax) developed by ElectraNet is consistent with HoustonKemp's own recent internal assessment of what a contemporary estimate of a commercial discount rate should be.

A2.2 Capital and operating cost inputs

Capital cost estimates for each economic assessment have been developed by ElectraNet using internal cost estimates and external cost information. We understand that this process involves an estimation team and project managers who are informed by contractor quotes and previous experience of similar projects.

Similarly, operating costs for maintenance and refurbishment works are estimated based on prevailing contract rates as well as previous experience from operating the same or similar equipment.

The total capital cost inputs for each project are summarised in the various tables in Appendix A.1 above.

Sensitivity tests have been run on low and high capital costs by ElectraNet to ensure the robustness of option rankings. These tests apply cost assumptions that are 30 per cent higher and 30 per cent lower than the central assumptions developed by the ElectraNet estimation teams.

[12] AER, *Final | Regulatory investment test for transmission*, 29 June 2010, paragraph 14.

[13] Grid Australia, *RIT-T Cost Benefit Analysis Handbook*, July 2011, p. 11

A2.3 The Value of Customer Reliability

A key benefit for a number of investments[14] is expected to be a reduction in the amount of expected unserved energy going forward. The benefit associated with the reduction in unserved energy is valued at the Value of Customer Reliability (VCR), expressed in $/MWh. A VCR measure estimates the value customers place on having reliable electricity supplies.

ElectraNet has applied a VCR value of $35,411/MWh for each economic assessment where it is relevant. This value is sourced from AEMO's 2014 Value of Customer Reliability Review,[15] and represents an aggregate VCR (including direct connects) for South Australia.

Sensitivity tests have been run on low and high VCR values to ensure the robustness of option rankings. These tests investigate values that are assumed to be up to 30 per cent higher and 30 per cent lower than AEMO's VCR estimate.

A2.4 Avoided 'risk cost' input values

ElectraNet has applied an asset 'risk cost' evaluation framework to quantify the risk cost reductions associated with asset replacement and refurbishment projects that are primarily focused on mitigating risk as input to the economic evaluation and options analysis. These 'risk cost reductions' have been calculated as the product of:

- probability of failure (PoF), which is the probability of a failure occurring (eg, a line conductor falling to the ground) based on asset failure history information and industry data;
- likelihood of consequence (LoC), which is the likelihood of an adverse consequence (eg, if a line conductor falls to the ground the likelihood of it starting a bushfire) based on historical information and statistical factors and assumptions; and
- cost of consequence (CoC), which is the cost of the adverse consequence (eg, if a line conductor falls to the ground and starts a bushfire the damage to life and property that could result) based on cost of consequence model assumptions.

Avoided risk cost values used in ElectraNet's economic assessments have been estimated by AMCL (an asset management consultancy), working in conjunction with ElectraNet, as the difference between risk costs incurred under the base case and respective option cases.

We understand that the adverse consequences resulting from the occurrence of a failure include, but are not limited to, electricity service interruption, electricity service interruption at a supply point, bushfire, personal injury, repair cost, service level breaches and environmental damage. Implicit for service interruption events are load loss estimates that are based on historical consumption information and connection point demand forecasts.

Sensitivity tests have been run on low and high avoided risk cost benefits to ensure the robustness of option rankings. These tests investigate avoided risk cost benefits that are assumed to be up to 30 per cent higher and 30 per cent lower than avoided risk cost benefits estimated using the risk cost evaluation tool.

More detail on the key inputs and assumptions made for individual asset risk cost evaluations can be found in ElectraNet's asset risk cost modelling guideline.

[14] In particular, the Eyre Peninsula reinforcement project, 14031 - Protection systems unit asset replacement, 14056 – ParaDavenport, 14014 - Energy Management System Technical Upgrade, 14091 - Online asset condition & 12330 - One IP substation.

[15] AEMO, *Value of Customer Reliability Review for South Australia*, September 2014, p. 31 and p. 40.

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