Supporting Document 12.1.1
Risk Informed Optimisation
2019-24

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1 Introduction

1.1 Purpose

This Risk Informed Optimisation document sets out the process and methodology used for developing the final portfolio of standard control network capital investment by taking a targeted, risk-informed approach.

This document should be read in conjunction with the Asset Risk Management Procedure and Appraisal Value Framework which provides consistency when measuring the costs, risks and benefits of investment decisions. This ensures our approach delivers the value stakeholders expect while achieving our strategic objectives.

These stakeholders include: customers, shareholders, regulators, policy makers, industry groups, land owners, employees and the public.

1.2 Scope

This document covers how we have developed Essential Energy's portfolio of standard control capital expenditure.

It does not cover Essential Energy's non-network assets (e.g. property and fleet), which have separate asset management strategies and plans. It also does not cover alternative control services.

2 Building the portfolio

2.1 Identifying investment opportunities

The portfolio of investments was developed using the existing investment portfolio as a starting point. Subject matter experts were then involved to advance the portfolio by identifying varying alternatives (options) and new opportunities for the existing programs.

Presently, investments have been valued and assessed at a program level, with individual projects being valued in the coming years. We have staged the implementation of individual project valuation to ensure we first establish a strong and representative asset risk management and appraisal value framework. During this time, we will be vetting and verifying our asset condition data and models so we are content such a value and risk-based approach is consistent and valid.

2.2 Building investment alternatives

To develop alternatives for our investment programs, we challenged our subject matter experts to develop alternatives for the lowest and highest reasonable levels of expenditure, giving consideration to factors such as failure rates and deliverability. For several investments, particularly programs with significant expenditure or value, a greater number of alternatives were explored.

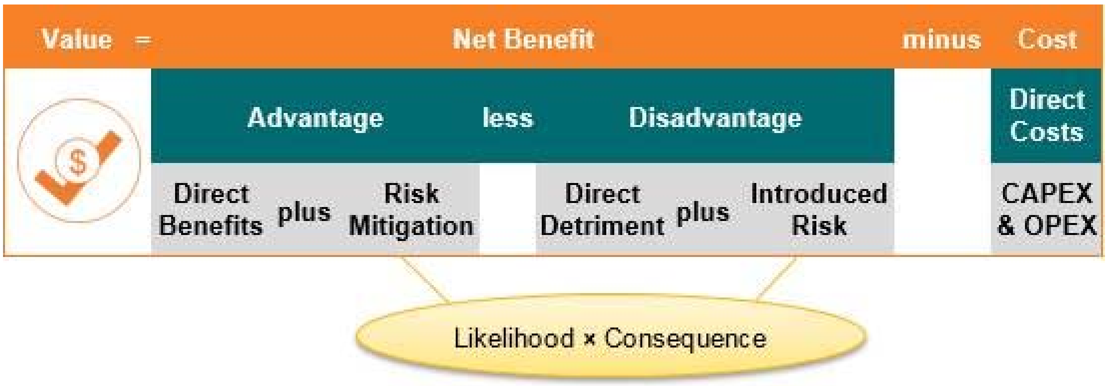
2.3 Bottom-up build

The bottom-up build is constructed from the recommended alternatives for each investment when considered in isolation from the rest of the portfolio and the relative value the investment delivers. The criteria used was the investment which maintained failure rates in that particular asset class using the traditional methods of prioritising investment.

2.4 Valuing investment alternatives

The investment portfolio was built by quantifying the value delivered by each of the investment programs, and options relating to reducing or increasing the cost. **Error! Reference source not found.** shows the investment value calculation.

Figure 1 - Investment value calculation



Benefit can come in the following forms

- Mitigating safety risk
- Mitigating network reliability risk
- Mitigating environment risk
- Mitigating compliance risk
- Mitigating financial risk
- Mitigating reputation risk
- Reductions in future OPEX or CAPEX expenditure

Cost can come in the following forms:

- CAPEX cost (investment and failure cost)
- OPEX cost (inspection, maintenance and failure cost)

In some circumstances, risk is introduced through an investment. For example, network reliability risk may be introduced to mitigate a safety risk. In these cases, the introduced risk is considered a cost of completing the investment alternative.

3 Top down challenge

The top down challenge is a 'Risk vs Expenditure' model developed by CutlerMerz to assess network risk under varying network investment scenarios for the 2019-2024 regulatory period. The objective of the model is establishing the minimum level of investment required to maintain the existing level of network risk reflected in the bottom-up build. The outcome of the model has informed the capital expenditure constraint placed on the portfolio

The top down challenge used the bottom-up build as a starting point. The model seeks to identify the changes to the economic costs and risks associated with a proposed investment scenario to allow the potential for under and over investment to be tested. This risk modelling was used to challenge and guide the valuing of the investment portfolio. The top down challenge also influenced the development of the Appraisal Value Framework.

The report also includes a number of recommendations which have been considered when developing the final portfolio, and are discussed in detail in the following chapters.

4 Optimising the portfolio

The aim is to develop a portfolio that delivers improved value (considering risk mitigation, benefits and costs) across the entire portfolio of investment within constraints.

The portfolio has been optimised via an iterative process considering:

> The ‘bottom-up build’ of investments
> The top-down ‘risk vs expenditure’ challenge
> Constraints placed on the portfolio

4.1 Governance and quality assurance

A review group was established to provide governance around critical inputs, and quality assurance over the outputs. This group met as required during the development of the portfolio to review selected models, challenge assumptions and sources of information, and review the output of the iterative optimisation process. Feedback from the review process was then provided to the team developing the inputs and running optimisation scenarios.

A review group was also established to review the investment case documentation to ensure the documents provided an appropriate and consistent level of detail. Models were sense-checked and loaded into the system by a system administrator to provide a further layer of consistency.

4.2 Constraints

Constraints have been used to ensure the portfolio meets the objectives of the organisation and the expectations of customers.

The following cost constraints have been used to build the final portfolio:

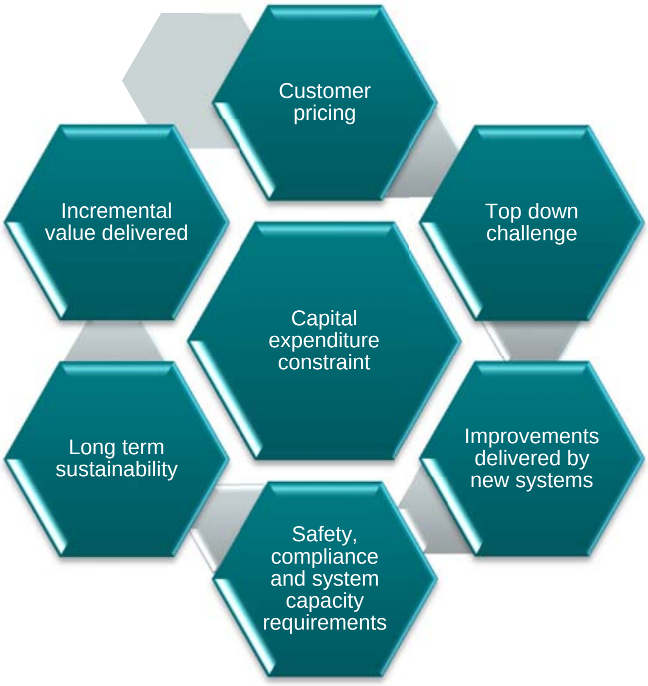
> CAPEX – to set an upper bound on the level of capital expenditure
> OPEX – to set an upper bound on the level of operating expenditure

Some additional value measure constraints were included to test the validity of the portfolio.

> Safety – to maintain the safety of the distribution system
> Environment – to maintain the safety of the distribution system
> Reliability – to maintain the reliability of the distribution system

The capital constraint has been set by considering multiple decision criteria, including customer priorities such as pricing as well as other factors shown in **Error! Reference source not found.**.

Figure 2 - Setting the level of capital expenditure



4.3 Optimised Portfolio

The bottom-up options and alternatives are valued using the Copperleaf C55 Asset Investment Planning System (C55). This system has been configured with the values in Essential Energy's Appraisal Value Framework to allow the systematic assessment of multiple benefits.

C55 is designed to optimise the value of an investment portfolio with regard to objectives, while staying within constraints. It uses mixed-integer linear programming to efficiently optimise the best candidate scenarios using a consistent process.

Whilst a bottom-up build makes the best decision for a single investment, it is isolated in determining this outcome and hence the total portfolio can be conservative in nature. By utilising C55, a top down approach can be applied to the bottom-up portfolio by applying financial constraints. The final portfolio is collated and compiled into an associated two-year rolling plan of projects.

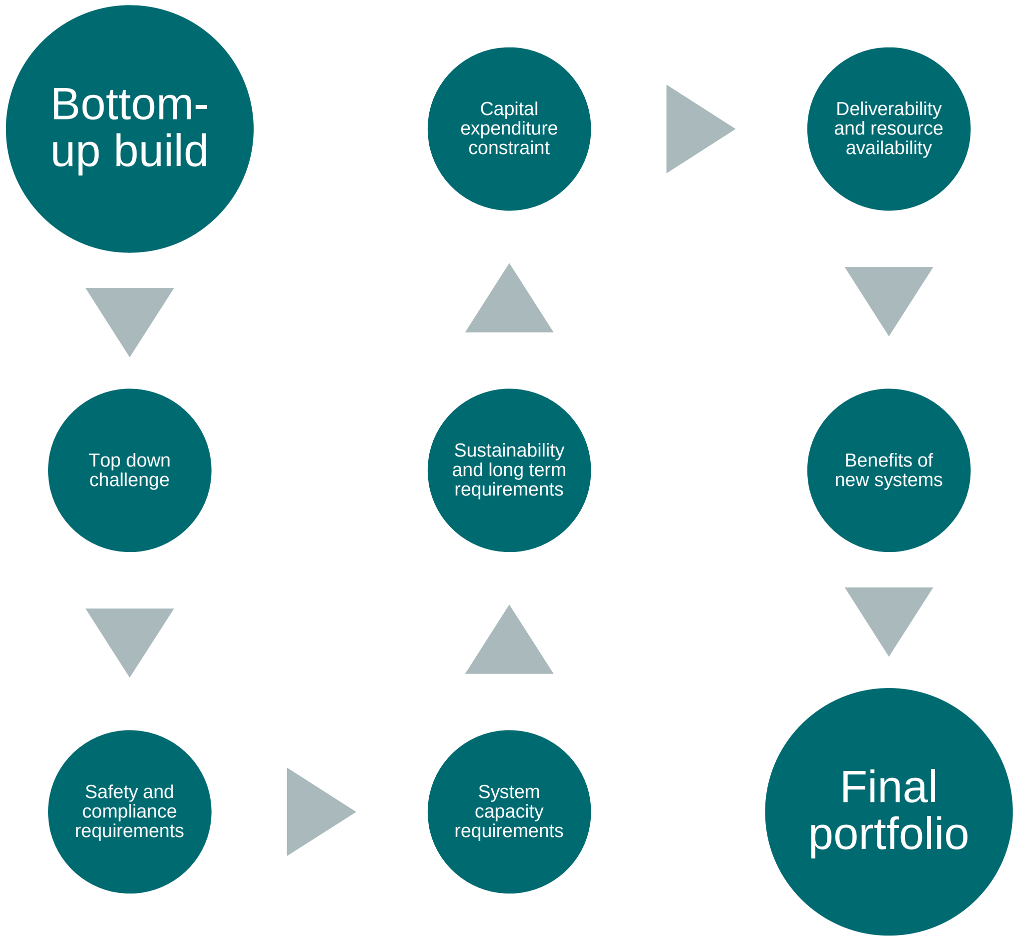
4.4 Final Proposal

The optimisation has been checked to ensure the portfolio is reasonable and meets objectives. This is consistent with Copperleaf's suggested approach of implementing refinements and to account for factors that cannot be captured by the model[1].

[1] White Paper - Optimization in C55: An Overview, Copperleaf Technologies, 2016

The outputs of the optimised portfolio have been adjusted to account for improvements in systems and processes that will enable Essential Energy to deliver work more efficiently and better target investments to achieve similar outcomes at lower cost.

Figure 3 – Developing the final proposal



5 Comparison to other models

The AER uses a repex model to understand the capital required for non-demand-driven replacement of an asset with its modern-equivalent, where the timing of the need can be directly or implicitly linked to the age of the asset. This model is dependent on the five-year RIN data that Essential Energy provides annually.

In practice, at a population level, age may be used as a proxy for condition and health. At an individual asset level, Essential Energy uses asset condition assessments to inform its investment decisions. Further, Essential Energy has adopted a value-based decision-making framework which means maintaining previous replacement rates and replacement age may not necessarily be the optimal decision for meeting objectives and delivering value to customers.

In summarising Essential Energy's proposed expenditure in the submitted Asset Management Plans (AMPs), a direct comparison of the repel model and value-base expenditure proposal is conducted. To achieve this, many of the repex model categories have been split[2] into the asset systems of underground, overhead and zone

[2] A crossarm category has been introduced and projected to aid in understanding REPEX spend.

substations of which the AMPs are based[3]. Essential Energy's proposed expenditure did not align directly to the repex categories, so they were split according the unit rates and average number of replacements in the last five years[4].

The top down challenge proposed significant reductions in augmentation expenditure relative to the bottom-up build. Essential Energy has scrutinised the proposed augmentation expenditure, and has proposed a level of augmentation which is broadly in line with this recommendation. Essential Energy does not believe the augex model reflects prudent investment in network augmentation.

Table 1 compares the five-year total expenditure contained in the final proposal to the bottom-up build, the repex and augex models, and the top down challenge.

Table 1 - Comparison of direct standard control capital expenditure models (Real $FY19)

	Final proposal	Top-down challenge[5]	Repex / augex model[6][7]	Bottom-up build
Replacement Total	**$819.7M**	**$817.0M**		**$990.2M**
- Poles	$201.4M	$160.6M	$236.6M	$221.9M
- Pole top structures	$231.6M	$199.2M	-	$261.0M
- Overhead Conductor	$94.1M	$164.5M	$150.1M - $160.6M	$134.6M
- Underground Cables	$16.0M	$0.4M	$11.9M - $29.3M	$18.9M
- Service Lines	$27.9M	$11.0M	$32.2M - $36.1M	$60.4M
- Transformers	$68.1M	$78.4M	$45.5M - $61.7M	$85.1M
- Switchgear	$117.4M	$116.5M	$145.2M - $146.3M	$138.7M
- SCADA, Network Control & Protection	$19.0M	$18.2M	-	$18.2M
- Other	$44.2M	$68.3M	-	$51.3M
Augmentation	**$166.1M**	**$174.3M**	**$566.3M**	**$276.3M**
Connections	**$25.1M**	**$25.2M**	**-**	**$25.2M**
LIDAR	**$56.7M**	**$60.8M**	**-**	**$60.8M**
Total Standard Control Capital Expenditure	**$1067.6M**	**$1077.4M**	**-**	**$1352.5M**

[3] Secondary System assets do not form part of the REPEX model.

[4] Steel and concrete poles utilised 2016 replacement numbers as opposed to a five-year average due to a change in replacement practice

[5] The Top down challenge did not consider Network Connections, Secondary & Comms, Streetlights, LIDAR and minor compliance programs

[6] The repex and augex models do not model several categories of replacement expenditure. For example, low clearance expenditure is not captured by the repex model.

[7] The augex model, as well as the repex model for poles, are indicative outputs modelled by Essential Energy and are not the AER's results.

5.1 Overhead Network

5.1.1 Poles and pole top structures

There are four primary drivers of pole and crossarm investment:

- Pole replacement program
- Pole reinforcement program
- Crossarm replacement programs
- Low clearance rectification program

For pole and pole top structure investment, the largest difference between the final proposal and the other models is the inclusion of the low clearance program. Raising low clearance spans are closely tied to replacement of poles and crossarms, which is the reason for including the expenditure in these categories.

The repex model does not specifically model low clearances. The top down challenge found that the risk reduction achieved from raising the clearance height is not as high as other investments per dollar invested. When only looking at the risk reduction achieved from raising a span, the valuation of investment alternatives broadly agreed with this conclusion.

It should be noted that raising low clearance spans provides added benefits of replacing aged poles and crossarms. However, the cost of pole and crossarm replacement in these situations is higher than the cost of like-for-like pole replacement, as there are additional design requirements to ensure the network meets clearance standards.

The top down challenge noted that compliance was not modelled. To meet the Safety & Environment Strategy, and to appropriately manage our compliance obligations, the final proposal includes expenditure for low clearance rectification in the pole and crossarm categories to work towards reaching a position compliant with industry standards.

The repex model indicates that there is an underspend for timber poles and an overspend in non-timber poles. The reason for this discrepancy is due to the repex model being inaccurate when non-like-for-like replacement occurs, such as the historical replacement of timber poles with steel and concrete. As the repex uses a five-year average for its input data, it is unable to predict the change of pole replacement practice that Essential Energy has undergone in the last few years i.e. only using timber poles on the network. Even without low clearance included, the repex model proposes an increase in total pole expenditure compared to the final proposal.

The top down challenge recommends a marginal decrease in expenditure in the pole replacement program.

The repex model does not model pole top structures. Modelling has been performed using an estimated age profile in order to test the reasonability of the expenditure. The program valuation indicates that there is a high amount of value for a low replacement cost (as it mitigates similar risk as a pole replacement for a lower cost), and therefore proposed expenditure is greater than an age-based replacement program.

5.1.2 Conductor

The repex model indicates increasing conductor replacement. The top down challenge also recommends increasing conductor replacement.

The valuation of investment alternatives suggests that, given the way the program is currently implemented, there are other investments that yield a greater risk reduction for the same expenditure. This is due to the relatively small fault and emergency cost to ‘splice’ the conductor back together compared to the relatively large cost to replace the conductor.

However, there are instances where conductor may fail in a high bushfire risk area, or affect a large number of customers. A further consideration is the long term sustainable replacement requirements for the network. On this basis, the lowest level of viable expenditure, which is equivalent to current rates of investment, has been locked in for the final proposal.

Essential Energy acknowledges that current replacement rates will not be sufficient to replace the assets long-term. The top down challenge has confirmed that high-value investments are able to be made in this category. Our intent is to continue conductor testing and sampling to improve the way these investments are targeted, and to provide reassurance that any future increase in expenditure will provide high value.

5.1.3 Overhead services

The bottom-up build proposed a significant increase to the overhead service replacement program. Issues associated with the transition to outsourcing this program resulted in the delivery of fewer units than planned in recent years.

The primary driver of this replacement program is the safety risk associated with degraded services. There is also a reliability risk associated with overhead services, as when customers report a wire down event the nearest remotely controlled protection device (which may be the feeder circuit breaker) may be operated by system control to ensure safety. Nevertheless, the top down challenge identified service replacements as providing relatively low risk reduction.

A further consideration is the long term sustainable replacement requirements for the network. The lowest level of viable expenditure, equivalent to current rates of investment, has been locked in for the final proposal. This level of expenditure is expected to approximately maintain failure rates at current levels.

Essential Energy acknowledges that current replacement rates will not be sufficient to replace the assets long-term. With the benefit of smart meter rollouts, we may have the opportunity to improve the way this program is targeted.

5.1.4 Pole mounted transformers

Essential Energy’s strategy for pole-mounted transformers is to only replace assets which are defective or have functionally failed. The top down challenge recommends maintaining this level of expenditure.

The repex model proposes less expenditure in overhead distribution transformers. Essential Energy has changed its financial practices to capitalise failed pole mounted transformers. As such, the five-year replacement numbers used within the repex model under-forecast the future requirements.

5.1.5 Overhead switchgear

The top down challenge recommended:

- maintaining current expenditure in replacing gas switches, sectionalisers, fuses and link.
- decrease in expenditure for planned replacements of air break switches and reclosers.

The repex model indicates that the proposed expenditure results in a mean asset replacement age of 43 years, which is slightly longer than the 40-year expected life. Further, the repex model does not capture the separate controller replacement required in a recloser, which has a serviceable life of 15 years and therefore such expenditure inadvertently increases the unit rate for a recloser replacement.

There are other benefits to replacing aging hydraulic reclosers such as bushfire risk mitigation, remote operability and access to data logs.

The final proposal maintains current levels of expenditure in overhead switchgear.

5.2 Underground Network

5.2.1 Underground cables and services

Essential Energy has adopted a run-to-failure practice for underground cables and services. The repex model is based on replacement before failure, hence it overestimates the required expenditure. There are planned replacement programs for underground cable terminations, however the expenditure in these categories is marginal.

Essential Energy acknowledges that current replacement rates will not be sufficient to replace the assets long-term. We are observing improvements made to underground cable testing, so that any future planned replacements will be targeted.

5.2.2 Ground mounted substations and switchgear

Essential Energy has identified an area for improvement in the inspection and maintenance of these assets. Due to a number of explosive failures and reported safety incidents, an inspection program was put in place which has identified assets which require investment prior the end of serviceable life. As such, there is a step increase in expenditure in this area. The top down challenge recommended reducing the ground mounted switchgear program. However, the risk associated with identified defective assets is considered intolerable from a safety perspective.

5.3 Zone substations

5.3.1 Zone substation transformers

The top down challenge recommended reducing the zone substation transformer expenditure by 22%.

Essential Energy's final proposal has reduced the zone substation transformer expenditure by 25%. While the valuation of investment alternatives suggests there is benefit in replacing more transformers, greater value can be delivered by making alternative investments within the capital expenditure constraint.

5.3.2 Zone substation switchgear

The top down challenge recommended increasing expenditure in zone substation switchgear due to the substantial reliability risk mitigation which can be achieved.

There is likely a slight under forecast in the repex model due to capture of replacement quantities over the last five-years. When one notes the projected replacement age with the proposed spend, we note the assets are still 7-16 years older than Essential Energy' expected serviceable life figure, indicating the spend is not out-of-line with asset age-based replacements.

5.4 Summary

Using a risk-informed approach, Essential Energy has developed a prudent portfolio of expenditure which provides improved value within a reasonable financial constraint. Essential Energy will continue to refine the portfolio as improvements are made to data, systems and modelling. We are confident the overall CAPEX budget is prudent for our next regulatory period, as it is reasonable with respect to the overall level of expenditure recommended by the top-down challenge and repex model.

Appendix A – Abbreviations

Abbreviation	Definition
Repex	Replacement expenditure
Augex	Augmentation expenditure

Appendix B – Standard control network expenditure

The following table lists the programs of standard control network expenditure which make up the final proposal. All figures are provided in Real $FY19.

	Investment Name	FY20	FY21	FY22	FY23	FY24
ESS_1	Distribution Growth - Voltage Constraints	$5,437,593	$5,087,595	$4,935,138	$4,844,698	$4,807,957
ESS_1001	Beryl to Mudgee - implement 66kV backup changeover scheme	$0	$0	$0	$0	$0
ESS_1004	Cartwrights Hill ZS - construct 66 kV bus bar	$0	$0	$0	$0	$0
ESS_1005	Cobaki - establish 66/11kV substation	$0	$0	$1,457,903	$3,764,949	$0
ESS_1006	Cobar town supply augmentation	$0	$0	$0	$0	$0
ESS_1008	Cooma - TransGrid rebuild 66/11kV substation	$0	$0	$0	$0	$0
ESS_1009	Deniliquin to Moulamein tee - convert section of 66kV single cct to dual and add 66kV bay	$0	$0	$0	$0	$0
ESS_100D	Replace unsafe streetlight pot belly columns - defined projects	$243,079	$233,574	$224,928	$217,221	$211,948
ESS_101	LIDAR - Capitalised Overhead Data Capture	$13,545,105	$10,736,135	$11,107,188	$8,814,300	$12,491,630
ESS_1010	Gloucester BSP - establish 132/33kV substation	$0	$0	$0	$0	$0
ESS_1011	Googong Town - establish new 132/11kV substation	$0	$0	$0	$0	$0
ESS_1012	Queanbeyan TG to Googong Town ZS - Reconnect 132 kV Line	$0	$0	$0	$0	$0
ESS_1013	Goulburn to Woodlawn - upgrade 66 kV line	$0	$0	$0	$0	$0
ESS_1014	Griffith - Augment Supply to Tharbogang/Goolgowi	$0	$0	$0	$0	$0
ESS_1016	Marulan South - rebuild 66/33kV substation	$0	$0	$0	$0	$0
ESS_1017	Metering for ZS (Power Quality meters)	$336,689	$316,816	$301,300	$286,778	$275,662
ESS_1018	Nyngan 132kV network reinforcement	$0	$0	$0	$0	$0
ESS_1020	Orange North - TransGrid rebuild Orange 66kV busbar	$0	$0	$0	$0	$0
ESS_1022	Orange to Blayney - reconductor 66kV feeder	$0	$0	$0	$0	$0
ESS_1023N	Rectification of low clearance - all allocations	$23,331,338	$22,170,916	$21,538,571	$21,104,682	$20,903,158
ESS_1025	Sutton ZS - install 66/11kV transformer	$0	$0	$0	$0	$0
ESS_1026	Tamworth - TransGrid 132/66kV substation relocate 66kV feeders	$0	$0	$0	$0	$0
ESS_1027	Tamworth to Quirindi - secure easements for future second feeder	$0	$0	$0	$0	$0

	Investment Name	FY20	FY21	FY22	FY23	FY24
ESS_1028	Terranora to QLD border - refurbish 110kV towers in line with Powerlink	$0	$0	$0	$0	$0
ESS_1030	Googong to Tralee - construct dual 132kV feeder (operate at 11kV)	$0	$0	$0	$0	$2,851,673
ESS_1031	Wellington to Narromine - convert 66kV to 132kV	$0	$0	$0	$0	$0
ESS_1033	Yarrandale to Gilgandra - rebuild existing 66kV feeder	$0	$0	$0	$0	$0
ESS_1034	Monaltrie to Alstonville - secure easements for future needs (Lismore 132kV strategy)	$0	$0	$0	$0	$0
ESS_1036	Yarrandale to Gilgandra - new 66kV feeder	$0	$0	$0	$0	$0
ESS_1037	Woodlawn - rebuild 66/11kV substation	$0	$0	$0	$0	$0
ESS_1039	Wagga to Temora - rebuild Wagga to Junee 66kV feeder to 132kV and new Junee to Temora 132kV feeder	$0	$0	$0	$0	$0
ESS_1040	Wagga Copland St to Kooringal #1 feeder works	$0	$0	$0	$0	$0
ESS_12D	Poletop Switchgear replacement - defined projects	$1,708,053	$1,641,266	$1,580,513	$1,526,357	$1,489,299
ESS_12N	Poletop Switchgear replacement - allocations portion	$1,530,404	$1,454,287	$1,412,809	$1,384,348	$1,371,129
ESS_13D	HV regulator refurbishment and replacement - defined projects	$1,002,311	$963,119	$927,468	$895,688	$873,943
ESS_13N	HV regulator refurbishment and replacement - allocations portion	$409,059	$388,713	$377,627	$370,020	$366,486
ESS_14D	Poletop Recloser Replacement / Upgrading - defined projects	$2,527,697	$2,428,860	$2,338,954	$2,258,810	$2,203,970
ESS_14N	Poletop Recloser Replacement / Upgrading - allocations portion	$0	$0	$0	$0	$0
ESS_15N	Pole Staking/Reinforcement - all allocations	$2,427,221	$2,306,499	$2,240,714	$2,195,576	$2,174,611
ESS_16D	Replacement of Bare OH Conductors - defined projects	$8,669,933	$11,038,484	$10,025,409	$12,793,886	$12,381,579
ESS_16N	Replacement of Bare OH Conductors - allocations portion	$204,054	$193,905	$188,374	$184,580	$182,817
ESS_17N	Pole Replacement Distribution - all allocations	$25,742,258	$24,479,241	$23,837,743	$23,488,509	$23,514,455
ESS_18	Poor Performing Feeders	$7,998,911	$7,882,218	$7,788,708	$7,704,176	$7,703,948
ESS_19	Worst performing feeder segments	$1,805,877	$1,689,639	$1,639,007	$1,608,971	$1,596,769
ESS_2	Distribution Growth - Thermal Constraints	$4,724,722	$4,420,609	$4,288,140	$4,209,557	$4,177,632
ESS_20	HV network augmentation - PQ	$612,162	$572,759	$555,595	$545,414	$541,277

	Investment Name	FY20	FY21	FY22	FY23	FY24
ESS_2001	Wagga Copeland St - TransGrid 132/66kV substation relocate 66kV feeders	$0	$0	$0	$0	$0
ESS_2002	Wagga 66kV network - reconductor various small section of conductors	$0	$0	$0	$0	$0
ESS_2003	Williamsdale TG to Googong Town ZS - Refurbish and Connect 132 kV Line	$0	$0	$0	$0	$0
ESS_2004	Williamsdale Acquire Route (1km)	$0	$0	$0	$0	$0
ESS_2005	Queanbeyan TG to Googong Town ZS Refurbish Line 975	$0	$0	$0	$0	$0
ESS_2006	Zone Substation Capacitors Bank Replacement	$51,013	$49,019	$47,204	$45,587	$44,480
ESS_2007	IP Data Network Asset Replacement	$714,189	$245,094	$660,860	$227,934	$622,721
ESS_2009	Utility Blackspot Plan	$1,424,709	$1,325,802	$1,282,718	$1,257,161	$1,246,778
ESS_2010	Queanbeyan South - 11 kV transformer cable upgrade	$0	$0	$0	$0	$0
ESS_2011	Hillston ZS - Dynamic Compensation	$0	$0	$0	$0	$0
ESS_2012	Ulan 66kV switch station works	$0	$0	$0	$0	$0
ESS_2013	Reactive power compensation	$0	$0	$0	$0	$0
ESS_2014	Casino to Casino North - acquire route new 66kV feeder	$0	$0	$0	$0	$0
ESS_2015	Coffs Harbour South - refurbish 66/11kV substation	$0	$0	$0	$0	$0
ESS_2016	Cudgen to Casuarina - acquire sub site and easements for 33kV network	$0	$0	$0	$0	$0
ESS_2017	Hallidays Point 66/11kV substation - construct 66kV & 11kV feeders	$0	$0	$0	$0	$0
ESS_2018	Beryl to Dunedoo - new 66kV feeder	$0	$0	$0	$0	$0
ESS_2019	Gulgong West - establish new 66/22kV substation	$0	$0	$0	$0	$0
ESS_2020	Borthwick St / Wynne St - relocate Wynne St 66/22kV assets to Borthwick St	$0	$0	$0	$0	$0
ESS_2021	Maher St - new 66kV feeder	$0	$0	$0	$0	$0
ESS_2022	Cooma to Bega - convert 66kV feeder to dual 132/66kV	$0	$0	$0	$0	$0
ESS_2024	Orange Ring 66kV augmentation	$0	$0	$0	$0	$0
ESS_2025	Bathurst Russell St - rebuild 66/11kV substation	$0	$0	$0	$0	$0

	Investment Name	FY20	FY21	FY22	FY23	FY24
ESS_2026	Googong Town to Tralee - acquire route new dual 132kV feeder	$0	$0	$0	$0	$0
ESS_2027	Leeton ZS Upgrade	$0	$0	$0	$0	$0
ESS_2028	Pole top refurbishment of Taree to Forster 66kV feeders	$0	$0	$0	$0	$0
ESS_2029	Pole top refurbishment of Dubbo to Nyngan 132kV feeder 943/1, 943/2 and 9GU	$0	$0	$0	$0	$0
ESS_21	LV network augmentation - PQ	$1,326,350	$1,240,978	$1,203,790	$1,181,730	$1,172,768
ESS_22	Crossings of Navigable Waterways	$4,474,901	$925,698	$194,387	$191,185	$190,112
ESS_23N	LV Spreader Installation - all allocations	$476,585	$462,470	$396,814	$334,027	$276,215
ESS_26	Service Overhead Replacement	$5,844,453	$5,848,700	$5,436,414	$5,241,683	$5,104,077
ESS_27	Service Replacements due to voltage drop - PQ	$0	$0	$0	$0	$0
ESS_29	Overhead Rural LV conversion to UG for bushfire prevention	$0	$0	$0	$0	$0
ESS_3	Distribution Growth - Fault Level Constraints	$8,733,505	$8,171,361	$7,926,496	$7,781,237	$7,722,225
ESS_3000	Ancillary radio Asset Replacement	$408,108	$392,150	$377,634	$364,695	$355,841
ESS_3001	Two Way Radio Base Replacement	$0	$0	$0	$0	$0
ESS_3002	Mobile Two Way Radio Replacement	$102,027	$98,038	$94,409	$91,174	$88,960
ESS_30N	Condition Based Transformer Replacement - all allocations	$8,484,695	$9,654,565	$9,395,705	$9,097,591	$8,722,796
ESS_31	Enclosed Substation Refurbishment Program	$6,835,804	$6,568,515	$6,325,375	$6,108,637	$5,960,329
ESS_32N	Overhead Substation Refurbishment Program - all allocations	$5,107,718	$4,853,678	$4,715,244	$4,620,257	$4,576,139
ESS_33	LV Protection Installation program forecast Far West	$0	$0	$0	$0	$0
ESS_35	Substation Augmentation - PQ	$744,797	$696,857	$675,975	$663,587	$658,554
ESS_36	Distribution Substation Monitoring - NT	$510,135	$495,025	$485,968	$477,963	$475,279
ESS_38	2 pole Substation Safety Program	$165,366	$158,900	$153,018	$147,775	$144,187
ESS_4	Distribution Growth - Customer Connections	$4,772,535	$4,807,191	$4,841,847	$4,876,503	$4,911,159
ESS_4000	Coffs Harbour North to Coffs Harbour South - new 66kV feeder	$0	$0	$0	$0	$0
ESS_4001	TG Parkes to Parkes zone - new 66kV feeder and substation work	$0	$0	$0	$0	$0
ESS_4002	Gunnedah to Narrabri Tee via Boggabri - refurbish 66kV feeders	$0	$0	$0	$0	$0

	Investment Name	FY20	FY21	FY22	FY23	FY24
ESS_4003	Yarrandale to Gilgandra - acquire route new 66kV feeder	$0	$0	$0	$0	$0
ESS_4004	Zone Substation Outdoor Bus and Isolator Refurbishment and Replacement	$2,673,764	$2,482,022	$2,818,604	$1,267,269	$1,919,866
ESS_4005N	Poletop Refurbishment Distribution - allocations portion	$24,408,014	$23,137,514	$22,395,930	$21,849,568	$21,528,873
ESS_4006	Pambula - install 66 kV CB	$0	$0	$0	$0	$0
ESS_4007	Taree - TransGrid 132/66/33kV substation relocate 33kV feeders	$0	$0	$0	$0	$0
ESS_4008	Subtransmission minor projects	$510,135	$495,025	$485,968	$477,963	$475,279
ESS_4009	Subtransmission cables - polymer termination replacement	$826,418	$794,104	$764,710	$738,507	$720,577
ESS_4010	Subtransmission minor route and land	$0	$0	$0	$0	$0
ESS_4011	Orange South ZS - Augmentation	$0	$0	$0	$0	$0
ESS_4012	Quira ZS - 2nd tx substation work	$0	$0	$0	$0	$0
ESS_4013	Molong - install 2nd 66/11kV transformer	$0	$0	$0	$0	$0
ESS_4015	Wagga Copland St to Kooringal #2 feeder works	$0	$0	$0	$0	$0
ESS_4016	Morrow St - construct 66kV busbar	$2,040,539	$0	$0	$0	$0
ESS_4017	Googong - construct 132kV o/h line for relocation	$0	$0	$0	$0	$0
ESS_4019_Laminated	Poletop Refurbishment Distribution - Laminated - allocations portion	$1,449,678	$1,435,603	$1,420,678	$1,406,273	$1,394,897
ESS_4019_PEC	Poletop Refurbishment Distribution - PEC - allocations portion	$4,272,074	$4,027,371	$3,827,121	$3,623,429	$3,428,405
ESS_4020N	Street Lighting poles and column replacement - all allocations	$0	$0	$0	$0	$0
ESS_4021	Griffith - Augment Supply to Nericon	$3,060,808	$3,960,204	$0	$0	$0
ESS_4022	Casino - Augment Supply to Urbenville	$0	$0	$1,416,129	$0	$0
ESS_40D	Failed UG cable replacement - defined projects	$918,242	$882,338	$849,677	$820,563	$800,641
ESS_4100	PQ Mitigation Equipment Installation	$1,020,269	$990,051	$971,935	$955,927	$950,558
ESS_41D	LV switchgear and pillar replacement - defined projects	$387,702	$372,543	$358,753	$346,460	$338,049
ESS_42D	High Voltage Cast Pothead Replacement - defined projects	$408,108	$392,150	$377,634	$364,695	$355,841
ESS_43D	LV UG Cable replacement (CONSAC) - defined projects	$1,286,305	$1,236,008	$1,190,256	$1,149,472	$1,121,565
ESS_45D	Pole Top Refurbishment Subtransmission - defined projects	$0	$0	$0	$0	$0
ESS_45N	Pole Top Refurbishment Subtransmission - allocations portion	$5,581,758	$5,242,749	$5,036,561	$4,876,663	$4,763,535

	Investment Name	FY20	FY21	FY22	FY23	FY24
ESS_46D	Pole Replacement Subtransmission - defined project	$1,410,077	$1,356,818	$1,312,685	$1,281,577	$1,276,569
ESS_46N	Pole Replacement Subtransmission - allocations portion	$1,410,077	$1,341,801	$1,309,608	$1,297,266	$1,311,704
ESS_48	RF Infrastructure Refurbishment	$816,215	$784,300	$283,226	$227,934	$222,400
ESS_49	RF Linking replacement	$408,108	$392,150	$377,634	$364,695	$355,841
ESS_5	Distribution Feeder Voltage Profile - NT	$510,135	$495,025	$485,968	$477,963	$475,279
ESS_50	Telecomms into Brownfields zone subs	$0	$0	$0	$0	$0
ESS_500	Capitalised Overheads	$0	$0	$0	$0	$0
ESS_5000	Subtransmission Planning Network - long term expenditure	$0	$0	$0	$0	$0
ESS_5001	Sovereign Hills - establish 33/11kV zone substation	$0	$0	$0	$0	$0
ESS_5002	Kootingal - loop in/out 66kV	$0	$0	$0	$0	$0
ESS_5003	Bonny Hills - establish 33/11kV substation	$0	$0	$0	$0	$0
ESS_5005	Augmentation of the Orange to Blayney 818 line	$0	$0	$0	$0	$0
ESS_5006	Power factor improvement Oberon 132/11kV ZS	$0	$0	$0	$0	$0
ESS_5009	Power factor improvement at Dareton 66/22kV ZS	$0	$0	$0	$0	$0
ESS_5011	Tweed 66kV ring reconductor	$0	$0	$0	$0	$0
ESS_5012	Thrumster - Rocks Ferry 33kV reconductor	$0	$0	$0	$0	$0
ESS_5013	Add Sectionaliser to Marulan Nth feeder tee	$0	$0	$0	$0	$0
ESS_5014	Crookwell - replace tx with higher tap buck range	$0	$0	$0	$0	$0
ESS_5015	Murrumbateman ZS - upgrade 22 line (formerly 66)	$0	$0	$0	$0	$0
ESS_5016	Ardlethon ZS - replace relay at Temora ZS to allow sectionaliser to operate	$0	$0	$0	$0	$0
ESS_5017	Tuross ZS - add recloser to 7711	$0	$0	$0	$0	$0
ESS_5018	Snowy Adit ZS - add 132 isolator between 97K/1 and 97K/2	$0	$0	$0	$0	$0
ESS_5019	Googong Town ZS - add 2nd Tx	$0	$990,051	$0	$0	$0
ESS_5021	Yass Town ZS - install isolator on 66 bus	$0	$0	$0	$0	$0
ESS_5022	Goondiwindi - install 2nd 132/66kV tx	$0	$0	$0	$0	$0
ESS_53	New FI Plant - Timeclocks Solution	$612,162	$198,010	$0	$0	$0
ESS_54	Controllable load - DM	$0	$0	$0	$0	$0
ESS_55	Replacement FI Plants	$357,094	$343,131	$330,430	$319,108	$311,360

	Investment Name	FY20	FY21	FY22	FY23	FY24
ESS_56	Load Control Relay replacement	$2,693,511	$2,588,191	$2,492,387	$2,406,985	$2,348,548
ESS_57	Convert existing legacy controllers to enable migration into PoF	$122,432	$117,645	$113,290	$109,408	$106,752
ESS_58	Mobile FI Plant Studies	$0	$0	$0	$0	$0
ESS_59	Synchronisation of multiple FI plant	$28,568	$27,721	$27,214	$26,766	$26,616
ESS_6	High Voltage Feeder Control Point monitoring - NT	$0	$0	$0	$0	$0
ESS_60	Scada Development Upgrades	$663,175	$643,533	$631,758	$621,353	$617,862
ESS_61	Remote Site Dual RTU Developments	$91,824	$89,105	$87,474	$86,033	$85,550
ESS_62	Replacement program of existing RTU hardware	$1,652,836	$1,588,208	$1,529,419	$1,477,014	$1,441,154
ESS_63	Installation of SCADA facilities into existing ZSS sites	$0	$0	$0	$0	$0
ESS_64	Replacement Program Existing Model / SIMs	$550,945	$534,628	$524,845	$516,201	$513,301
ESS_65	Broken Hill asset refurbishment	$816,215	$98,038	$47,204	$319,108	$44,480
ESS_68	Broken Hill Safety & Legal	$102,027	$0	$94,409	$0	$0
ESS_69	Protection upgrades and replacement (SS)	$1,341,654	$1,289,194	$1,241,473	$1,198,934	$1,169,826
ESS_70	Zone Substation Power Transformer Refurbishment	$1,154,196	$1,047,294	$958,134	$871,828	$792,067
ESS_71	Zone Substation Power Transformer Replacement	$2,443,556	$1,901,749	$2,131,590	$1,263,749	$1,413,748
ESS_72	Zone Substation Power Transformer Unplanned Failure Replacement	$1,686,858	$1,739,184	$1,795,197	$1,856,465	$1,937,801
ESS_74	Zone Substation On Line Tap Changer Refurbishment	$162,631	$156,272	$150,487	$145,331	$141,802
ESS_75	Zone Substation Perimeter Fencing & Security Refurbishment and Replacement	$468,304	$137,253	$80,247	$77,498	$182,368
ESS_76	Zone Substation PCB decontamination (Power Transformers)	$0	$0	$0	$0	$0
ESS_78	Zone Substation Circuit Breaker replacement	$2,490,281	$2,444,339	$2,403,169	$2,342,893	$2,309,995
ESS_79	Zone Substation Indoor Switchboards (Replacement, Refurbishment)	$310,063	$1,736,612	$1,278,133	$1,874,785	$1,606,342
ESS_79-Conversion	Zone Substation Indoor Switchboards (Conversion)	$213,693	$208,623	$2,993,876	$2,627,874	$4,994
ESS_80	Zone Substation Station Battery Replacement	$632,567	$656,851	$821,355	$902,619	$880,705
ESS_81	Zone Substation Voltage Transformer Replacement	$449,599	$431,294	$418,019	$402,107	$392,503
ESS_82	Zone Substation Current Transformer Replacement	$921,293	$885,269	$852,500	$823,289	$803,301
ESS_83	Zone Substation Surge Diverter Replacement	$496,194	$476,792	$125,432	$121,134	$118,193

	Investment Name	FY20	FY21	FY22	FY23	FY24
ESS_84	Zone Substation Unplanned Equipment Failure Replacement	$0	$0	$0	$0	$0
ESS_85	Zone Substation Protection Upgrades and Replacements	$918,242	$882,338	$849,677	$820,563	$800,641
ESS_86	Zone Substation Environmental Compliance	$560,128	$424,732	$641,477	$401,489	$399,234
ESS_87	Zone Substation Earthing System Refurbishment	$316,283	$303,916	$292,667	$282,638	$275,776
ESS_88	Zone Substation Civil Refurbishment	$101,619	$97,645	$94,031	$90,809	$88,604
ESS_89	Zone Substation Building Refurbishment	$1,058,529	$1,017,139	$979,489	$945,927	$922,961
ESS_9	Power factor correction - DM	$0	$0	$0	$0	$0
ESS_90	Minor Zone Substation Monitoring	$214,384	$208,034	$204,228	$200,864	$199,736
ESS_91	Meters for new connections	$0	$0	$0	$0	$0
ESS_92	New load control Relays	$184,579	$179,113	$175,835	$172,939	$171,968
ESS_93	Meter replacement program	$0	$0	$0	$0	$0
ESS_94	New Zone Sub & Padmount (>315kVA) meters	$0	$0	$0	$0	$0
ESS_95	Power Quality Monitoring utilising metering technology - PQ	$0	$0	$0	$0	$0
ESS_96N	Spot Luminaire Replacements - all allocations	$0	$0	$0	$0	$0
ESS_97N	Council LED program: luminaire fusing	$0	$0	$0	$0	$0
ESS_99D	Replace rusting streetlight triangular columns -defined projects	$0	$0	$0	$0	$0