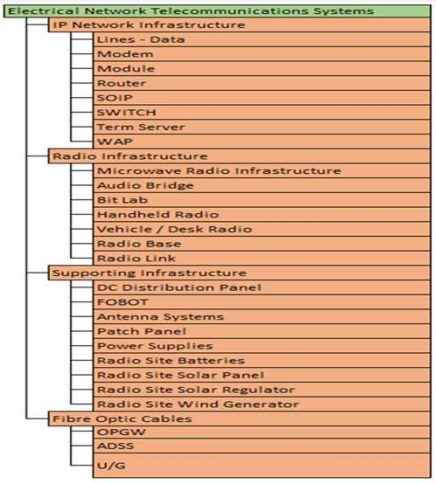
Electrical Network Telecommunications System Investment Case

The Electrical Network Telecommunications (ENT) System is a critical enabling system for any transmission or distribution system. ENT system are designed to meet defined performance requirements to ensure the safety of people, provide protection of equipment, support operational visibility and support operational control of the electrical network.

Scope

This investment case addresses Electrical Network Telecommunications (ENT) Systems. These systems support critical functions across the electrical network including remote control/visibility/real time status of certain network assets, communications to support safety in remote locations, as well as communications to field staff during emergency events such as bushfires and storms.

The investment is required to meet the capital expenditure objectives (NER 6.5.7) for quality, reliability, safety and security of electricity supply and to meet regulatory and legislative obligations for Standard Control Services.



Forecast $FY24

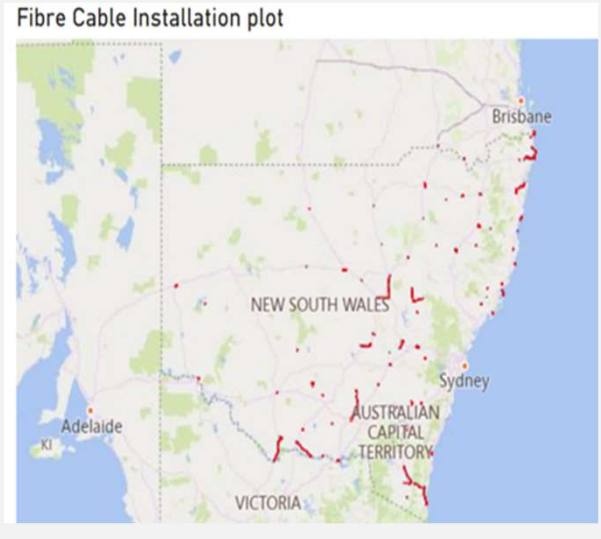
The ENT forecast accounts for 1.47% of the total Repex portfolio for FY25 to FY29.

FY25	FY26	FY27	FY28	FY29
$3.3M	$3.3M	$3.3M	$3.3M	$3.3M

Asset Profile

Asset Profile

The ENT System provides coverage across 95% of NSW. It is responsible for approximately 8300 unique assets consisting of 4726 Modems, 1168 Low Bandwidth Radios, 627 Routers, 135 Switches, 106 Microwave Radio's, 717 other Active devices such as Multiplexors and Power Supplies and the remaining assets consisting of numerous non active pieces of infrastructure. These assets are located at thousands of sites across NSW. Each of these sites are exposed to diverse environmental conditions.

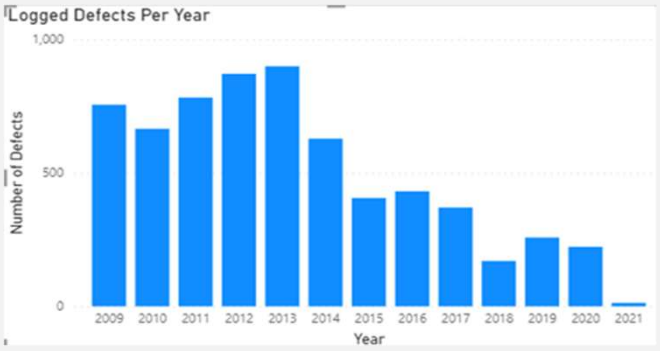


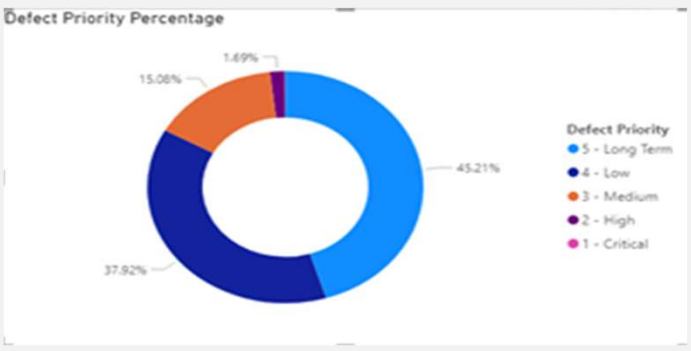
Risk Analysis

This following risk section provides an overview of the Electrical Network Telecommunications System risk model. It is supported by documents **6.03.02 Network Risk Management Manual, 6.03.03 Appraisal Value Framework and 6.03.04 System Capital - Risk and Value Based Investment** methodology.

Defect Analysis

The logged defect graph below includes all logged defects between 2009-2021. Inspections are conducted at all radio sites each year with defects and re-aligning of radio equipment rectified while onsite. Analysis of historical failure information has been difficult to conduct due to a lack in clarity of task and cause information as the "VFire" Asset Management System used to log defects, not being setup to allow for capture of concise failure mode effects and criticality analysis (FMECA) information.
The defect priority graph provides the breakdown of defects by priority. Due to the levels of redundancy in the ENT System most defects are logged as Priority 3,4 or 5 faults. This allows for most faults to have streamlined work issued to field resources.





Consequence of Failure (CoF)

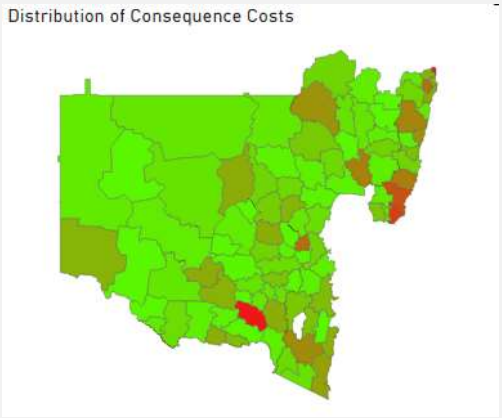
The CoF for an ENT System asset describes the impact of a functional failure. Only the ENT System components providing SCADA communications to substations were modelled in this iteration. Consequences have been evaluated using 6.03.03 Appraisal Value Framework.

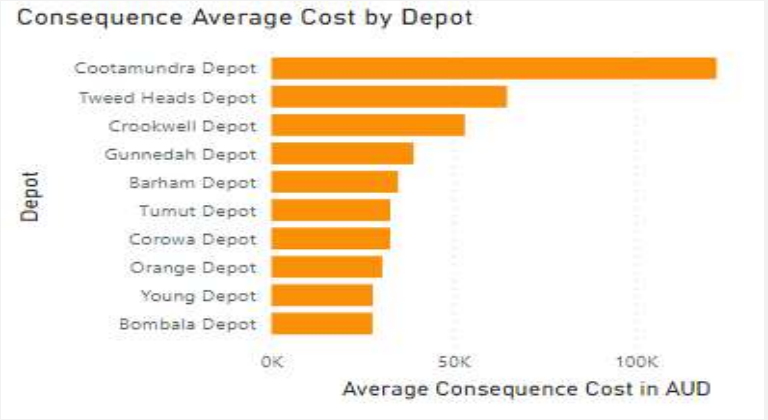
Consequence costs are dominated by network costs**.** The Total combined consequence cost of the ENT System is $28,527,580.75.

Every individual asset has a calculated safety fatality rate conforming within acceptable criteria as per **6.03.02 Network Risk Management manual.**

Asset Type	Safety Consequence	Network Consequence	Financial Consequence	Environmental Consequence
SWITCH	$ 30,590.98	$ 2,046,913.71	$ 847,339.53	$ 1,102.47
Protection Multiplexer	$ 28,647.52	$ 1,755,182.97	$ 68,052.42	$ 1,032.60
Module	$ 28,512.08	$ 2,408,124.21	$ 750,268.81	$ 1,027.44
Router	$ 28,120.52	$ 6,514,503.25	$ 5,330,236.89	$ 1,012.79
Microwave Radio Infrastructure	$ 15,791.90	$ 513,559.87	$ 1,897,039.04	$ 569.15
Radio Link	$ 9,486.21	$ 1,860,886.13	$ 2,145,714.09	$ 341.45
Power Supplies	$ 7,618.44	$ 588,300.04	$ 864,697.64	$ 274.38
Radio Site Batteries	$ 2,419.36	$ 347,384.40	$ 101,844.69	$ 87.03
Radio Base	$ 1,240.85	$ 194,601.87	$ 128,048.14	$ 44.67
Radio Site Solar Regulator	$ 666.21	$ 0	$ 6,273.00	$ 24.01
Grand Total	$ 153,094.06	$ 16,229,456.44	$ 12,139,514.25	$ 5,516.00

The images below display a **summary of asset criticality** (quantified by the average of total consequence per asset failure) for ENT System assets by depot. Tweed Heads has the highest total of consequence risks, which is expected given the population density and the criticality of the network in the region. Cootamundra has the highest average consequence.





Network Risk

Asset risk is a function of the probability of failure (PoF) and CoF. As a POF model was not produced due to poor data availability, defect analysis and consequence models were used to inform and provide a risk view. The risk model has been developed using the Asset Risk Management Framework, and represents the relationship between the primary drivers behind ENT System functional failures and the components used to determine the consequence of failure.

Radio Site Infrastructure

Radio site infrastructure is critical to the ENT System and presents unique challenges to the teams that support it. Access to these typically remote sites can require technicians to traverse steep tracks and other higher risks roads/paths to attend site. The operation of these sites becomes significantly more critical in events such as bushfire and flood events however these events can also make access to these sites unsafe and therefore limit their critical functionality at these times. The recent Royal Commission into the 2019/2020 bushfire season in NSW highlighted that the loss of communications assets was a very significant impediment to minimising both the impacts of fires and the recovery process once the fire had passed. There are a number of things that Essential Energy can do to limit exposure to the heightened travel risk as well as ensuring sites are more available. These things include increased remote visibility capability, as well as development of solar infrastructure to provide power backup when mains power is lost (refer **10.07.04 Resilience Radio Sites Solar and Batteries Investment Case**).

Background

This Electrical Network Telecommunications investment case covers the following investments:

- IP Data Network Asset Replacement
- Two-way Radio Base Replacement
- New/refurbished Zone Substation - Comms
- RF Infrastructure Refurbishment
- RF Linking replacement
- Telecomms into Brownfields zone subs
- Network Fibre program

The main focus of this investment case is on IP Data Network Asset Replacement, RF infrastructure refurbishment, and the Network Fibre program.

IP Data Network Asset Replacement

The IP Data Network provides backbone communications to substations, bulk supply points, depots, control rooms and data centres.

This program is to refresh end-of-life assets with functionally similar replacements in the following categories:

- Ruggedised routing and switching equipment in substations
- High capacity routing systems in data centres, depots and offices
- Cellular routers and radio site routers
- Voice radio routing system

These investments are required to ensure SCADA and protection schemes operate correctly.

Two-way Radio Base Replacement

This investment program is primarily to split the radio system to ease congestion, as the number of users means it can become overloaded in emergency situations.

New/refurbished Zone Substation – Comms

This investment program includes end-of-life network access switches, as well as to provide standard efficient WiFi capabilities to Zone Substations, allowing for reliable WiFi capabilities and improved cyber security.

RF Infrastructure Refurbishment

RF Infrastructure assets include fixed infrastructure including radio site compounds, huts, towers & poles. These assets provide critical communications between vehicles, depots and control rooms.

The RF Infrastructure Refurbishment program is to remediate safety and operational defects on radio infrastructure assets.

RF Linking replacement

The RF Linking replacement program is an ongoing asset refresh for the replacement of End of Life Radio Frequency linking equipment used to currently provide SCADA connectivity to Zone Sub Stations, and provide tele-protection circuits. This program will replace voice radio linking equipment due to regulatory changes in spectrum licencing.

Telecomms into Brownfields zone subs

This investment is to deliver telecommunications infrastructure between brownfield Zone Substations and the nearest Essential Energy communications point of presence. This includes installing Remote Terminal Units (RTU) to provide local and remote monitoring and control capability.

Network Fibre Program

The network fibre assets support the Operational Technology systems and provides telecommunications infrastructure services. This program of investment includes upgrading overhead earth wire (OHEW) to optical ground wire (OPGW) fibre, as well as installing or relocating fibre underground.

Forecasting Approach

The replacement Capex forecast (FY25-FY29) has been calculated using Essential Energy's optimisation software (Copperleaf) which uses a risk based methodology to maximise the value of the investment portfolio within constraints established by Essential Energy that are consistent with our Corporate Risk Framework, Asset Management System, applicable standards, rules, regulations and licence conditions. To assure efficiency our portfolio has been constrained to meet customer and stakeholder expectations.

In line with NER capital objectives, the objectives of our total replacement portfolio have been informed through extensive stakeholder engagement and consist of:

- **Maintain reliability performance (network risk)**:
- **Improve bushfire risk:** Upgrade reclosers to allow total-fire-ban settings
- **Maintain safety performance:** Ensuring telecommunications infrastructure works correctly when relied on for safety of staff and public.

The expenditure for the 2024-29 period is based on internal analysis as detailed below.

Alternatives

IP Data Network Asset Replacement
IP Data Network Asset Replacement is primarily for data network refresh, data security uplift, and upgrading end-of-life 3G assets. Data security upgrades at radio sites cost ~$30k per site.
If the investment is not made, we could expect:

- Unplanned Failure – The older IPDN equipment is no longer supported by vendors and spares are either not available or extremely scarce. Failures of this nature can affect 3 or more Zone Substations as they are often configured in a ring configuration. This results in an unacceptable escalation of network reliability risk.
- Resource management – The management and planning of resources is directly affected based on the high workload required to engineer new solutions at short notice due to the impacts of unplanned failures. Unplanned failures of this nature have a knock on effect creating resource impacts on planned works.
- Service Level Performance – Agreed service levels cannot be guaranteed creating operational impacts on the business.
- Equipment will not meet evolving business requirements – Continual changes across the SCADA environment will require render the existing investment obsolete.

RF infrastructure refurbishment
Site upgrade costs vary widely, up to $700k per site.
If the investment is not made, we could expect:

- Escalating safety risk due to structural failures.
- Very high risk to network reliability as equipment cannot be added, upgraded, repaired or serviced on towers that are designated "Do Not Climb".
- High financial risk as alternative sites will need to be either built or leased.
- High reputational risk in the event of site failure.
- Very high risk of failing to meet regulatory requirements for workplace safety and construction standards.

Network Fibre Program
There are also optic fibre investments – to replace overhead earth wire with optical fibre ground wire, or trench / under bore the optical fibre cable. There are too few of these projects to produce unit rates.

Assumptions

Attribution and categorisation

- Attribution and categorisation of tasks to specific assets and maintenance tasks was not possible in general. However mapping of tasks was achieved by using data scripts to analyse free text fields. This mapping was then able to produce estimates for which tasks and/or calls were failures and which were just defects. It also enabled the hardware type to be identified and categorised.

Consequence models

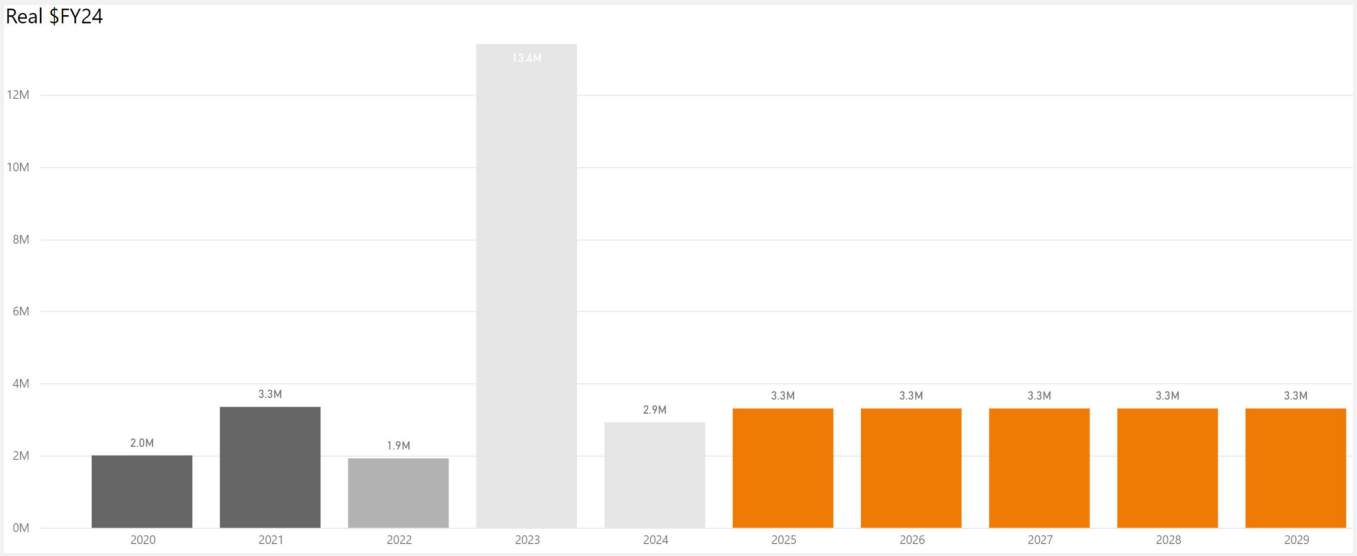
- Consequence models were developed in accordance with the 6.03.03 Appraisal Value Framework, the model was developed using a mix of SME estimates, extrapolation of data from systems such as Power on Fusion, Vfire, EAM, TotalSafe, Reliability database and the Telecommunications Links Database.

10 Year Replacement Capex Forecast

Forecast replacement expenditure for ENTs across the 2024-29 period is $16.5M, averaging $3.3M per annum. Actual and projected expenditure for the remainder of the 19-24 period is $20.7M.

The capex expenditure for FY23 includes a step increase in the following programs:

- Network Fibre program ($5.7M)
- IP Data Network Asset Replacement ($1.0M)
- RF Infrastructure Refurbishment ($5.1M)



Data source: Actuals: Internal delivery reports, Forecasts: Copperleaf
Note: All values are in FY2023-24 real dollar terms

Justification

We are confident that our approach delivers an efficient and prudent level of investment as:

- **Clear drivers from Asset Management Objectives** for Reliability, Quality, Safety and Compliance (as detailed in **Attachment 10.01 Strategic Asset Management Plan**).
- **NER Capex Objectives:** form the basis of our proposal
- **Review and moderation:** Our forecasts have been tested and reviewed by our executive management and the Board, subject to top-down challenges (as detailed in **6.03.04 System Capital Risk and Value Based Investment**) and the forecasts moderated based on feedback and discussion.

The major benefits from the proposed ENT investments (against the **change nothing** scenario) are:

- **Improved network risk and maintainability**: Investment in this asset class will reduce network risk through replacement of ENT of degraded condition and/or in high risk locations with more resilient materials of acceptable condition; and
- **Maintain levels of service for our customers:** Maintaining the health of assets through addressing locations of highest risk, will result in fewer unplanned failures from asset degradation and therefore will enable us to maintain service reliability for customers.

Forecast replacement expenditure for ENTs across the 2024-29 period is $16.5M, compared to actual/projected expenditure for 2019-24 period of $20.7M.

Strategic Direction

We shall

Acquisition

Selection Criteria
- Review existing IP Capable devices to ensure compliance with requirements set out in CEOS2546 Telecommunications Network Security Management Standard can be met.
- Look for vendor opportunities in the 5G, CAT M1, LORA WAN and Satellite space for recloser communications.
- Continue to closely monitor vendor and carrier driven obsolescence to ensure that telecommunications equipment and links are not allowed to fall out of support and required end of life transitions are done in the most cost effective manner.

Procurement
- Continue to create period contracts for existing standard telecommunications active infrastructure to ensure best price.
- Look to develop period contracts for fibre optic infrastructure.
- All telecommunications infrastructure to be procured by the Telecommunications team

Stock Holdings:
Conduct a review of current spares holding practices with regards to critical microwaves

Supply Chain
- Maintain existing supply chain.

Ops & Maintenance

Preventative Maintenance (Inspections):
- Short: Reduce onsite radio maintenance frequency to hub sites annually and end sites every 18 months.
- Medium: Develop a remote radio maintenance capability to further reduce onsite radio maintenance frequency to 3 yearly visits to line up with tower inspection requirements.
- Medium: Look to leverage grounds maintenance contracts to get regular images of radio sites in lieu of site visits from EE staff where possible.
- Short/Medium: Optical fibre asset's to be inspected as part of asset inspector programs

Corrective and Breakdown Maintenance :
- Short: Continue to replace or repair defective components as per current practices.
- Medium: Develop FMECA based capability in new EAM system to ensure a full dataset for future analysis requirements.

Operational Monitoring:
- Short: Develop monthly availability reporting for all Scada enabled sites.
- Medium: Develop a remote management capability for most cost efficient way to manage and support Recloser modem firmware upgrades and mass configuration changes.

Interventions

Futureproofing and removing duplication of radio linking
- Short/Medium: Remove duplicated paths between 2 radio sites or end of life links with a single radio link that can support all data types.

Prioritisation
- Continue with current prioritisation practices
- Medium: Develop appropriate prioritisation of faults within new EAM system

Replacement Programs
- Short: Cease replacing analogue base radios
- Medium: Centralise all ENT system assets into the new EAM System

Cyber Security
- Short: Adjust Architecture and Design standards to incorporate new cyber security requirements.
- Medium: Implement designs as required to achieve compliance with CEOS2546 Telecommunications Network Security Management Standard

Disposals

Individual Assets or Entire Asset Variants
- Continue to investigate opportunities to re-use and recycle assets in accordance with CECP8074.
- Continue to dispose of active ENT Systems equipment in accordance with CEOP2319

Hazardous Materials
- Continue to use technical standards, such as CERM1000.75, to review safe disposal – e.g. Radio site batteries.

Asset Support

Process & Information
- Short : Review CEOM7621.01 Technology Guideline - Places in the network, look at options to merge Type 2 and 3 Zone substation classifications given cheap cost of 4G redundancy capability and the savings this makes in reductions to after hours call outs. Additionally look to a 3rd path using 4G for type 1 and 2 zone substations where both paths go back to the same depot.
- Short : Work with Innovation to conduct trials on pole mounted satellite solutions and TeleProtection over MPLS.
- Short: Continue to consolidate ENT System Assets into EAM.
- Medium: Make new EAM the primary Asset Management system for all ENT System assets
- Medium: Work to ensure linking capability in EAM will allow for downstream impacts of upstream failures to be clearly understood.

People & Training
- With expected growth in ENT Systems driven by 3rd party connections such as new generation and complex loads, budget from the ongoing charges to these 3rd parties needs to be allocated to the ENT system support teams to ensure ongoing maintenance and upgrades can be appropriately resourced.
- Continue with current regulatory and periodic training.
- Look to develop a fibre optic splicing capability at selected depots for emergency repair situations.