Revised Proposal

Attachment 5.13.L

Justification for Operational Technology & Innovation Programs

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Content

1 OVERVIEW OF THE OPERATIONAL TECHNOLOGY & INNOVATION PROGRAM

The Operational Technology & Innovation program encompasses Ausgrid's core operational technology requirements for the regulatory period. It comprises four sub-programs (excluding the ADMS project now detailed in attachment 5.13N), which are outlined below. Forecast expenditure of $77m is proposed for the FY20-24 regulatory period. This includes an increased expenditure forecast from the original proposal for the Operational Technology Cyber Security program following further information regarding critical infrastructure management requirements.

Program 1 - Network Innovation Program ($42.02m)

This program covers a range of innovative network technology pilots including expansion of previous trials to develop advanced solutions to resolve network needs more efficiently than traditional network investment approaches.

An independent review of the program and cost benefit analysis modelling to support expenditure in this program is included in attachments 5.13.L.1 and 5.13.L.2 respectively.

Program 2 - Planning and Technology Data Usage ($11.95m)

This program covers data system enhancements and the acquisition of detailed asset data to enable a higher level of service delivery and improve delivery efficiency over time.

A business case, cost benefit analysis modelling and an independent review by GHD supporting expenditure in this program is included in attachments 5.13.L.3, 5.13.L.5 and 5.13.L.4 respectively.

Program 3 - Operational Technology Cyber Security ($19.56m)

This program covers mandatory Operational Technology cyber security upgrades and capability enhancements to meet core compliance requirements under Ausgrid's Critical Infrastructure Licence Conditions and Commonwealth Government requirements for critical infrastructure.

A Cyber Security Investment Review conducted by Ernst & Young and Ausgrid position on best practice cyber security is included in attachments 5.19.2 and 5.13.L.6 respectively.

Program 4 – Control System Core Refresh ($3.39m)

This program covers periodic critical upgrades and refresh of Ausgrid's existing core control system servers, operator work stations and network equipment such as routers, switches, firewalls and operator work stations.

This expenditure was accepted by the AER in its draft determination and therefore Ausgrid has made no material changes to this program.

2 PROGRAM 1 – NETWORK INNOVATION

2.1 Program description

Ausgrid has a long history of innovation, and the Network Innovation Program builds on this experience to identify, develop and integrate into core corporate systems and processes a range of new and innovative solutions to both existing and emerging problems in a fast-changing industry. It addresses risks related to the sub-optimal use of capital to resolve network constraints, and the failure to meet changing customer service level expectations in line with advances in technology. In this context, innovation encompasses the trials and pilots necessary to prepare the business for advanced technology which will have long term gains but is not mature enough to deliver on business as usual services; and the deployment of technology to enhance the uptake or deliver on new and improved energy services desired by our customers.

Importantly, this program is therefore designed to achieve the following specific objectives:

- develop the capability to integrate new network and customer technology into the network to drive efficiency in energy distribution over the long term; and
- deploy enabling technology, devices and systems to facilitate the transition towards a more decentralised energy system including the realisation of customer objectives to maximise the utilisation of distributed energy resources.

To achieve these objectives, the Network Innovation Program encompasses a diverse range of projects which may evolve over time as technology matures. To manage the uncertainty associated with investment of this nature, a more involved consultation and governance process including an external advisory committee will apply to this program.

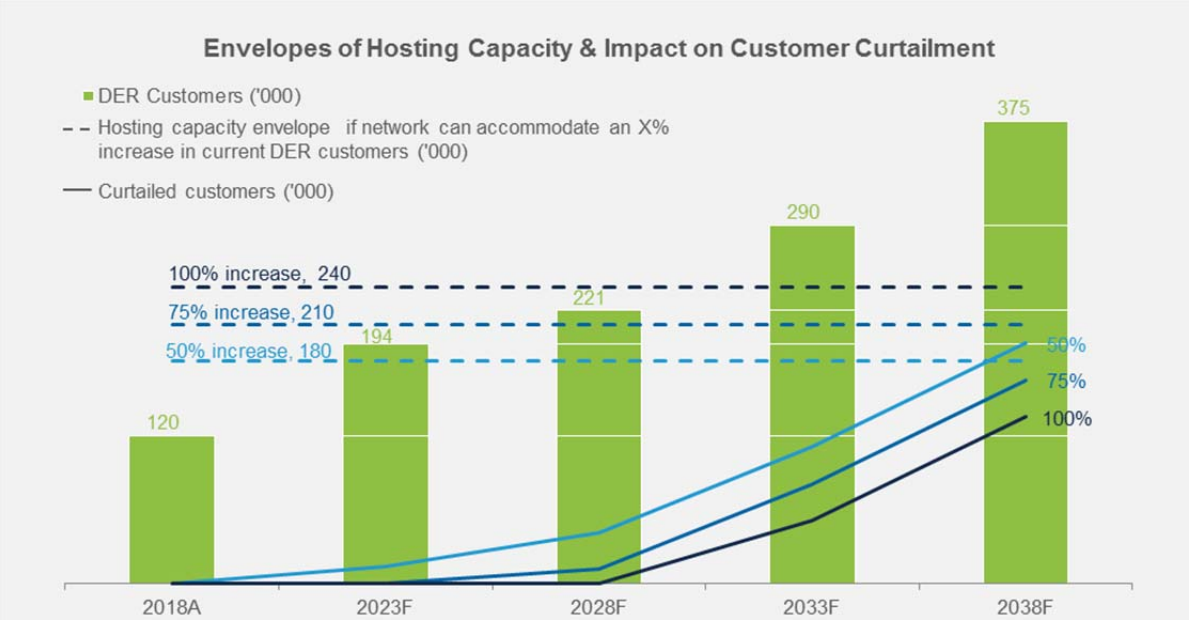
2.2 Background

The Australian energy market is currently undergoing a period of unprecedented change. Across the entire national electricity market a substantial proportion of the roles and functions are changing, with significant disruption in the wholesale generation market, on-going asset replacement and renewal in the transmission and distribution networks, and an overhaul of the retail landscape through the Power of Choice regulations. Overlaying these changes are rapid technological advances driving changing consumer expectations about their energy services and providing many opportunities for advanced technology solutions to solve traditional and emerging energy network problems.

Our customers have told us they want to embrace new technology such as renewable generation, batteries, electric vehicles and energy monitoring. They are also eager to ensure that they leverage as much value as possible from their investments through services such as peer-to-peer trading and demand aggregation. A significant challenge for Ausgrid in the coming regulatory period is supporting these customer needs.

Modelling by Energeia forecasts our Distribution Energy Resources (DER) customers to grow 61% to 2023 and 136% to 2038. The 12% gap between the highest penetration substation (16%) and lowest (4%) in 2023 is forecast to grow to 17% by 2038. If Ausgrid's hosting capacity was insufficient to accommodate all customer DER, grid feed in would need to be curtailed to maintain power quality and protect infrastructure. Indicative analysis of the impacts on customers of our response to this challenge is shown in Figure 1 below.

Figure 1. Impacts on customers of DER hosting capacity limitations



Envelope	Capacity relative to 2018 DER customers	Customers hosted (k)	Customer DER forecast (k)		Customers curtailed (k)		Typical customer FiT revenue[1]	Customer value foregone ($m)	
			2023	2028	2023	2028		2023	2028
1	+50%	180	194	221	14	41	$478	$6.6	$19.8
2	+75%	210			-	11		-	$5.5
3	+100%	240			-	-		-	-

The decline in costs of advanced network technology continues to provide opportunities to reduce capital and maintenance expenditure on traditional network "poles and wires" solutions. Ausgrid is committed to expanding the envelope of innovation within the distribution network, and this program encompasses several investments in these areas to improve service delivery and maximise the value we deliver to our customers and the market.

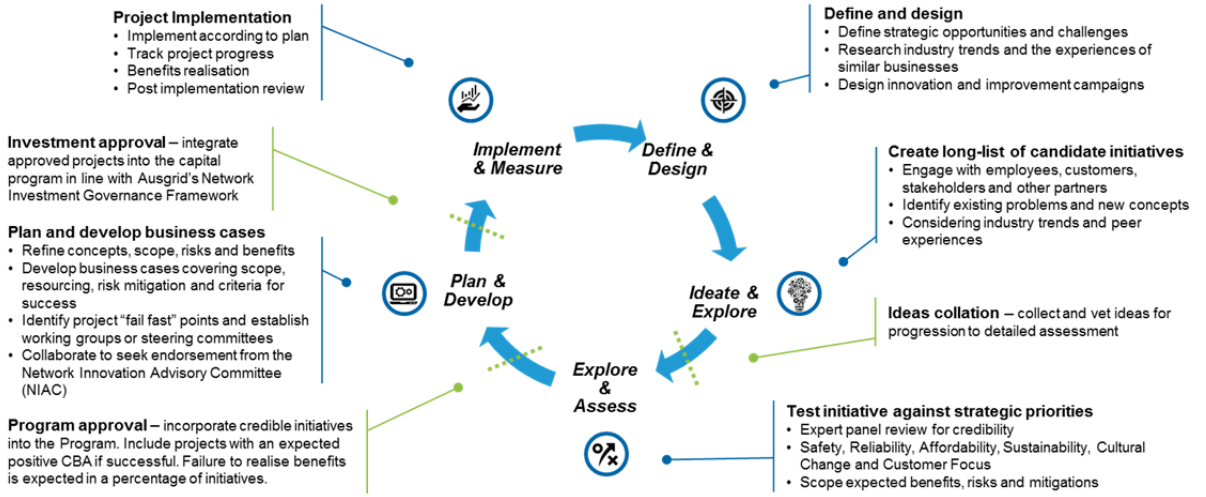
2.3 Innovation Framework and Governance

The key objective of the Network Innovation Program is to develop the capability to deploy innovative technology capable of providing a better core service to customers at lower cost and more safely than existing methods, or new services that our customers want but that we currently cannot deliver with our existing assets. By their nature, most of these technologies are not at the level of maturity that enables accurate and detailed determination of unit costs and overall project costs at early project stages. To ensure optimum outcomes are achieved, Ausgrid utilises an innovation and improvement framework to design, assess, develop and measure the benefits of these programs to deliver greater customer and shareholder value.

It includes a critical assessment of the criteria for success and failure, along with a tolerance for risk appropriate for the level of investment and possible positive outcomes for the customer. A key element is engagement with the newly formed Network Innovation Advisory Committee, comprised of key customer stakeholders, as part of the project evaluation and approval process. This process is further described in Chapter 3 of our revised proposal.

The Innovation and Improvement framework is shown in Figure 2 below.

Figure 2 Innovation and improvement framework



Resources and priorities continue to be evaluated across the program to ensure that the core challenges and opportunities are being addressed in the way which maximises value to our customer and stakeholders.

Delivery of these projects aims to ensure the Ausgrid can deliver on the National Electricity Objective over the long term. Cost benefit analyses have been undertaken to validate investment these projects and are contained in Attachment 5.13.L.2. These assessments have been independently assessed and verified by GHD (see Attachment 5.13.L.1), and some refinements have been incorporated into the modelling following this review.

2.4 Advanced Voltage Regulation Pilots

Voltage control is a core element of operating and maintaining an electricity distribution network. Ausgrid's network already comprises on-load tap changing transformers at sub-transmission and zone substations and, in key locations on the sub-transmission and high voltage networks, we operate line voltage regulators, reactors and capacitor banks. These devices act to maintain voltages within an acceptable envelope.

Over the last ten years there has been a significant increase in distributed generation, specifically rooftop solar, which has changed load patterns on low voltage networks in ways unforeseen when they were designed decades prior. There are currently over 115,000 homes and businesses with a rooftop solar system in the Ausgrid area and over time, as penetration of these systems increases, control of network voltages within the required thresholds will become increasingly difficult and expensive. As experienced in other Australian networks, power quality issues as a result of high concentrations of distributed generation may also curtail the ability of customers to connect additional systems.

Advances in technology mean that advanced voltage regulation devices, including Static Compensators (STATCOMs), are now cost effective in some situations at the distribution level (see Figure 3). Ausgrid intends to undertake a series of pilot projects of advanced voltage control technology within both our low voltage and high voltage networks, to develop a technically and operationally feasible solution that can be deployed as required to reduce traditional network expenditure on upgrading assets. This will deliver better customer value in network areas constrained by poor voltage and power quality performance.

The key benefits expected from this project include future capex deferral benefits from installation of proven low cost STATCOMS as an alternative to traditional conductor or transformer upgrades where voltages do not meet limitations. Unquantified benefits also include increased hosting capacity for customer DER on network circuits equipped with

STATCOMs where more dynamic control of voltage facilitates a higher tolerance for variable local generation.

Figure 3. Impact of LV STATCOM device on Voltage Profile

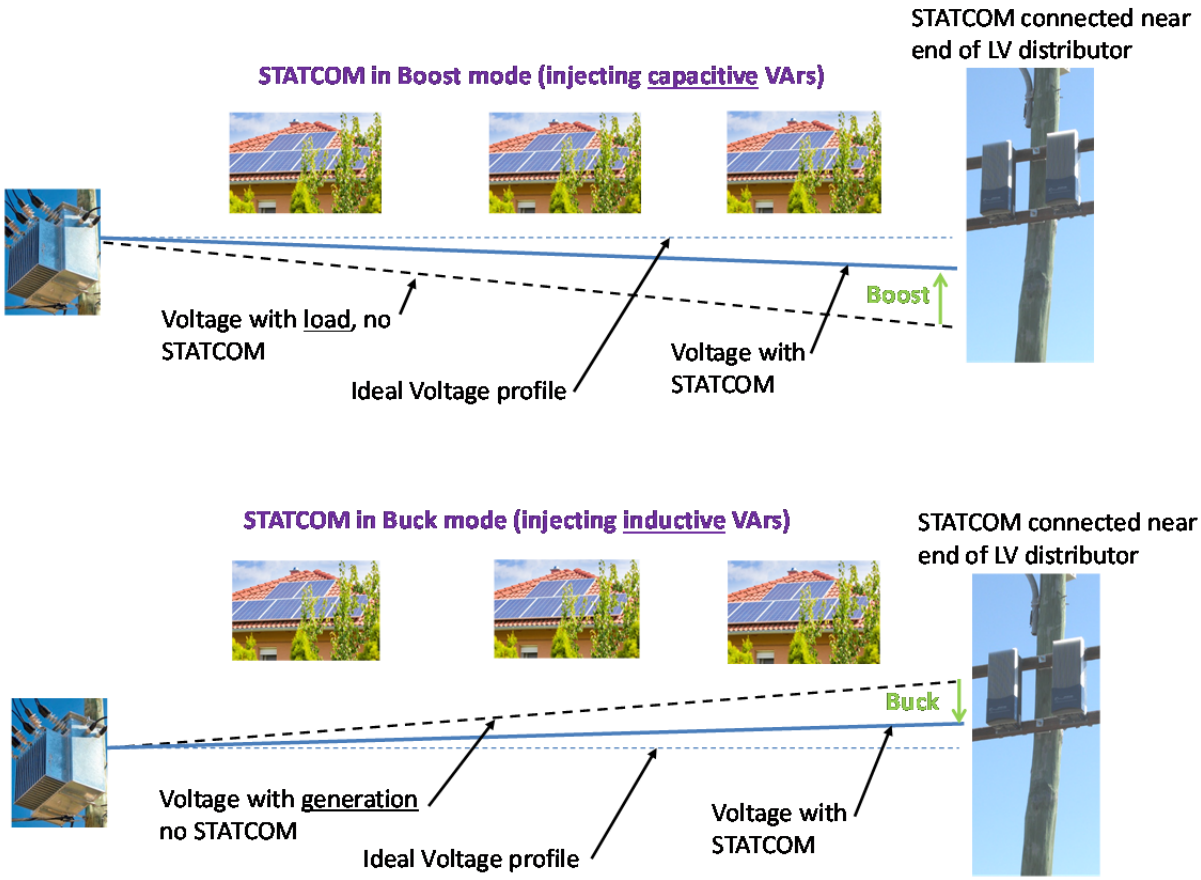


Table 1. Key features of the STATCOM trial and pilot projects

Target Customer Benefit	Success Criteria	Total Indicative Timeframe	Indicative Cost FY20-24
Increased capacity to accommodate customer DER resources and reduced network costs	Viability and efficacy of various voltage regulation technologies at increasing network DER capacity	FY18-FY22	$3,000,000

2.5 Network insights

Ausgrid has approximately 5,500 existing online Distribution Monitoring and Control devices (DM&C devices) installed in kiosk style substations across some of our 33,000 distribution substations. This initiative increases the reach of these devices via a retrofit program for the upgrade of existing devices with the latest technology, and the installation of new devices in a number of strategic high capacity surface chamber locations. This initiative will enhance and support the integration of the ADMS into network operations and planning, facilitating self-healing networks initiatives and allowing the network to be dynamically reconfigured to reduce technical constraints that occur due to the roll out of DER. Importantly, it will also give

Ausgrid a rich data set to support any 'open networks' information platform made available to our customers, facilitating easier and more cost effective connections, enabling customers to extract greater value from DER, and foster greater levels of innovation in the industry.

The scope of this program covers the installation of approximately 300 new generation substation control and monitoring devices with remote control capability to be retro-fitted into existing distribution substations, as well as development of back-office systems and protocols to facilitate the inclusion of these devices as standard in new substations where beneficial.

Key benefits include long term reductions in network opex and capex, as well as reductions in unserved energy, from increased visibility and control of the distribution network. Broader market benefits, such as the value of the increased visibility of network conditions and the potential increase in hosting capacity have not been quantified but will become increasingly valuable as they facilitate greater penetration and utilisation of distributed energy resources.

Table 2. Key features of new generation substation control and monitoring devices pilots

Target Customer Benefit	Success Criteria	Indicative Timeframe	Indicative Cost FY20-24
Increased capacity to accommodate customer DER resources and better safety, reliability and security of supply	Network insight technology embedded in network design and data on key network locations available for analysis	FY18-FY24+	$10,500,000

2.6 Grid Fringe Optimisation

Over the next regulatory period, Ausgrid plans to investigate, develop and implement a program of projects where micro-grids and stand-alone power system solutions offer more cost-effective alternatives to traditional network expenditure over the long term. Potential drivers of such projects include improving power reliability for customers through providing a back-up supply solution in the case of a power outage, addressing bushfire risks or the reduction of operating and capital expenditure.

This project will include detailed investigation, modelling and identification of future scenarios and network locations where micro-grids or stand-alone power systems are likely to be a more cost-effective than traditional network solutions, now and into the future.

Case Study
Barnard Stand-alone Power System

Working with the National Parks & Wildlife Service, Ausgrid provided a grant to install a stand-alone power system in the Hunter Valley. This enabled us to decommission overhead power lines through bushfire prone land in a National Park, reducing fire risk and saving on the significant future expenditure otherwise required to maintain those assets.

Key benefits quantified for this project including avoided operational and capital expenditure on maintenance over the longer term, a significant reduction in bushfire and safety risks due to fallen mains, and a reduction of unserved energy for these remote customers.

It is noted that the realisation of these benefits in the longer term is dependent on changes in the National Electricity Rules to permit DNSPs to own and operate stand-alone power systems to provide the least cost solution to our supply obligations.

Table 3. Key features of grid fringe optimisation pilots

Target Customer Benefit	Success Criteria	Indicative Timeframe	Indicative Cost FY20-24
Reduced network costs for customers and better safety, reliability and security of supply	Successful and operating demonstration system. A cost-benefit model to quantify the efficiency boundary of the traditional network	FY19-23	$4,700,000

2.7 High Voltage Micro-Grid

Over the next regulatory period, Ausgrid plans to investigate, develop and implement a pilot of high voltage micro-grid power system solutions where they are a more cost-effective alternative to traditional network expenditure over the long term. Potential drivers of such projects include improving power reliability for customers by providing a back-up supply solution in the case of a power outage, addressing bushfire risks and/or the reduction of operating and capital expenditure. We are currently developing a project in a community on the western shore of the Pittwater in Northern Sydney that will result in the implementation of a range of innovative demand management and supply solutions with extensive input from the community.

This project will build on the learnings achieved during the initial phases of the Grid Fringe Optimisation project, A successfully operating micro-grid could provide improved reliability of supply and significantly reduce bushfire risk during high fire danger periods, as well as potentially reducing capital and operating costs over the long term. The potential for specialised micro-grid tariffs will also be examined under this project.

Table 4. Key features of high voltage micro-grid power system pilots

Target Customer Benefit	Success Criteria	Indicative Timeframe	Indicative Cost FY20-24
Reduced network costs for customers and better safety, reliability and security of supply	Successful and operating micro-grid systems which meets customer expectations and allows evaluation of cost, risk and performance benefits of micro-grid.	FY21-FY24+	$17,200,000

2.8 Advanced EV Charging Platform

This initiative examines the ability for Ausgrid's network to interact with multiple electric vehicles (EVs) at a single location. In collaboration with suitable industry partners, this initiative will evaluate the technical parameters and market mechanisms for a suite of EV chargers that can sense the level of charge in vehicle batteries, manage their charge rate and optimise the concurrent charging of individual vehicles to best utilise the available network capacity.

Key benefits include avoided future capex through management of charging demand to minimise network augmentation requirements under the increased penetration of electric vehicles, as forecast by the Australian Energy Market Operator (AEMO).

Table 5. Key features of EV charging platform pilots

Target Customer Benefit	Success Criteria	Indicative Timeframe	Indicative Cost FY20-24
Better service experience for EV owners and reduced network costs to facilitate EV charging stations	Development of effective model for deployment of EV charging stations	FY20-FY22	$1,200,000

2.9 Grid battery pilot

Ausgrid is planning a small number of grid battery pilots to assess the viability of network use cases including the deferral of network augmentation through peak shaving, improving power quality and reliability outcomes, particularly in locations with high PV penetration, and provision of other network support services. A priority of these trials is to demonstrate and evaluate the operating (and partnership) models that can unlock additional value for customers. For example, by providing access to 'virtual partitions' within a community battery, enabled though a cloud based trading platform, giving customers access to the range of value that a battery can deliver without exposing them to the upfront installation cost, and maximising the potential economies of scale to reduce costs for all consumers and bring forward adoption of local renewables. It is estimated that a community level battery, given the economies of scale and diversity in demand, is four times more efficient than individual house-hold batteries.

This trial will also seek to learn about appropriate tariff structures to ensure customers using community assets are not at a disadvantage compared to behind-the-meter generation and storage solutions.

Key benefits include deferred capex longer term due to the ability of the battery to support the network during times of peak demand, and a reduction of unserved energy for customers if configured to operate for a local area in islanded mode.

Unquantified benefits include the broader economic benefits for participants when compared to purchase and operation of behind the meter batteries, due to the greater economies of scale and diversity from a community scale battery.

Table 6. Key features of grid battery pilots

Target Customer Benefit	Success Criteria	Indicative Timeframe	Indicative Cost FY20-24
Facilitate access to DER for customers who otherwise could not participate in the clean energy transition	Identified benefit to customers from installation of grid batteries. Optimum regulatory and tariff framework identified.	FY20-FY22	$2,000,000

2.10 Portable all-in-one off-grid supply units

This initiative will trial the use of portable, modular off-grid energy supply units that can be deployed rapidly and provide grid quality supply to a customer (or customers) for an extended period without a physical grid connection. There are multiple uses for portable off grid power, and this trial would be expected to test all such cases, including providing additional support during network maintenance, supporting remote and vulnerable customers during extended planned and unplanned outages, or islanding customers to alleviate bush fire risk, or assessing the suitability of permanent 'off-gridding'. This initiative

will evaluate the effectiveness of several off the shelf units to deliver improved customer outcomes.

Table 7. Key features of portable off-grid supply pilots

Target Customer Benefit	Success Criteria	Indicative Timeframe	Indicative Cost FY20-24
Reduced network costs for customers and better safety, reliability and security of supply	Improved customer outcomes identified, and technology assessed for business as usual adoption	FY20-FY22	$1,000,000

2.11 Self-Healing Network Trials

This project includes expanding trials of automated network reconfiguration capabilities on the network to enable dynamic grid re-configuration for improved customer restoration times, better emergency response and increased overall network capacity through potential time of day reconfiguration and network optimisation.

This type of technology was originally trialled in 2012 and Ausgrid continues to operate a small 'fault detection, isolation and restoration scheme' (FDIR scheme) in the Newcastle area using several high voltage 'IntelliRupter' fault interrupters. This initiative will expand the trial to new sites and evaluate the operation of a number of other devices including those being developed under the Network Insights project. It will evaluate and assist in scoping the requirements for network automation devices following the successful commissioning of the ADMS.

Self-healing network applications ultimately have the potential to provide substantial reliability, capacity and efficiency benefits for the Ausgrid network. These trials would include technologies from multiple manufacturers under various network configurations to ascertain their performance within the Ausgrid network context to ensure that the most cost effective solutions are ultimately adopted.

The key benefits quantified for this project are primarily avoided unserved energy for customers. Further benefits in future of automation longer term include potentially significantly increased utilisation of existing assets through more dynamic control of network configuration.

Table 8. Key features of the automated network devices pilots

Target Customer Benefit	Success Criteria	Indicative Timeframe	Indicative Cost FY20-24
Increased capacity to accommodate customer DER resources and better safety, reliability and security of supply	Operating self-healing network segments with demonstrable benefits to customer reliability, augmentation deferral and DER capacity	FY19-FY23	$600,000

2.12 Dynamic Load Control

Ausgrid operates a significant customer load control system involving nearly 500,000 installations of hot water storage heater control. Advances in technology, including the long

term roll-out of smart meters, will provide opportunities to explore more flexible and advanced load control technologies covering a wider range of devices. A number of previous trials over the past five years have explored the potential for control of air conditioners and pool pumps, and Ausgrid is currently migrating existing load control circuitry to smart metering in conjunction with the Power of Choice led smart-meter roll-out. Opportunities also exist to provide better flexibility, value and choice to customers where they live in areas of high network capacity.

Under the Network Innovation Program further pilot projects will continue to build on our past experience gained in this area to identify potential to reduce future capital expenditure by utilising the capability of new smart meters and their ability to individually address customer load control timing.

Key benefits quantified for this project include avoided future capex on replacement of aged ripple control systems and deferral of future network augmentation due to dynamic demand response capabilities to better manage network voltage constraints under scenarios of increased DER penetration levels.

Table 9. Key features of dynamic load control system pilots

Target Customer Benefit	Success Criteria	Indicative Timeframe	Indicative Cost FY20-24
Increase choice and control of energy and reduced network costs for customers	A more flexible load control system delivering tangible improvement in network operation and DER hosting capacity	FY19-FY22	$600,000

2.13 On-line Asset Condition Monitoring

Ausgrid employs condition based maintenance to manage the majority of our network assets. Generally, this relies on periodic inspections to determine asset condition and respond accordingly, with inspection periods carefully assessed to balance the cost against risk of failure. Technology has been available for some time which provides real-time, control system integrated monitoring of some asset condition indicators, however has not ultimately been a cost effective substitute to periodic inspections. With advances in technology and the increased capability of the ADMS, the maturity of this technology will be re-assessed.

This project will assess a variety of modern on-line asset condition monitoring technologies available in the market to provide real time assessment of asset condition for critical assets, including integration into the ADMS.

A cost benefit analysis of potential outcomes was undertaken for this project, specifically considering the potential deployment of cable condition monitoring solutions to defer future capex on subtransmission cable augmentation.

Table 10. Key features of on-line asset condition monitoring devices pilots

Target Customer Benefit	Success Criteria	Indicative Timeframe	Indicative Cost FY20-24
Reduced network costs for customers and better safety, reliability and security of supply	Proven efficacy of on-line condition monitoring for network deployment	FY19-FY22	$600,000

2.14 Advanced Line Fault Indicator Trials and Pilot Deployment

Line Fault Indicators provide a visible indicator for field crews to quickly identify network faults, particularly in the dark or during adverse weather. Modern line fault indicators can communicate directly with the ADMS, to provide system operators with more information about network issues before crews are dispatched. They also provide real-time performance indication of network flows and thus support a better understanding of network capacity, particularly in long and diverse overhead networks. This project involves an examination of modern line fault indicator technology and a targeted pilot deployment to network locations to quantify the operational benefits achievable.

Key benefits quantified for this project including a reduction of unserved energy for customers and opex savings from a reduction in manual feeder patrols

Table 11. Key features of line fault indicator pilots

Target Customer Benefit	Success Criteria	Indicative Timeframe	Indicative Cost FY20-24
Reduced network costs for customers and better safety, reliability and security of supply	Deployed and operating fleet of devices integrated into operational systems, with quantified benefits	FY18-FY24	$600,000

2.15 Forecast

The overall forecast for this program is shown in the table below.

Table 12. Network Innovation Program Forecast ($,000s)

Program	2020	2021	2022	2023	2024	Total FY20-24
OTI_03.19	$7,635	$7,428	$9,461	$8,757	$8,738	$42,020

3 PROGRAM 2 – PLANNING & TECHNOLOGY DATA USAGE

3.1 Program description

This program will drive enhancements of asset data and systems to safely and effectively optimise usage of network assets. This will be done by improving data integration from various information systems, the capture of new asset data, and systematically upgrading business processes and systems to better utilise this data. It will improve capital delivery efficiency and address risks relating to sub-optimal capital expenditure due to inadequate or insufficient asset and performance information.

3.2 Background

Ausgrid undertakes design, planning and analysis under modelled and forecast conditions for its electrical network infrastructure. We currently capture some limited spatial data and high resolution imagery of our assets utilising aerial patrols with Light Detection and Ranging (LiDAR) equipment. Greater integration of this type of information into our core asset management decision making processes will enable more efficient standards and designs, planning, ratings and maintenance decisions and processes, leading to better value for our customers. We have also identified a need to support greater transparency to our customers and other stakeholders on network capability and capacity to support emerging technologies such as electric vehicles and other distributed energy resources, which we will seek to address through this program of works.

3.3 Network Digitisation Project

Ausgrid has been undertaking helicopter based aerial photography and LiDAR analysis of the network since 2012 to manage bushfire risk in rural areas, covering approximately 25% of our overhead network. We are commencing a program over FY17 and FY18 to further digitise the network using LiDAR across urban areas of the network using fixed wing aircraft. In the FY20-24 period we intend to capture significantly more asset data via ground based LiDAR and high definition photography services, and integrate this data to provide a digital visualisation of the network.

Detailed asset data supports advanced analytics, the development and enhancement of mature asset management strategies, and underpins efficient and effective operational activities for the organisation. Advanced data collection technologies provide the means to rapidly capture a greater level of detail on assets and their surrounds. This data can then be analysed, in some cases automatically, reducing the need for traditional manual data collection methods.

What is LiDAR?

Light Detection and Ranging (LiDAR) is a technology using laser light targeted at an area looking to be analysed. It measures the timing and reflectivity of the surface being targeted to determine the exact positioning of objects and surrounds. The GPS synchronisation and use of this technology over a large area enables the construction of a 3D model of the area.

The market availability of applications to host and analyse LiDAR and other large datasets has grown in recent years. These applications have reached the stage of maturity where they are capable of processing the large data volumes, converting this information into digital virtual environments. They have easy to use interface tools for end users to fully utilise these datasets for decision making.

A fully digitised virtual network asset world is a strategic opportunity which will provide the foundation for transformational change in the way Ausgrid executes routine tasks such as maintenance inspections, network planning and surveying, data verification, and asset capture.

A project business case has been developed to create a digitised virtual world of the Ausgrid network, integrating current practice and leveraging further technology advances to increase capital delivery efficiency by understanding exact configuration of assets and improving risk prioritisation methods for effective capital delivery.

GHD have conducted an independent review of the business case and cost benefit analysis model and confirmed the robustness of the model and input assumptions, stating in conclusion:

> *'On balance, we find that the project is sufficiently defined for its purpose (justification of expenditure for inclusion in the forecast of expenditure in the next regulatory period), the financial analysis is sound and the assumptions reasonable.'*

The business case, cost benefit analysis model and independent review by GHD are included in attachments 5.13.L.3, 5.13.L.5 and 5.13.L.4 respectively.

Table 13. Key features of the network digitisation project

Target Customer Benefit	Success Criteria	Indicative Timeframe	Indicative Cost FY20-24
Reduced network costs for customers and better safety, reliability and security of supply	Ongoing delivery efficiency improvements from improved access to accurate information and more effective capital prioritisation	FY19-FY24	$11,950,000

3.4 Connection Maps for EV Charging and Embedded Generation

Ausgrid intends to partner with universities and industry bodies to develop a web-based system to provide information for the competitive market on optimum areas to connect new services to the network, including electric vehicles (EV) and embedded generation.

The purpose is to better facilitate the market led roll-out of these types of energy services. This will deliver better value to our stakeholders and the energy market in general. This project is expected to be low cost, but high value by bringing together key network connections data in a form which will help market proponents navigate the connections process in a more streamlined way.

It is expected that given the collaborative nature of this project and broader market benefits, this project can be achieved without regulated funding.

Table 14. Key features of connection maps project

Target Customer Benefit	Success Criteria	Indicative Timeframe	Indicative Cost FY20-24
Increased visibility to communities of areas that can accommodate DER, including EVs	Increased uptake of DER in areas requiring limited or no network augmentation in a timely manner	FY20-FY21	No Funding Allowance Requested

3.5 Forecast

Table 15. Planning & Technology Data Usage Forecast ($,000s)

Program	2020	2021	2022	2023	2024	Total FY20-24
OTI_03.12	$4,370	$4,370	$1,070	$1,070	$1,070	$11,950

4 PROGRAM 3 – OPERATIONAL TECHNOLOGY CYBER SECURITY

4.1 Program description

This program enhances Ausgrid's control system security position to comply with NSW Distributors Licence, specifically the Critical Infrastructure Licence Conditions, and broader Commonwealth Government Cyber security guidelines. It addresses the significant complexity associated with maintaining cyber-security capability and technology to industry best practice on critical control system network infrastructure used to service 20% of Australia's GDP and 15% of its population.

4.2 Background

In the 12 months to end of December 2018, 10 major attacks on critical infrastructure with international significance have been observed. These attacks have been discussed broadly in industry to understand existing cyber security threats and potential industry solutions. An increasing frequency of infrastructure related security incidents is being observed, and governments and regulators are increasingly focused on mitigating risks to infrastructure critical to the nation.

On 1 December 2016, additional licence conditions were imposed on Ausgrid by the NSW State Government to ensure critical infrastructure security systems were in place. The conditions related to Critical Infrastructure were subsequently revised and re-issued on 5 December 2017. Additionally, the Commonwealth Government has recently introduced the Critical Infrastructure Act (2018), which seeks to manage the complex and evolving national security risks associated with Critical Infrastructure, including many of Ausgrid's assets. This, in coordination with the formation of the Australian Government Critical Infrastructure Centre, will continue to drive Ausgrid's security requirements for the management of its Operational Technology (OT).

Ausgrid's electricity distributors licence conditions are governed by the NSW Electricity Act 1995 and require Ausgrid to deploy appropriate cyber security protections to maintain system control from only within Australia and allow information access only by authorised persons and only from within Australia. These key requirements are outlined in clauses 9.2 and 10.1 as:

> *Clause 9.2 – …the Licence Holder.*
>
> *(a) must, by using best industry practice for electricity network control systems, ensure that operation and control of its distribution system, including all associated ICT infrastructure, can be accessed, operated and controlled only from within Australia, and that its distribution system is not connected to any other infrastructure or network which could enable it to be controlled or operated by persons outside Australia;*
>
> *Clause 10.1 – Licence Holder must ensure that:*
>
> *(a) all of its information (being design specifications, operating manuals and the like) as to the operational technology (such as the SCADA system) and associated ICT infrastructure of the operational network is held solely within Australia, and that such information is accessible only by a Relevant Person who has been authorised by the Licence Holder and only from within Australia*

Expectations for industry best practice are evolving. Ausgrid interprets best industry practice in a manner consistent with other industry participants, such as the Australian Energy Market Operator (AEMO). This includes adoption of key industry standards as detailed in Ausgrid's assessment of best practice provided in attachment 5.13L.6.

As recommended by the Commonwealth Government's 2017 *Independent Review Into the Future Security of the National Electricity Market* (the "Finkel Review"), AEMO developed a Cyber Security Framework[1] for Australian energy companies in 2018. This framework has been tailored for the Australian energy sector – referred to as the Australian Energy Sector Cybersecurity Framework (AESCSF) - and has adopted the industry frameworks from the US Department of Energy's Cybersecurity Capability Maturity Model (ES-C2M2) and the NIST Cyber Security Framework (CSF). This framework has 11 dimensions of cyber security and 3 maturity levels for each dimension.

As part of a coordinated industry wide approach to cyber security, AEMO facilitate ongoing industry wide assessments of cyber security maturity utilising the AESCSF. Out of 150 market participants, Ausgrid is one of 17 classified as high criticality and/or regionally important entities. Ausgrid's self-assessment results are summarised below in Figure 4 from both 2017 and 2018 showing the improvements delivered during this period.

Figure 4 - Ausgrid Cyber Security Assessment Results

[redacted]

Expectations for industry best practice are evolving. AEMO expects all network companies achieve a Maturity Indicator Level (MIL) of 2 within the next 12 to 18 months. [redacted]

To meet these regulatory, government and stakeholder requirements, investment in systems that are capable of addressing evolving cyber security risks and ensure alignment with industry best practice for Ausgrid's OT and related IT systems is required.

4.3 OT Cyber Security Plan & Priorities

This program addresses requirements to achieve industry best practice OT security as required by Ausgrid's licence conditions. The program has been developed by leveraging relevant industry standards as outlined in Attachment 5.13.L.6 to develop capability with cyber security protections correlated to preventative, detective and recovery capabilities. Industry and general cyber security best practice is expected to change and evolve as the threat landscape changes over the time.

[1] AEMO Website: https://aemo.com.au/Electricity/National-Electricity-Market-NEM/Cyber-Security

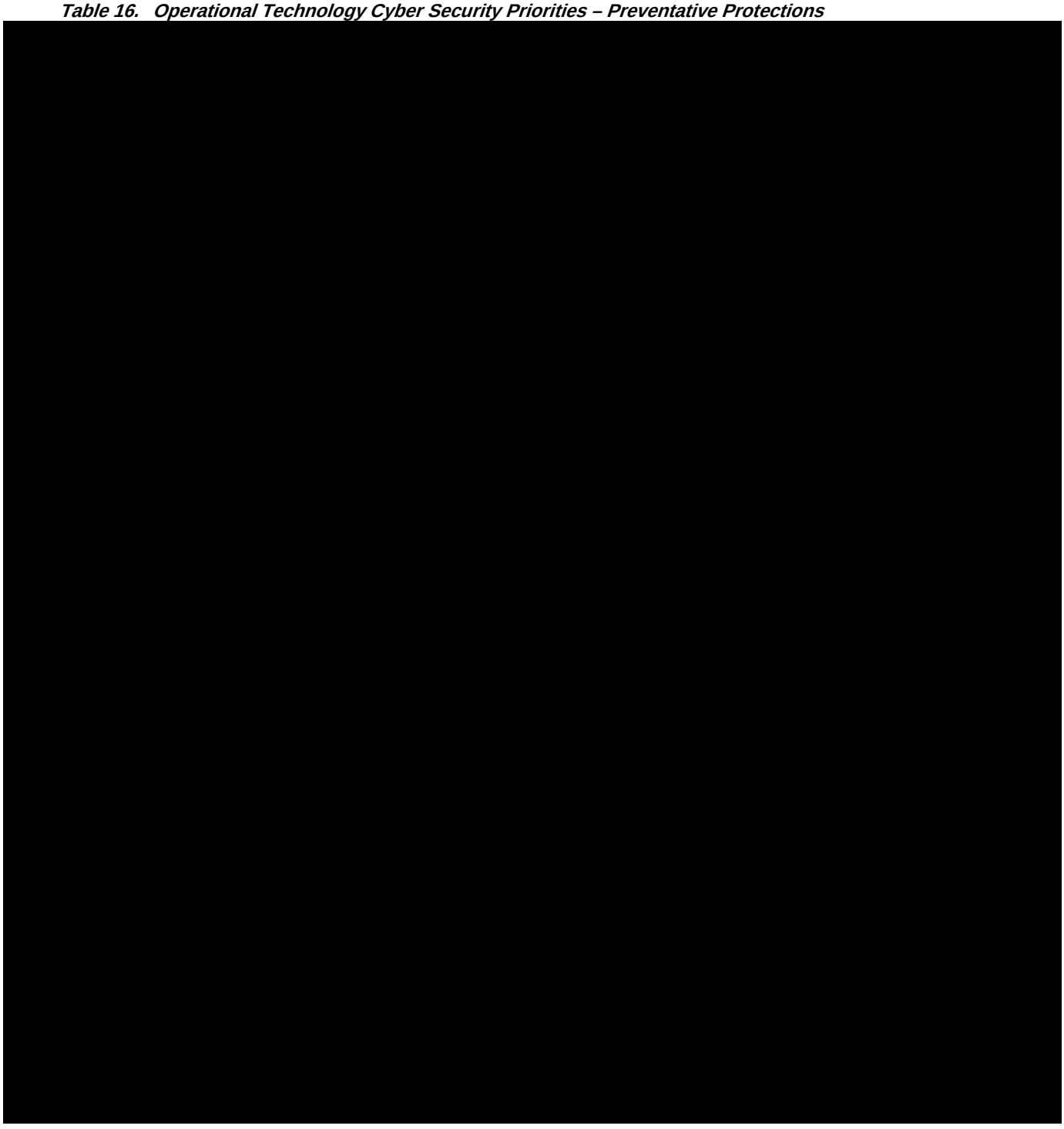
Analysis from Ernst and Young (Attachment 5.19.2) conducted in November 2018 confirms that increasing risks to utilities such as Ausgrid require greater focus and investment on cyber security during the FY20-24 regulatory period.

The proposed program investments will deliver to the OT environment:

- Additional capability to increase level of maturity and meet industry best practice; and
- Uplift, enhancement or refresh of existing capability.

Key project areas of focus are described below in Table 16, 17 and 18 below and include forecast timing of works over the FY20-24 regulatory period to achieve the associated levels of maturity.

Table 16. Operational Technology Cyber Security Priorities – Preventative Protections



[redacted]

Due to the rapid evolution of threats in the OT domain, investment in this program will be managed in combination with an external advisory committee inclusive of informed stakeholders and customer representatives. More information on this proposed Technical Review Committee can be found in Section 2.9 of Chapter 2 of our revised proposal.

The timeframes required to achieve levels of maturity as identified by Ernst & Young (in Attachment 5.19.2) has driven the planned investment over the FY20-24 period [redacted]

In November 2018 Ausgrid provided AEMO with the results of its assessment for incorporation into AEMO's 2018 Cyber Security Preparedness Report[2]. [redacted]

As the Licence Conditions require Ausgrid to use best industry practice an annual plan is developed to maintain compliance in line with Ausgrid's interpretation of industry best practice. Ausgrid consults with industry participants and bodies continuously and incorporates feedback into each annual planning cycle.

[2] https://aemo.com.au/Electricity/National-Electricity-Market-NEM/Cyber-Security/2018-Cyber-Security-Preparedness

4.4 Industry Roadmap

The broader energy industry acknowledges the need to improve and maintain cyber protections and has described cyber security as a matter of national importance. The following is an extract from AEMO's website[2] describing the current industry position:

> *Protecting the Australian energy sector against increasingly sophisticated cyber threats is a matter of national importance - not only to ensure the integrity and reliability of electricity supply via the grid, but also for economic stability and national security purposes.*
>
> *The AESCSF also leverages recognised industry frameworks similar to Ausgrid in understanding best industry practice.*
>
> *This new framework provides a foundation on which the sector can be consistently assessed and will provide the insight required to uplift the maturity of its cyber security capabilities, and ultimately strengthen its cyber resilience.*

In April 2018, the approach adopted by AEMO was endorsed by the Australian Cyber Security Centre (ACSC) and Critical Infrastructure Centre (CIC).

The new framework was used to undertake assessments of cyber security maturity across the energy sector. The completion of an AESCSF Self-Assessment by all Market Participants was summarised in a report released in December 2018[3].

AEMO and industry will use the lessons learnt from this process to drive a roadmap of prioritised activities over the medium term. Ausgrid's Operational Technology Cyber Security Program is a key component of our commitment to this roadmap to deliver best practice cyber security. This is supported by AEMO's confirmation[3] as described below.

> *The lessons learnt from the 2018 assessment process and feedback attained from participating members will be utilised in updating the current version of the AESCSF. The updated version will also align to changes in the evolving threat, regulatory and technology framework.*
>
> *AEMO working in partnership with its industry and government partners will be establishing a cyber security vision for the energy sector with an associated roadmap of prioritised activities across a three-year horizon.*

Through the implementation of Ausgrid's Critical Infrastructure Licence Conditions, engagement with the Commonwealth regarding the implementation strategy for the ADMS, implementation of the Critical Infrastructure Act 2018, Ausgrid has incorporated insights provided by the Commonwealth into the OT cyber security program.

The Commonwealth Government has also recognised the need for an uplift in cyber security capability of operators of Critical Infrastructure. The stated aim of the Commonwealth Government's Critical Infrastructure Resilience Strategy[4] is the continued operation of critical infrastructure in the face of all hazards. The Strategy notes that more resilient critical infrastructure will also help to achieve the continued provision of essential services (provided by critical infrastructure) to businesses, governments and the community, as well as to other critical infrastructure sectors.

There are two core policy objectives under the Strategy. The first objective is for critical infrastructure owners and operators to be effective in managing reasonably foreseeable risks to the continuity of their operations, through a mature, risk-based approach. The second objective is for critical infrastructure owners and operators to be effective in managing

[3] https://aemo.com.au/Electricity/National-Electricity-Market-NEM/Cyber-Security/2018-Cyber-Security-Preparedness

[4] https://www.tisn.gov.au/Documents/CriticalInfrastructureResilienceStrategyPlan.PDF

unforeseen risks to the continuity of their operations through an organisational resilience approach.

4.5 Forecast

The program forecast has been developed understanding recent investment in Operational Technology systems to improve cyber security protections following the introduction of Ausgrid's critical infrastructure licence conditions in 2016.

In 2017 approximately $9.6m was invested in 2017 to transition towards compliance with the ministerially imposed licence conditions and transition plan. Following this transition, an annual review identified a further $4.6m of investment in 2018 to introduce new functionality to manage the control system environment consistent with industry practice.

A five-year forecast was developed [redacted] This forecast is summarised in the table below.

Table 19. Operational Technology Security Forecast ($,000s)

Program	2020	2021	2022	2023	2024	Total FY20-24
OTI_03.16	$5,375	$3,450	$2,605	$5,480	$2,653	$19,563

5 PROGRAM 4 – CONTROL SYSTEM CORE REFRESH

5.1 Program description

This program funds periodic critical upgrades and refresh of Ausgrid's existing core control system servers, operator work stations and network equipment such as routers, switches, firewalls and operator work stations.

5.2 Background

Ausgrid's control system environment consists of field devices, communications and control systems. These control systems are driven and managed by software that resides on hardware provided by a system severs, operator work stations and network equipment such as routers, switches and firewalls and other associated supporting equipment that comprise the core control system.

Ausgrid's core control system dates from the 1990s. This program covers defined enhancements or replacements of systems components which comprise this core control system, based on risk assessments that consider end of life failure or maintainability factors, or additional functionality requirements to meet core regulated business needs.

This program replaces the previous systems maintenance program (OTI_03.04) and forecasts a significant reduction in on-going expenditure in this area compared to the current regulatory period, due largely to recent or proposed investment in major system upgrades or replacements such as the ADMS (OTI_03.15) and the operational technology off-line environment (within OTI_03.16).

This expenditure was approved by the AER in their draft decision on our initial proposal, and for clarity in this proposal we have combined the two sub-programs of our initial proposal to align with the AER's determination and classification as wholly non-network expenditure.

5.3 Requirements

This program covers the enhancement and replacement of severs, operator work stations, network equipment, other associated supporting equipment that comprise the core control system. This equipment needs to be regularly refreshed based on a risk based assessment of their end of life and technical obsolescence for ongoing operations and support.

As required by critical infrastructure licence conditions, Ausgrid must use best industry practice for electricity network control systems, and ensure that operation and control of its distribution system, including all associated infrastructure, can only be accessed, operated and controlled from within Australia.

As part of applying industry best practice for a control system to meet this objective, it is critical that this supporting equipment that comprises the core control system is refreshed based on a risk based assessment. This enables the management of equipment end of life and technology obsolescence in conjunction with available vendor support arrangements, for example maintaining servers and workstations on currently supported operating system version releases.

The expenditure under this program covers maintenance and integration activities for remaining control systems infrastructure before, during and after the transition to the ADMS over the 2019-24 regulatory period. It is a reduction in expenditure from the current regulatory period due to complementary upgrade works associated with the ADMS and other operational technology security investment.

5.4 Forecast

Table 20. Control System Core Refresh Forecast ($,000s)

Program	2020	2021	2022	2023	2024	Total FY20-24
OTI_03.18	$954	$779	$778	$441	$441	$3,392