Strategy

Network Innovation

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Responsibilities

This document is the responsibility of the Network Innovation Team, Tasmanian Networks Pty Ltd, ABN 24 167 357 299 (hereafter referred to as "TasNetworks").

Please contact the Network Innovation Team Lead with any queries or suggestions.

- Implementation All TasNetworks staff and contractors.
- Compliance All group managers.

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Table of Contents

1 Introduction

The electricity industry is undergoing significant change; much of this change is being driven by disruptive technologies. Disruption has now become the status quo and innovation is one of the strategies that TasNetworks is using to ensure it continues to maximise the utilisation and benefits of the existing networks to Tasmanian customers, both big and small.

Innovation is required from all areas of TasNetworks. The purpose of this document is to focus the attention of TasNetworks on the key innovations that will assist with the evolution of TasNetworks network assets and provide guidance on the use of innovation more broadly across TasNetworks.

TasNetworks wishes to be, and be seen as being innovative. In the context of the national and international power industry, TasNetworks is a small player and generally adopts the approach of being a *fast follower* in terms of adopting new technologies.

Rather than investing effort in the development of new technologies, we focus our efforts on how we can apply emerging technologies for the benefit of network users, while acknowledging that due to the size and unique characteristics of the Tasmanian power system, not all emerging technologies will suit the Tasmanian context. In this way we can manage risk and use our compact networks to best advantage. Energy Networks Australia's (ENA) recent Network Transformation Roadmap provides a mechanism to innovate collaboratively with other network businesses, recognising many of the issues facing networks are not unique to Tasmania.

Customers have an expectation that TasNetworks will be innovative and the metering and tariff reforms currently underway will be important planks in building the perception of TasNetworks as an innovative organisation. This has been a strong message from customers during the recent customer engagement process.

More recent drivers are the decarbonisation of the National Electricity Market (NEM) and Tasmanian energy security, resulting in an increase in large scale renewable generation wishing to connect to the Tasmanian network, including a potential new high voltage direct current (HVDC) Tasmania-Victoria interconnector. This has introduced a new set of challenges that will require innovative solutions to maintain the security and resilience of the Tasmanian networks.

The network innovation strategy sets the innovation direction and priorities out to 2024. This strategy includes innovation objectives to guide overall innovation, as well as specific initiatives to focus attention and resources.

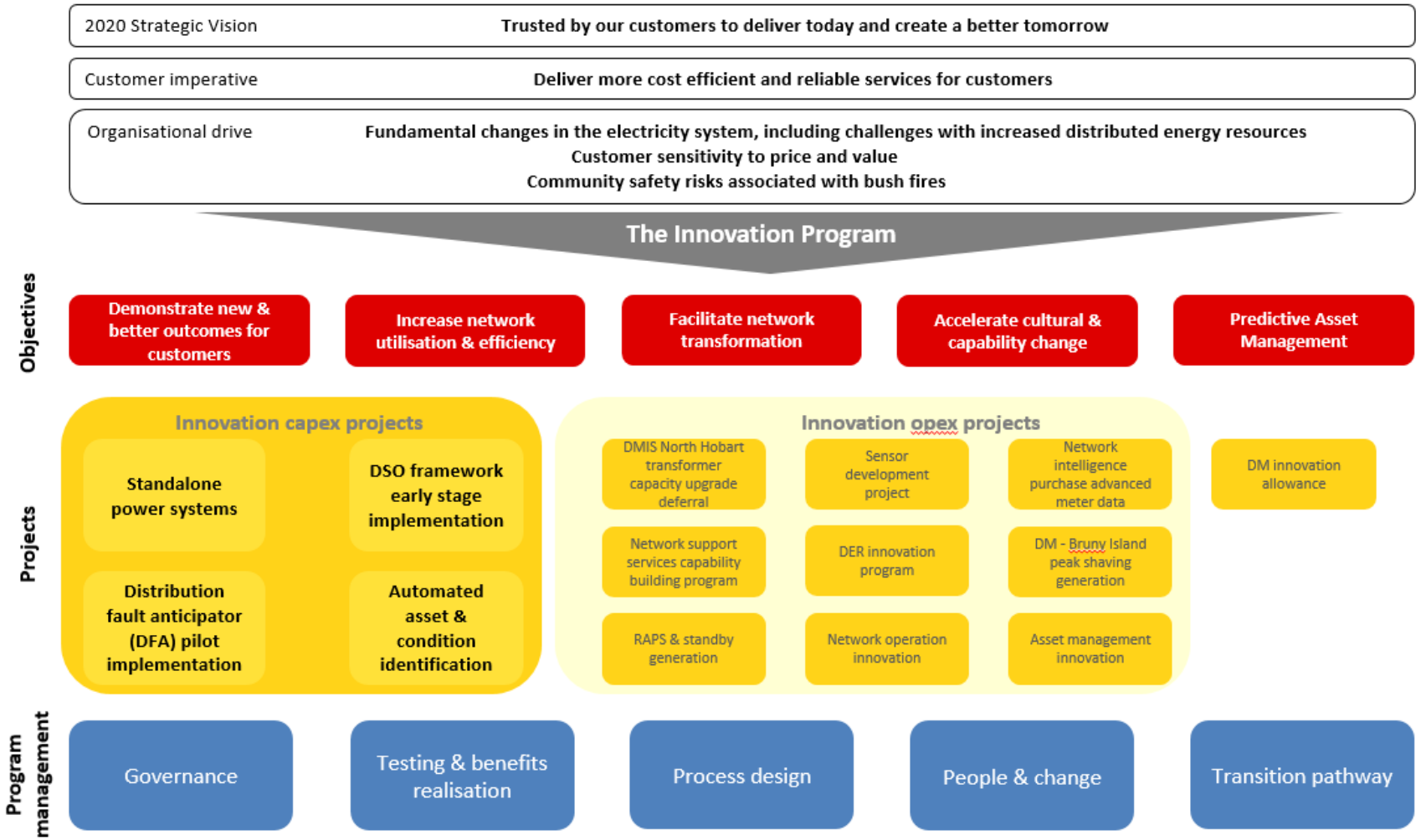

Figure 1 Overview of TasNetworks Innovation Strategy

2 Scope

This strategy defines objectives to guide network innovation projects at TasNetworks to ensure customer benefits are maximised while making efficient use of resources. The scope of this strategy applies to technical innovation on both the transmission and distribution networks. This strategy also defines a targeted innovation work program for implementation out to 2024.

The Innovation Strategy scope includes research and development, technology trials and innovation adoption projects associated with network assets.

3 Strategic Context

The TasNetworks' vision to be "*trusted by our customers to deliver today and create a better tomorrow*" helps to set the direction of developing a network for the future. The TasNetworks business plan 2017-18 identifies the need to position the business for the future.

The Network Innovation Strategy seeks to contribute to the delivery of this vision, by utilising both mature and emerging technology to the benefit of TasNetworks, its customers, and the broader Tasmanian community.

The Network Innovation Strategy will assist the implementation of the following TasNetworks strategic initiatives:

- Customer Net Promoter score: through demonstrating innovation to customers;
- Lowest sustainable prices: by developing efficient network alternatives;
- Network service performance maintained: by developing new technologies to improve performance in poorly performing areas;
- Sustainable cost reductions: improving network utilisation through new technologies and information; and
- Efficient field and business services works delivery: leveraging technology to improve works efficiency.

3.1 Transformation Roadmap 2025

TasNetworks has contributed to the development of the ENA and CSIRO Network Transformation Roadmap (NTR) that outlines a plan to transform energy networks by 2025. The NTR outlines multiple work streams that must be developed to ensure networks transition sustainably through the disruption facing the industry. The Network Innovation Strategy is influenced by the NTR and will align activities to ensure TasNetworks is actively contributing to progressing the NTR.

TasNetworks has developed a Transformation Roadmap 2025, to guide strategic activities required to transition the business to cater for the future needs of our customers. The Network Innovation Strategy seeks to develop key capabilities in alignment with the Transformation Roadmap 2025.

4 Our Innovation Network Strategy

This section outlines our Innovation Strategy. This includes a description of:

- Why innovation is needed across the business (organisational drivers of innovation);
- What we are trying to achieve through innovation (innovation objectives);
- How we will foster innovation in the way that we run the network (process and governance); and
- When we will innovate.

4.1 Drivers of innovation

As set out in the ENA and CSIRO NTR, the electricity system is changing on an unprecedented scale, driven by customers as they embrace new technologies, take control of their energy use and support action on climate change. In this decentralised but integrated energy future, electricity networks must be responsive to the changing demands for traditional services while enabling new opportunities for energy resource sharing and balancing.

With higher levels of rooftop solar photovoltaic (PV), and increasingly, battery technologies across the electricity system the role of networks is changing. In particular, traditional network services designed to facilitate one way flows of electricity from large scale generation to customers are changing as customers install their own sources of generation and seek to share excess electricity generated with other consumers in the market. As the penetration of these technologies increase upgrades will be required to facilitate two way flows of power. This new supply chain model may see network services increasingly being used as insurance.

Within TasNetworks' network, we are observing the following new challenges in managing the network:

- Fundamental changes to the electricity system: PV technology continues to be installed at a high rate by customers. Battery storage has started to be adopted by customers, with two batteries per week being connected in Tasmania. These technologies together have the potential to fundamentally shift customers' requirements of a network. Customers will want to draw energy from the network at times of low prices, but use or export their stored energy at other times. This change of usage introduces technical and economic challenges to the network.
- Customer sensitivity to price and value: while Tasmanian customers have largely been shielded from the extent of electricity price increases experienced in other NEM regions, our customers are very sensitive to the price of electricity. Our large and small customers are telling us that electricity prices are increasingly placing pressure on their budgets, and they are actively looking for alternatives to lower costs and are looking to us to help provide solutions.
- Community safety risk: Tasmania has experienced a number of serious bushfires over the last decade, which has caused both loss of life and property. A key cause of fire starts are electricity networks. That is why many electricity network businesses are required to report on their 'fire danger rating'. TasNetworks is committed to increasing public safety through reducing bushfire related risks associated with network infrastructure. TasNetworks released its Bushfire Risk Mitigation Plan in September 2017 and it highlights the need to focus on the high bushfire loss consequence areas (HBLCA).

5 Innovation objectives and principles

Our specific innovation objectives and principles have been guided by:

- TasNetworks' vision to be "*trusted by our customers to deliver today and create a better tomorrow*;"
- ENA and CSIRO's Electricity Network Transformation Roadmap;
- TasNetworks' Transformation Roadmap 2025; and
- The outcomes of customer and stakeholder consultation.

Building on the drivers of innovation and the broader transformation agenda and objectives of TasNetworks, we have identified a number of objectives for innovation that underpin our strategy. These objectives are designed to specify the outcomes that we are seeking across the business from the application of innovative solutions. By building on the drivers of innovation and TasNetworks' transformation agenda, these objectives seek to guide the business to use innovation to address issues and challenges, rather than innovate for innovation sake.

Our Innovation objectives include:

- Demonstrate new and better outcomes for customers, particularly reliability and price competitiveness: This objective focuses on changes to processes, systems and technologies that can reduce costs for customers while maintaining high reliability performance. Specific examples of these initiatives could include:
    - Deferring augmentation and replacement capital expenditure through better network monitoring;
    - Reducing capacity uplift capex by better spreading energy transmission;
    - Reducing opex by reducing physical inspections and night call outs;
    - Enabling customers to adopt and utilise distributed energy resources (DER) to their full potential; and
    - Efficiently supporting new generation capacity in Tasmania.
- Increase network utilisation and efficiency throughout the planning, construction and asset management phases: A cost effective and technically efficient network is essential to ensure sustainable pricing of network services. Many new and innovative technologies can address existing and emerging issues. The key network issues facing TasNetworks are:
    - Localised peak demand and voltage issues;
    - Aging and life-expiring assets, with limited visibility of actual condition;
    - Asset management, fault and emergency costs;
    - Risk of asset stranding from uncertain load growth;
    - Expensive to maintain edge-of-grid assets (such as single wire earth return (SWER) networks);
    - Availability of accurate and timely distribution network data for decision making purposes;
    - Network constraints; and
    - Localised / regional lower reliability performance.

- Facilitate network transformation: The services offered by the network to customers must continue to transform and respond to changing customer needs. The Strategy focusses effort into core innovation activities that progress TasNetworks along its transformation journey. This includes increasing the technical hosting capacity of renewable generation in the network and network pricing reform.
- Accelerate cultural and capability change to effectively transition to the future system operator model: Ensuring that we have a culture of innovation and have the right capabilities within the business to identify, investigate, pursue and implement innovative solutions is critical to facilitating network transformation. This includes setting up people systems and processes to reward innovation and to make sure that failure is not punished.
- Improve asset safety through real-time detection of asset failure, fire and safety risks and inappropriate use of the network: Improving asset safety will ensure better outcomes for customers, both in terms of service and cost. New technologies, including smart metering on the network, can provide us with more information in relation to issues as they arise on the network. Utilising these technologies will help transform our network, while ensuring that we ensure the safety of our staff and our customers at an efficient cost.

To achieve these objectives, a set of principles have been established. These principles guide the way we will work, provide consideration of specific innovation opportunities, and assist in refining solutions and projects to meet our objectives. These principles are applied in practice through TasNetworks' innovation framework to identify and rank option and assess the outcomes of pilots / trials.

- Customer focussed: benefits must be realisable in the medium term;
- Business led: innovative solutions will be designed to solve actual problems;
- New to business: projects need to be new and investigative;
- Governance assured: from inception to benefits realisation and transition to business as usual (BAU), governance arrangements are to be followed;
- Integrated: new projects must support workforce adoption through people and process change;
- Scalable: solutions must be capable of expansion; and
- Intent to transition: retained focus on innovation transitioning to BAU.

6 Innovation processes and governance

TasNetworks' innovation framework sets out a process for investigating, pursuing and implementing innovative network solutions at TasNetworks. The framework allows anyone at TasNetworks to innovate and enables the benefits of that innovation to be captured by setting out processes, documentation and governance to streamline outcomes.

TasNetworks' innovation framework is detailed below.

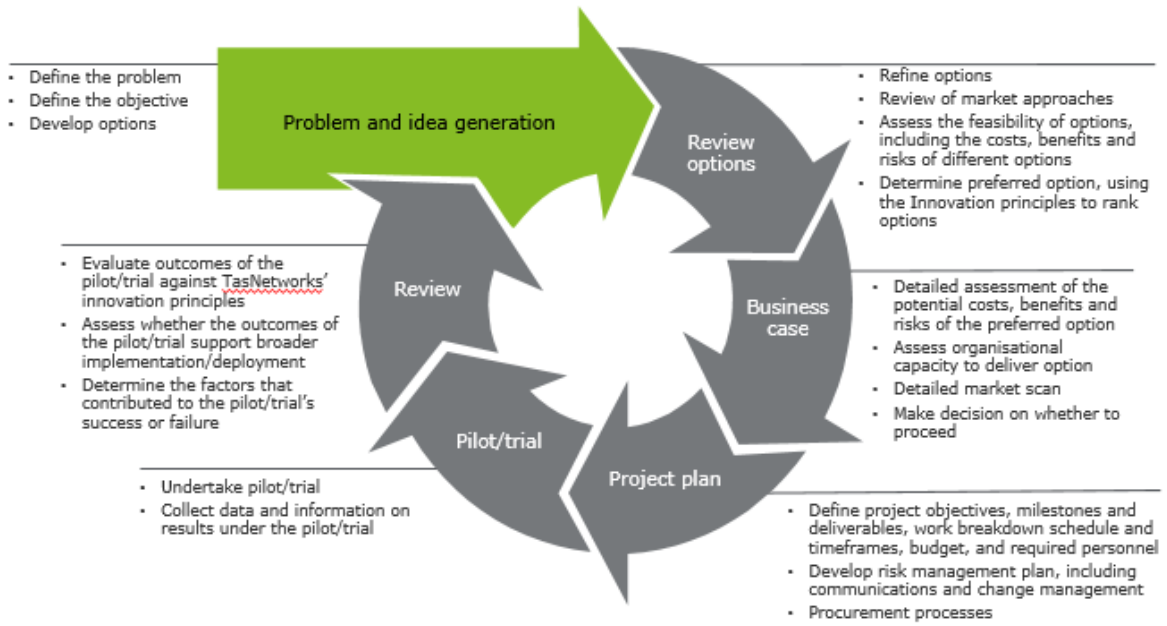

Figure 2 TasNetworks innovation framework

The network innovation framework is owned by the Network Innovation Team Leader and operated across the Strategic Asset Management and Service Delivery parts of the business. All innovation projects follow the framework to ensure that the process of identifying, investigating and implementing innovative solutions is as efficient and effective as possible by coordinating, prioritising and learning from innovation projects.

The governance arrangements need to be particularly rigorous due to the importance of the Innovation Program to the future delivery of network services, and the need for collaboration across the business, with customers, and with other network businesses (generally through ENA).

The purpose of the governance arrangements are to clearly establish:

- The lines of responsibility and accountability for the planning, developing, commissioning and operations of innovation projects;
- A consistent framework and process that can support delivering the target objectives of the project;
- The mechanisms through which issues and risks will be escalated and resolved;
- Requirements for dissemination of information to stakeholders so that they can fulfil their roles effectively; and
- The mechanism for release of funding.

TasNetworks Innovation Program will utilise the following two organisational frameworks that are applied to all projects:

- The Gated Investment Framework – this framework is TasNetworks' governing document for the assessment and management of business investments. The framework is designed to ensure TasNetworks' capital is efficiently allocated and investment expenditure is managed effectively. The framework forms part of TasNetworks' broader governance framework for the management of business risks and operates in conjunction with relevant approved organisational policies, processes, financial and regulatory obligations.
- The End to End Works Process – this process details the way TasNetworks projects should be established, delivered, and closed out.

While the Strategy will operate within these organisational governance frameworks, an augmented governance approach has been designed to support these highly technical and specialised projects. The augmented governance approach is provided below. Its key features include:

- Establishment of an Integrated Core Project Team that includes resources from the Innovation Team and the relevant Business Unit. This team will be responsible for the day to day delivery of innovation projects. This ensures a balanced, business focussed approach to projects. It also increases the ability of projects to be effectively transitioned to BAU;
- Establishment of a Steering Committee for each innovation project that includes specialist resources that have the capability to support technology design and adoption, and / or change management. This committee will be responsible for key decision making relating to the innovation projects; and
- The Steering Committee will be able to escalate issues, scope changes, and budget variations to the General Manager, Regulation, Policy and Strategic Asset Management, as required.

The augmented governance for innovation projects is detailed below.

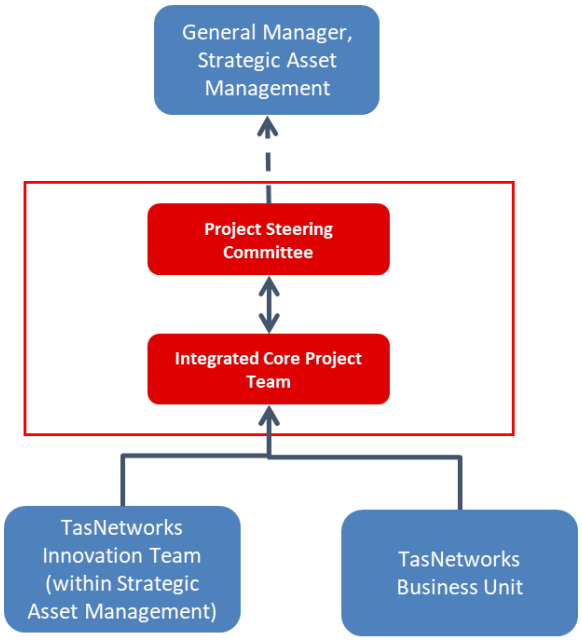

Figure 3 TasNetworks Innovation Governance Model

Reporting and benefits realisation

Innovation projects will be established to methodically measure project success. This includes a basic three step benefits realisation process:

- Establishment of project success criteria. Criteria should be measurable and will generally include:
  - Technical performance of the solution;
  - Cost effectiveness of the solution;
  - Business performance impact, including customer outcomes;
  - Achievability, including user adoption; and
  - Scalability.
- Design of an innovation project to sufficiently test the project against the criteria; and
- Structured and scheduled approach to criteria measurement.

Monitoring and reporting will be undertaken by the Integrated Core Project Team and reported to the Project Steering Committee on a scheduled basis.

Benefits realisation monitoring and associated governance is critical to informing the future of pilot project. Pilots deemed successful have a high likelihood of further rollout across applicable areas of the business, while unsuccessful pilots are likely to be ended or re-purposed. Unsuccessful pilots still offer TasNetworks the opportunity to analyse, document and disseminate learnings for future projects.

7 Network Innovation Program

Network innovation is structured as three distinct streams to address innovation across different business areas and drivers, and the progression of innovation from research through to adoption. The three innovation streams are:

1. Research and Development;
2. Specific technology pilots; and
3. Innovation Adoption.

TasNetworks has selected the following initiatives to achieve the Network Innovation objectives. Each initiative has alignment with one or more of the objectives. The following program has been designed to be concise, achievable and flexible in response to technology and market changes.

7.1 Research, development and demonstration

Research and development tasks focus on addressing longer term trends and issues affecting the electricity network and customers. TasNetworks seeks out research partnerships that align with the innovation objectives. The research activities are always a collaborative effort, leveraging external expertise, resources and funding where appropriate. The Australian Renewable Energy Agency (ARENA) has re-focussed its efforts on Distributed Energy Resources, funding another round of DER related research and demonstration projects.

Research topics include:

- ARENA/industry collaboration research projects;
- ENA Network Transformation Roadmap;
- Wooden pole soft rot detection; and
- Threatened bird studies.

Further detail of the research and development projects can be found in Appendix A.

TasNetworks is also a member of ENA's Australian Strategic Technical Program research funding organisation, contributing and benefitting from broad research across the industry.

7.2 Specific technology pilot projects

The specific technology trials are larger scale projects demonstrating or proving concepts as well as testing operational and customer experience. This program will be detailed in sections 8-10. The pilot projects are grouped into three key themes:

1. Distributed Energy Management and Demand Response;
2. Stand Alone Power Systems; and
3. Asset management innovation.

The specific technology projects include capex and opex expenditure. The capex investments are focussed around implementing small pilot projects on specific technologies where the technology has been proven in a limited capacity and requires larger real world tests prior to forming a business case for full "business as usual" implementation.

7.3 Innovation Adoption

Innovation Adoption is the adoption of existing technologies applied to the TasNetworks network taking account of the Tasmanian context. Adoption activities are detailed in the relevant asset management plans or defined by the works and services strategic road map. The risk and effort required to adopt technology is far less as the technology has achieved a level of maturity elsewhere, and there are learnings from other network businesses that can be leveraged. The network innovation framework assists TasNetworks introduce these technologies as efficiently as possible.

The adoption activities underway and planned equate to approximately $8M worth of expenditure per annum from 2019 and are listed below:

- Composite pole and cross arms;
- Pole staking and rebutting alternatives;
- Non-destructive pole testing;
- Pole fire-resistant paint;
- Enclosed air-break switches;
- IEC 61850 protection and control standard;
- LiDAR and aerial inspection techniques;
- Distribution Automation (Fault location, isolation, and restoration); and
- Dynamic reactive power support.

Further details of the above innovations are found in the relevant asset management plans.

8 Distributed Energy Management and Demand Response

8.1 DSO Preparation Project

There is considerable disruption in network businesses arising from policy, technological and customer change. This is transforming how customers think about, produce and use electricity. This transition to a decarbonised, decentralised and digitalised system is significant and requires a significant response from networks.

A more decentralised system introduces new participants in the marketplace (e.g. businesses, households, and their agents). The way these participants engage with both transmission and distribution operators will be key to sector transformation.

The increased penetration, use and sophistication of distributed energy resources in Australia's energy industry has given rise to conversations surrounding how best to manage these new distributed networks as the industry moves away from the traditional one-way energy flow to consumers.

The role of the Distribution System Operator (DSO) is to ensure reliability and efficiency in the operation of networks/ systems that have DER. The objectives of the DSO must be to maximise network access to DER in a fair and transparent manner, maximising customer utility, whilst simultaneously ensuring the network is operating within its safe technical limits.

The transition of Distribution Network Service Providers (DNSP) to DSOs is being led by the ENA, and is highlighted in their Open Energy Networks (OpEN) framework. The work seeks to test three future scenarios based around the operating model for optimal orchestration of DER. The outcomes of this work are expected in mid-2019. TasNetworks is an active participant in the OpEN consultation. Regardless of the outcomes of OpEN, there are some key preparatory steps required to move TasNetworks towards the DSO models.

8.1.1 DER Operating Envelopes

The current industry thinking focusses on the concept of deriving technical operating envelopes that DER can freely operate within. This will provide a light handed approach to maintaining network performance within the technical limits of the network whilst still allowing DER customers maximum access to the network.

The operating envelopes can be derived from the physical limits of the network connection and then communicated to the DER. The concept allows the envelopes to be relatively basic in the first instance and improved over time. TasNetworks is learning from the South Australian Power Networks (SAPN) DER Integration project as well as the Australian National University (ANU) led ENOPEN project. Both projects aim to build and communicate operating envelopes to DER.

TasNetworks must invest in both data and systems in the short term to develop static operating envelopes. Over time this will need to be extended to provide dynamic operating envelopes in some areas (constrained areas) or for certain use cases (FCAS market access).

The short term investment is in additional network monitoring devices in high DER hotspots to develop a model for identifying network constraints. Additionally investment in a constraint identification and operating envelope generation tool will be developed to determine static operating envelopes. Finally, the interfacing of constraints and network support requests to 3rd party DER aggregators will be expanded.

This project is a capital investment of $840,000 over two years from 19/20.

8.2 Bruny Island distributed storage aggregation

Distributed storage is an increasingly promising tool to manage the network. TasNetworks is presently implementing the CONSORT Bruny Island Battery trial project to test the use of battery aggregation to manage peak demand issues. Following the early successes of this project, TasNetworks is scoping a broader project to continue and expand the use of customer owned storage for managing the constraints on Bruny Island. This project seeks to expand the amount (kWs) of network support available, as well as increasing the number of 3rd party DER aggregators operating in Tasmania.

8.3 Network Intelligence - Advanced Meter Data

Low voltage monitoring is key to enabling the increased hosting of distributed energy resources. Limits will be reached in the distribution network from reverse flows in a difficult to predict fashion, and specific monitoring will be required to ensure the system does not breach it's technical limits. The most efficient approach to achieving network visibility is likely to be a balance between advanced metering and monitoring at other points in the network such as at distribution transformers.

8.4 Demand Response North Hobart Transformer deferral

The revised Demand Management Incentive Scheme provides up to 50% bonus for demand management expenditure. TasNetworks has identified a project to defer the 11kV to 110kV transformer augmentation at the North Hobart zone substation. The project was identified in late 2017, following the review of the revised Demand Management Incentive Scheme (DMIS), and the concept is being explored at present. This project provides an opportunity to test transformer level augmentation deferral.

8.5 Sensor Development

The Internet of Things (IoT) technology has the potential to improve the efficiency of operating the network as well as provide valuable asset management information. TasNetworks is exploring use of IoT technology for managing the network through a pilot project focussing on a limited number of use cases. The project is likely to expand through 2018 with more use cases added into 2019. The communications network options required for enabling IoT are also being considered.

9 Standalone Power Systems

The distribution network in Tasmania grew dramatically from 1950 to 1990, as the Hydro Electric Commission rolled out electrification across the: East Coast, West Coast, Central and Northern parts of the State. During this electrification period, the network was extended too many rural sites to facilitate new load connections as required. These practices have resulted in sites where small isolated loads are connected at the end of long distribution spur lines. These spur lines often travel through heavily vegetated areas in mountainous terrain. Issues associated with supplying these small isolated loads include:

1. Ongoing pole inspection and replacement costs relative to the supplied load;
2. Ongoing bushfire mitigation and vegetation clearing costs;
3. Fault operation cost;
4. Supply reliability and quality; and
5. Revenue collected from these customers.

TasNetworks has experience in the area of standalone power supplies. We deployed a remote area power system (RAPS) unit to supply customer loads at Crotty Dam. The technical performance of the RAPS system has been monitored over four years of operation as a test of the technical solution and business processes to support it. Implementing this solution has helped avoid the cost of maintaining the existing distribution spur line to Crotty Dam. This particular site has an atypical load pattern, which has resulted in several technical customisations to ensure suitably reliable operation.

TasNetworks proposes installing one Stand Alone Power System (SAPS) per annum over the next 5 year regulatory control period. The deployed standalone power systems unit will feature an optimal and efficient combination of generator/s and battery unit/s. Renewable energy will be considered in order to reduce the amount of diesel consumption and the need for regular refuelling. The renewable energy sources could include solar PV and/or wind. Beyond the first site at Crotty Dam, TasNetworks aims to implement a modular solution across the remaining sites, which will require further performance evaluation and change management to ensure a high quality outcome for customers.

The performance evaluation phase will be undertaken for 12 month in order to ensure that the deployed standalone power system technically performs as expected. Upon a positive evaluation result, the distribution spur line will be decommissioned and removed.

A business change project will also be run in conjunction to develop SAPS into a new asset class, to ensure the change is adopted within the business, and new processes, accountabilities, contracts, asset management plans are managed on par with other asset classes.

This project is a capital investment of $2.62M over five years from 19/20.

10 Asset Management Innovation

10.1 Distribution Fault Anticipator Pilot Implementation

Technology is emerging that allows a shift in asset management practices to toward a predictive and proactive asset replacement regime. This technology is commonly referred to as a distribution fault anticipator (DFA).

This provides TasNetworks an opportunity to be more sophisticated in its means of identifying network failures before they occur. The technology change requires a change in emphasis in asset management, work practices, technology deployment, and thinking to adequately manage risks and performance.

Obtaining information on the condition of distribution lines is currently a responsive process that is methodically carried out (for example, typically by field patrols and line inspection). These new technical solutions would be capable of remote sensing and reporting of assets in real-time to assist in locating proactively repairing assets prior to failing.

Success of this pilot project will reduce the number of asset related bushfire starts by pro-actively replacing failing assets prior to a fire start occurring. The project will test and demonstrate this across 7 feeders, and investigate the business case to implement it in further areas across the network.

The DFA pilot uses new technology to identify emerging issues on our distribution network, thereby enabling a more targeted maintenance regime that prioritises fault avoidance. The technology has been implemented successfully in a number of US Utilities to mitigate significant risks of bushfire, which are similarly prevalent in Tasmania.

The DFA technology uses waveform pattern analysis of current and voltage waveforms to segregate and characterise normal and abnormal events occurring on distribution lines. The waveform patterns representing abnormal events are often referred to as signatures, generally indicating a failing line component, are characterised and reported as actionable and operator interpretable information via the notification systems like System Control and Data Acquisition (SCADA) to asset managers and operations crews to assist in facilitating maintenance or replacement responses. These signature patterns, which outline a predicted failure mode and the root cause of failure in distribution lines, are still being developed globally with different utilities contributing to build a ‘dictionary’.

The DFA pilot aims to install and use fault anticipators on the priority feeders within the high bushfire loss consequence area.

As a result of the application of DFA, we expect to deliver capital expenditure efficiencies. DFA will highlight gradual equipment deterioration, and other issues not detected by conventional network monitoring. This will allow TasNetworks to proactively address emerging issues before they progress to faults and fire starts.

In addition to specific bushfire related asset issues, additional asset condition data will be assessed to understand broader asset management and reliability improvements.

This project is a capital investment of $500,000 over three years from 19/20.

10.2 Automated asset condition monitoring pilot

Asset condition monitoring refers to the process, systems and tools that automate the collection of asset information (e.g. vegetation, temperature or pressure thresholds, conductor clearances, etc.). This online collection of data is then transferred into actionable condition information. It is then the role of the user, in this case TasNetworks, to have the processes in place to effectively leverage condition information to better maintain network assets, both in terms of performance and efficiency outcomes.

Automated condition monitoring should support a strategically planned and implemented maintenance and repex regime appropriate to each asset class, to mitigate the risk of failure. If a maintenance regime is insufficient or neglected, deterioration in asset condition will increase the risk of triggering network events. These range from unscheduled downtime and lost services (best case) to environmental, health, and personal safety impacts (worst case).

The asset class where condition monitoring is needed to improve reliability, safety and cost efficiency outcomes is Concentric Neutral Solid Aluminium Conductors (CONSAC) low voltage cables. CONSAC cables represents 13 per cent of TasNetworks' low voltage cable network, however they represent 60 per cent of TasNetworks' average low voltage cable failures per annum (total 31). The failure rate of this asset class is disproportionally high.

The project objectives are to:

- Manage the risk of lower CONSAC replacement expenditure over the forward replacement program;
- Enable the current BAU approach to CONSAC replacement to continue over the forward replacement program;
- Defer CONSAC cable repex investment whilst still managing the risk;
- Prove automated asset condition monitoring technology for CONSAC;
- Quantify the value of incidental condition information gathered for adjacent assets; and
- Prove the business case for continued implementation across remaining CONSAC locations.

The project will also develop learnings for implementation of future automated asset monitoring projects across TasNetworks asset portfolio.

The pilot will involve approximately 50 of 500 transformers (i.e. 10%) within our distribution network that have CONSAC assets. The pilot will require hardware to be installed on transformers and connected to asset management software. During the pilot's inception, criteria will be developed for target network locations. This will likely include targeting CONSAC cable of sufficient length and customer connection, to make the investment beneficial.

The pilot will test:

- Underground cable and ground assets; and
- The condition of low voltage circuits.

The scope of the project has been separated into people, process, and technology requirements and all these aspects will form the project scope.

This project is a capital investment of $1M over three years from 19/20.

11 Resourcing

The Network Innovation Strategy will be resourced across TasNetworks within the current business structure and resourcing levels. The increasing complexity of technology impacts on the skills and capability required to manage it. There is an increasing focus on digital control, monitoring and communications in the distribution network requiring a greater level of skills in this area.

The Network Innovation Team focusses on supporting the research and development program as well as implementing technology specific trials. The Network Innovation team has recently increased its technical capability to meet this complexity. The rest of the business supports these programs within the existing resource levels.

Innovation adoption is implemented through the Network Innovation framework and end-end works program and driven by asset experts in each respective area. The innovation adoption activities represent a large value of work, but become less resource intensive as it becomes business as usual.

12 Risks

The major risks in delivering this strategy are shown below in Table 1:

Table 1 Network Innovation Risks

Risk	Description	Mitigation
Technology	Unproven technology on TasNetworks may fail, or cause project delays	The approach is to conduct trial phase, including lab testing, and then implement in full if successful. Learn from other utilities and forums. Risk sharing contracts. Business acceptance of appropriate risk.
Resourcing	The appropriate skills and resource availability is essential to success	Limit the breadth of Innovation program to ensure resources are not too thin. Obtain specialist external support as required. Collaborate widely across the industry to leverage external capability where gaps exist.
Ongoing business buy-in	There is a risk that the technology won't be accepted by the business	Collaborate and engage across the business. Ensure technology champions are identified early in projects, and maintain close relationship throughout. Engender confidence in the rest of business through a high standard of project implementation.

13 Funding

The Innovation Strategy will be funded within the existing capital and operating budgets. In some cases, budgets have already been obtained in the current regulatory periods, or proposed within the coming distribution regulatory period.

The budget for innovation activity is shared across the specific Network Innovation budget and all other areas of investment. The Research and Development work is predominantly operational funding, with the majority coming from the Network Innovation budget. Specific programs such as the threatened bird studies are contained within their own specific programs.

For clarity, the specific Network Innovation funding includes work category codes DMIAL, NNCMO, NNCMC, NNNOC and NNNOC, and these categories represent the majority of Research and Development and Specific technology pilot work.

The estimated capital cost to deliver the innovation program is $4.96 million over the 5 year regulatory control period. This spend is in line with TasNetworks current innovation budget of approximately $1 million per annum. The innovation program capex is more concentrated in the early years, which is recognition that these projects need to commence immediately to commence addressing issues in our network.

The figure below depicts the distribution of capex over the coming regulatory control period.

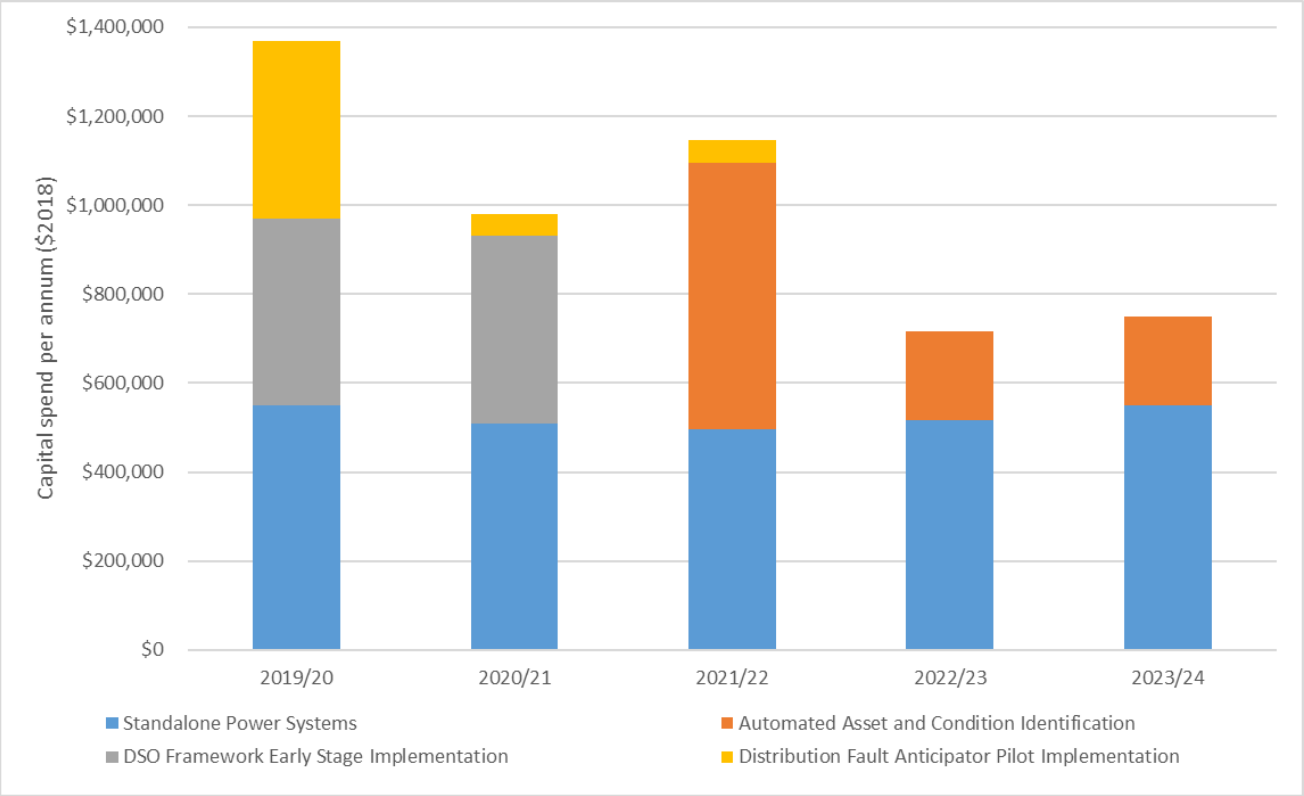

Figure 4 Network Innovation capex 2019/20 - 2023/24

The operating expenditure for the network Innovation initiatives across the five year regulatory control period is shown below:

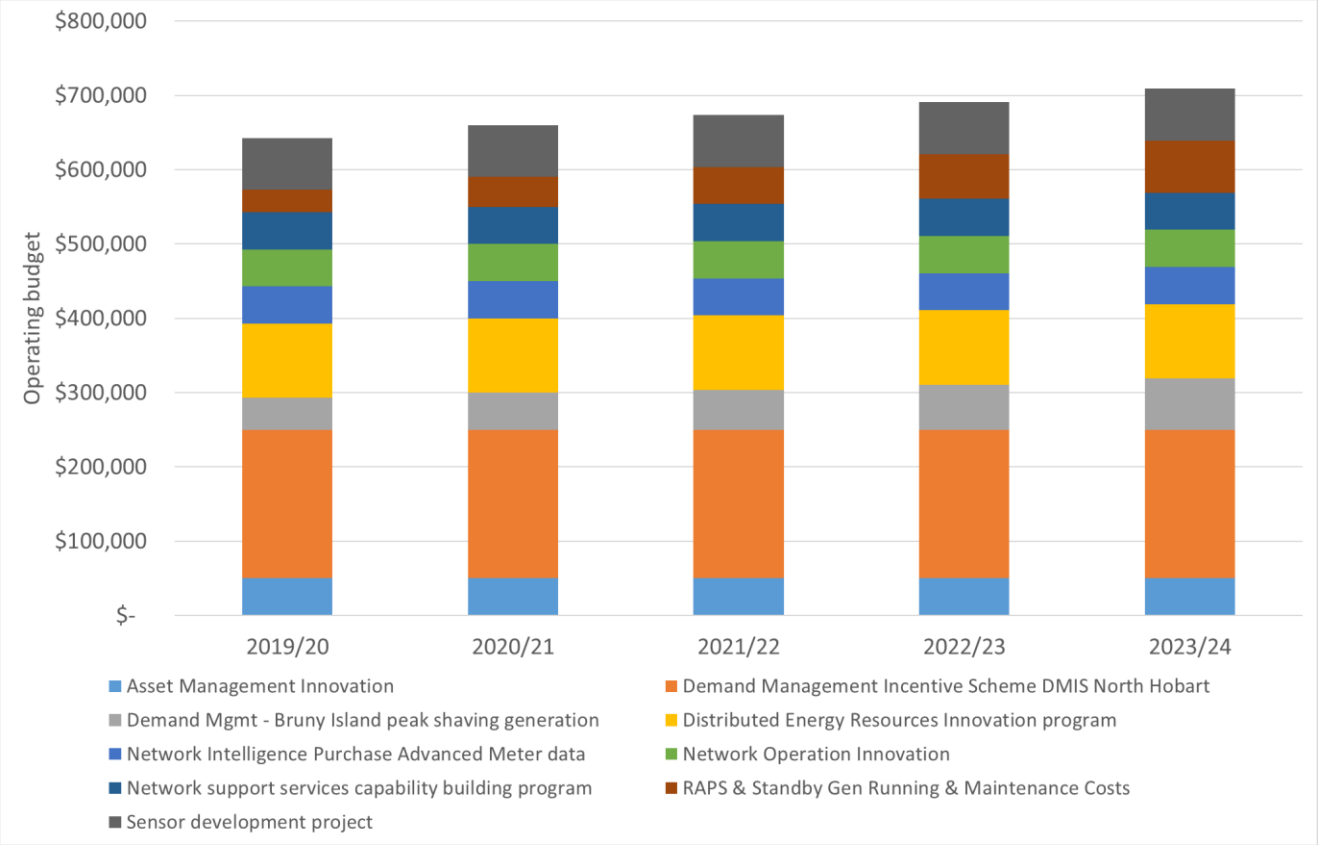

Figure 5 Network Innovation Opex 2019/20 - 2023/24

Appendix A- Research and Development projects

ARENA/industry collaboration research projects

TasNetworks is collaborating with industry and research organisations on several projects, focussed on enabling further DER and large scale renewable penetration. This activity is ongoing, and expected to continue in the short to medium term. TasNetworks has key capabilities and experience to assist with these research activities. The current committed projects include research on distribution state estimation, solar and PV output forecasting, and inverter testing and modelling.

We are working on several more projects, pending further discussion with project partners. Announcements will be made on these projects in due course.

ENA Network Transformation Roadmap (ENTR)

The ENTR outlines several research priorities; TasNetworks is committed to collaborating on the ENTR in a coordinated manner with other partner networks. TasNetworks expects to add value to this process by implementing a large project following from the learnings of the CONSORT Bruny Island Battery trial project.

Sensor development

The Internet of Things technology has lowered the cost point of sensor technology to allow the proliferation of low cost, low power sensors to monitoring the electricity network. TasNetworks is partnering with a local IoT firm to develop sensors for the Tasmanian electricity network.

Power pole soft rot

TasNetworks is working with biologists at the University of Tasmania to determine the types of fungus that contribute to soft rot in Tasmanian wood poles, as well as testing the relative effectiveness of non-destructive pole testing, in detecting soft rot. The research is being shared with ENA member organisations to assist the industry broadly.

Threatened bird studies

TasNetworks is working with the University of Tasmania to study the dispersion patterns of Wedge-tail Eagles to better understand the particular behaviours of Tasmanian eagles. The outcomes of the research is being used to improve mitigation measures used to help protect this endangered species. More details can be found in the TasNetworks Threatened Bird Strategy.