31 January 2023

Attachment 5.8a: Network innovation program

Ausgrid's 2024-29 Regulatory Proposal

Empowering communities for a resilient, affordable and net-zero future.

Ausgrid

1. Contents

2. Introduction

2.1. This document's purpose

The purpose of this document is to provide an overview of Ausgrid's Network Innovation Program, including its governance, achievements, learnings and evolution for the 2024-29 regulatory control period (**2024-29 period**). This document also outlines the business case for the proposed program of works for the 2024-29 period.

2.2. Related documents

Document
Attachment 5.8b: Network Innovation Program Mid-Term Review
Attachment 5.8h: Feedback on Network Innovation Program
Attachment 5.7: CER Integration Program
Attachment 5.5: Climate Resilience Program
Attachment 5.9: Technology Plan 2024-29

3. Executive summary

Ausgrid's Network Innovation Program (**NIP**) is a suite of research, trials and pilots covering leading edge technologies aimed at better meeting the needs and expectations of our customers in the context of the rapidly evolving electricity sector. The purpose of the program is to test advanced and emerging technologies in order to efficiently demonstrate the potential of these technologies to deliver significant benefits to our customer and the wider energy market if deployed at scale.

For the 2024-29 period, the NIP is structured in three thematic workstreams which deliver on:

- Building safe, intelligent networks;
- Improving community energy resilience; and
- Supporting and enabling customer energy resources (**CER**) integration.

These workstreams aim to respond to the challenges and opportunities facing Ausgrid including the need to help enable the transition to a low carbon economy, particularly through the uptake of customer energy resources (**CER**); the need to increase the resilience of our network to climate change and cyber threats; and the opportunity to create efficiencies through the expansion of digital technologies in order to enable simple and streamlined interactions with our customers.

The program and its governance were co-designed with our customers and incorporate ongoing, meaningful and transparent collaboration with customers, industry and academia. Collaboration is facilitated through the Network Innovation Advisory Committee (**NIAC**), which consists of a range of key customer advocates, technology experts from industry and academia, and Ausgrid employees managing development and delivery of the NIP. Members provide input to and endorsement of projects under the NIP, with meetings being held quarterly to ensure timely review of concepts and proposals.

Ideas for projects under the NIP are managed through Ausgrid's Innovation & Improvement framework. This provides a systematic way to design, assess, develop and measure the benefits of these programs. 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 customers. The projects carried out under the NIP are subject to cost benefit and economic analysis and are also subject to assessment under our Network Innovation Investment Principles, which were co-designed with and weighted by NIAC members.

In the 2019-24 regulatory control period (**2019-24 period**), significant, positive progress has been made across a wide range of projects, resulting in positive customer outcomes and associated benefits. Several projects, including low voltage static compensators (**LV STATCOMS**), have also been demonstrated as an efficient alternative to traditional network augmentation solutions and can be progressed as more efficient alternatives in future capital programs. In addition to monitoring and reporting on project progress and outcomes, many learnings have been documented at both the program and project level.

In developing the NIP for the 2024-29 period, a comprehensive review of the program outcomes to date was undertaken and we sought feedback from a wide range of internal and external stakeholders, including customer advocates. This input helped shape our proposed program including a workstream approach in lieu of specific projects, the inclusion of research and development funding and ongoing collaboration through the NIAC. The scope and scale of the proposed program was also consulted on through the Voice of Community (**VoC**) workshops, which led to the development of a number of program options, which are described in **Table 1**. All program options result in a positive net present value (**NPV**), as the constituent projects contained in each option are also forecast to be NPV positive.

Option 3 (as detailed in **Table 2**) is the recommended option as it optimises the potential benefits whilst maintaining a program that is practically deliverable, as well as supporting the feedback of our customers in delivering a meaningful NIP in order to support improved services to customers in a safe, efficient and reliable manner.

This option results in a program that is similar in size to the program in the 2019-24 period and prioritises those potential projects which have the largest benefit to cost ratio. This approach ensures that the proposed portfolio is one that

maximises value for money with a consistent delivery profile. Projects included in this option are outlined in **Section 9** of this document.

Table 1 Network Innovation Program Options

Program Options		$m, real FY24		
Option	**Description**	**Capex**	**Opex**	**NPV**
Option 1: Do Nothing	• Cease NIP and undertake traditional network investment only.	$0	$0	$0
Option 2: Full NIP	• Undertake 100% of identified projects and all customer research across the three workstreams in order to maximise the total benefits. • This results in a proposed program that has a split between 60% trials and 40% pilots.	$82.3	$5.4	$70.4
Option 3: Optimised NIP	• Undertake approximately 60% of identified projects and customer research across the three workstreams, prioritising those that have the largest expected cost benefit. • This results in a proposed program that has a split between 70% trials and 30% pilots.	$49.5	$5.0	$81.8
Option 4: Maximised breadth of NIP	• Undertake approximately 70% of identified projects and customer research across the three workstreams, prioritising the largest breadth of network innovation trials. • This results in a proposed program that has a split between 80% trials and 20% pilots.	$59.5	$5.1	$79.8

Table 2 Network Innovation Program Recommended Option

Recommended Option – Option 3 ($m, real FY24)							
NPV	$81.8						
Expenditure forecast		**FY25**	**FY26**	**FY27**	**FY28**	**FY29**	**Total**
	CAPEX	$10.7	$8.9	$8.6	$10.5	$10.8	**$49.5**
	OPEX	$0.8	$0.9	$1.0	$1.1	$1.2	**$5.0**

4. Our Network Innovation Journey

4.1. Inaugural Network Innovation Program

The Australian energy market is currently undergoing a period of unprecedented change. Rapid technological advances, the electrification of transport, increasing remote work and accelerating decarbonisation of the economy are driving changing consumer expectations about their energy services. These changes provide many challenges but also opportunities for advanced technology solutions to solve both existing and emerging energy network problems.

These macro shifts in society are driving major changes in the electricity sector, from the retirement of major coal power stations down to changes in customer metering and proliferation of smart, connected devices to reduce energy use and lower costs for consumers.

In the context of this rapidly changing energy market, and in order to better meet the changing needs and expectations of our customers, Ausgrid established the NIP to deliver a series of innovative trials and pilots focussed on new and emerging technologies and services. We have a long history of innovation, and this program was designed to build on our past experiencing in identifying, developing and integrating a range of new and innovative solutions to both existing and emerging problems in a fast-changing industry. The program and its governance were co-designed with our customers and incorporate ongoing, meaningful and transparent collaboration with customers, industry and academia. This ensures our customers are placed at the centre as programs have been designed, developed and delivered throughout the 2019-24 period.

Table 3 Ausgrid's Inaugural Network Innovation Program

Project	Benefit Cost Ratio	Estimated Cost ($m)	Key Customer Benefits
Advanced Voltage Regulation	1.75	$3.0	Better integration of customer energy assets
Network Insights Program	3.10	$10.5	Better integration of customer energy assets, improved reliability & outage information
Fringe of Grid Optimisation	3.02	$4.7	Safety & reliability for remote communities
HV Microgrid Trial	1.37	$17.2	Safety & reliability for remote communities
Advanced electric vehicle (EV) Charging Platform Trial	1.38	$1.2	Better integration of customer energy assets
Grid Battery Trial	1.01	$2.0	Better integration of customer energy assets
Portable All-in-one Off-Grid Supply Units	1.26	$1.0	Improved customer experience
Self-Healing Networks	1.19	$0.6	Improved reliability & outage information
Dynamic Load Control	1.05	$0.6	Better integration of customer energy assets
Asset Condition Monitoring	1.72	$0.6	Improved safety & reliability
Line Fault Indicators	1.11	$0.6	Improved reliability & outage information

The NIP, allowed by the Australian Energy Regulator (**AER**) in the Final Determination for the 2019-24 period, consisted of 11 distinct projects (**Table 3**). A comprehensive cost benefit analysis was undertaken for each project using a common set of value metrics, and the chosen projects were all assessed as being likely to deliver a net economic gain for customers. Care was taken to ensure that there was no duplication between the NIP projects and those in other programs, nor the forecast benefits of the NIP and other programs. The program was excluded from the AER's Capital Expenditure Sharing Scheme to encourage a 'use it or lose it' approach to expenditure and ensure that sufficient priority was placed on delivery of this program by Ausgrid.

4.2. Placing Customers at the Centre

The 2019-24 reset process marked the first time Ausgrid had truly embarked on a collaborative consultation process, with key customer advocates engaged across all areas of the Proposal. Prior to the Revised Proposal being submitted to the AER, a number of explorative workshops were held with customer advocates to:

- Create a common view of the future of the Ausgrid network and how it could better meet the needs and expectations of our customers;
- Develop a framework for how innovative trials and pilots could be undertaken whilst collaborating with customers in a meaningful, transparent and ongoing way; and
- Agree on an initial set of overarching principles that could be used to prioritise potential NIP projects in a way which best utilised both our existing assets and capabilities, and the funding available.

Following the Final Determination in April 2019, Ausgrid formed the NIAC, which first met in July 2019. The committee consists of a range of key customer advocates, technology experts from industry and academia, and relevant internal employees managing development and delivery of the NIP. The NIAC is chaired by Ausgrid's Executive General Manager – Asset Management, a visible demonstration of Ausgrid's top level commitment to advancing the objectives of the committee.

The committee is held quarterly and, prior to the COVID-19 pandemic, met face to face. In March 2020, these meetings were moved online to allow continued collaboration and today the meetings are a mix of both modes, depending on the needs of the committee members. Materials for the committee are typically provided in presentation format, to promote brevity and ease of comprehension, and they are provided one week in advance of the meeting. Most meeting materials are also loaded onto Ausgrid's website, available to the general public.

The NIAC operates under the *Ausgrid Customer and Stakeholder Committees Engagement Terms of Reference*, a document which sets out our engagement model and approach, including Ausgrid's customer engagement objectives. It also sets out the specific terms of reference for the NIAC including the purpose and mandate of the committee as well as the guiding principles for investment in network innovation projects.

Ausgrid's Customer Engagement Objectives

- **Build trust**
- **Build confidence**
- **Identify customer preferences**
- **Inform service design**

These Network Innovation Investment Principles (**Table 4**) were refined and agreed upon by the committee at its inception. An exercise was undertaken to assign weightings to each principle based on the anonymous input from all external committee members. All existing and potential NIP projects are scored on how well they meet each of the principles, allowing an objective way for the suitability of each project to be assessed in a fair and transparent manner. This is then used at project inception for projects included in the original approved program and is also used to assess and potentially include new ideas into the NIP, or de-scope projects that are seen to no longer effectively meet the defined principles.

At the suggestion of a committee member, a program dashboard was co-designed to provide a simple way of transparently articulating the progress of each project, including expenditure, timeframes, customer benefits and key status updates. The dashboard is updated regularly and provided with the materials for each meeting.

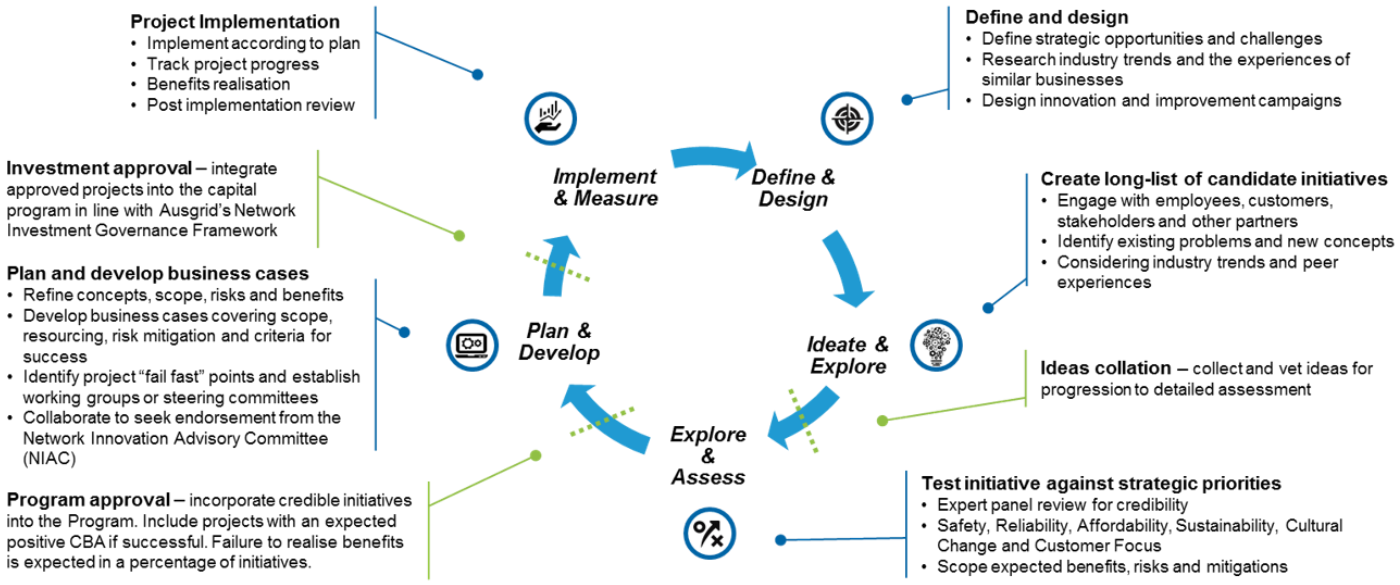
Table 4 Inaugural Guiding Principles for Network Innovation Investment

Guiding Principle	Weighting
Maintains safety for the employees & community	17%
Improves fairness	14%
Accelerates de-carbonisation	14%
Lowers costs for consumers	13%
Improves resilience	12%
Solves a specific problem	11%
Improves the economic utility of new & existing assets	10%
Uniqueness of problem & collaborative opportunities	9%

4.3. Ausgrid's Innovation Governance

In developing and delivering the NIP, Ausgrid utilises an innovation and improvement framework (**Figure 1**) to design, assess, develop and measure the benefits of these programs to deliver greater market 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 customers.

Figure 1 Ausgrid's Innovation & Improvement Framework



This framework operates in concert with Ausgrid's Network Investment Governance Framework (**NIGF**), which consists of policies, procedures, standards, work instructions and forms that cover how Ausgrid plans and invests in its network. It provides clear guidance and accountability for the planning, development, endorsement and approval of network investments. In practical terms, a large number of NIP projects are explicitly endorsed for further development by the NIAC after initial presentation at a committee meeting, as well as passing through the processes of the NIGF to allow for budget approval and funds assignment.

The NIP for the 2019-24 period consists of two distinct types of projects, each serving separate purposes and focusing on different segments in the lifecycle of a technology, product or service. The two project types are as follows:

- **Trials** – These will be typically undertaken when there is a low level of certainty that the proposed solution can deliver customer or business benefits, where the technology is largely untested, or that the risk of the solution failing to meet outcomes is high. In this instance the trial will seek to address these concerns or identify risk mitigation strategies. Technology trials will be undertaken to answer specific questions and increase the confidence in proceeding with a wider scale technology deployment. They will seek to identify potential deployment issues and provide input to the development of appropriate equipment specifications, designs, costings, standards and guidelines.
- **Pilots** – If a decision is made to implement a new technology solution, then a deployment model will be developed in conjunction with customer and business stakeholders. This deployment model will ensure that appropriate supporting processes, systems and information, including designs, standards and supply chain arrangements are established, and staff training is developed to ensure the successful implementation of the solution. In some cases a pilot will be undertaken as the first phase of a larger technology deployment initiative to validate design, implementation logistics, and identify business integration risks. Pilot projects will be a larger scale deployment of new concepts and technologies to demonstrate applicability to a wider range of real network environment challenges and develop and refine the approach for a 'business as usual' deployment.

'Business as Usual' (**BAU**) deployment is expected when the technology transitions from development stages into normal usage within the business. To be adopted as BAU the new concepts and technologies must have been validated through a trial or pilot process, have a justified deployment model based upon a defined business case, and are able to address targeted needs.

4.4. Program Achievements

As the scope of the NIP projects were developed it became clear that most projects would consist of a number of sub-projects due to the breadth of some of the topic areas, and the potential for positive customer benefits arising from the wide variety of trials being considered. As at 31 December 2022, implementation of over 15 projects have been commenced with another seven in 'plan & develop' phase. **Section 8** provides an overview of the key projects that have been undertaken to date, the expenditure for each (as at 31 December 2022), project outcomes and the customer benefits observed.

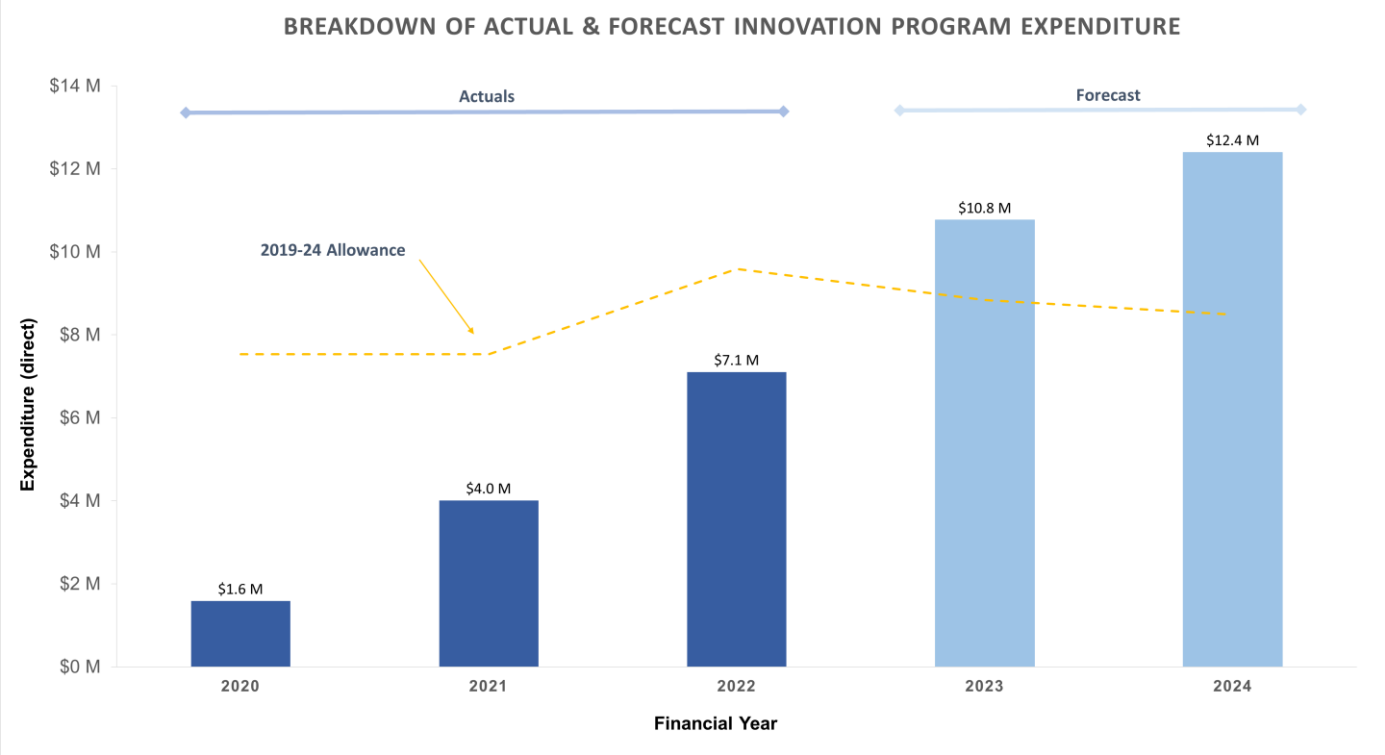
4.5. Program Expenditure

Actual and forecast expenditure across the NIP for the 2019-24 period is shown in **Figure 2**. At the start, expenditure was slower than forecast in the Regulatory Proposal, however, the expenditure trend is increasing and material increases in program delivery are expected in the second half of the 2019-24 period.

There are a number of reasons for the slower than expected expenditure, including:

- The short planning window at the commencement of the Regulatory Period – the allowance for the inaugural NIP was approved in April 2019, just prior to the start of the 2019-24 period. This resulted in a limited time to ramp resources and equipment to begin delivery of the program.
- The commencement of the COVID-19 pandemic in March 2020 had significant impacts across a number of areas including the ability to efficiently deliver field works in the usual planned manner (due to lockdowns as well as social distancing requirements) and delays in equipment and materials due to worldwide supply shortages.
- In 2019, due to the tragic death of an Ausgrid employee, we paused all live work on our network whilst a review of over 200 live work tasks was undertaken in order to implement additional safety controls where necessary. This necessary pause resulted in some backlogs of work, typically considered more critical than NIP projects, thus delaying the completion of some project items.
- Protected Industrial Action (**PIA**) during 2021 impacted on the delivery of some projects that involved the installation of field devices.

Figure 2 Network Innovation Program 2019-24 Actual & Forecast Expenditure ($m, Nominal)



5. Program Learnings

5.1. Mid-Term Review Process

In 2022, a mid-term review was undertaken to reflect on the design, delivery and outcomes of the program thus far at both the program and project level. The outcomes of this process were then used to inform the development of both the structure and the content of the NIP for the 2024-29 period. The review was undertaken in a number of different ways:

- Interviews of key stakeholders:
    - 13 interviews with 24 internal stakeholders;
    - Four interviews with seven external stakeholders;
- Surveys of key suppliers and stakeholders:
    - Six surveys of external suppliers;
    - Three surveys of external stakeholders;
- Review of program against the terms of reference;
- Gathered evidence of NIAC influence on program and approach to innovation investment;
- Documented program achievements;
- Development of a number of project level post implementation review (**PIR**) reports:
    - Community Battery Program Interim Report (Phase 1);
    - Statcom Trial Phase 1;
    - River Communities Microgrid;
- Produced ongoing, consolidated project learnings register that is now shared and updated at each NIAC meeting.

5.2. NIAC Influence on Ausgrid Innovation Decision Making

The NIAC has had and continues to have a pivotal impact on Ausgrid's approach and decision-making regarding network innovation investment. The ongoing operation of the committee ensures that we place the customer at the centre of our decision making in a transparent and meaningful way on an ongoing basis. It has played a key part of the cultural change within the business to ensure that we challenge our traditional way of thinking and that we continue to meet the changing needs and expectations of our customers. The mid-term review documents a number of explicit examples as evidence of the influence of the NIAC on Ausgrid planning and decision making.

5.3. Program Level

As a result of the mid-term review, there were a number of program level recommendations for the NIP produced across different themes, as outlined in **Table 4**.

Table 4 Program Level Recommendations from NIP Mid-Term Review

Theme	Recommendation
Program Structure	• Shift to portfolio model to allow more flexibility with bringing projects into the program and de-prioritising others • Be prepared to take on more risk – be more prepared to fail • Include capex and opex funding to allow for more fulsome assessment of potential project options, including an additional research and development focus to develop a greater understanding of customer needs

Theme	Recommendation
Program Governance	• Continue with NIAC • Expand committee membership to extend technical input
Project/Program Delivery	• Develop projects with a longer timeframe to deliver to ensure all stakeholders are adequately prepared, and there is adequate time to include in worklist and resource scheduling processes • Provide better communication and collaboration with internal stakeholders during project scoping
Realisation of Benefits	• Implement stronger change management governance internally to ensure that new technologies and processes are maintainable in the long term
Communication & Engagement	• Provide the NIAC with greater visibility of existing (and perhaps complementary) research projects (e.g. Reliability, Affordable Clean Energy Cooperative Research Centre (**RACE CRC**), demand management innovation allowance projects) • Provide the NIAC with greater visibility of sharing between networks and within industry
Regulation & Strategy	• Undertake better advocacy on where cyber security may impede innovation development, implementation and outcomes
Keep Doing	• Ongoing project reviews • Sharing knowledge from lessons learnt • Continue to embed transparency across the entire regulatory period, not just the reset process
Start Doing	• Bringing in ideas from customer advocates (related to recommendations to expand committee membership) • Incorporate fast fail processes that allow projects to take on more risk of unsuccessful outcomes with limited resource commitment • Bring more analytics to the table to better define problems and issues to be solved
Stop Doing	• Nothing yet identified

5.4. Formal Feedback from NIAC

The independent members of the NIAC have provided a formal report to Ausgrid (and the AER) that:

- Reviews the operation and effectiveness of the committee in meeting its objectives;
- Provides an assessment of Ausgrid's performance in delivering a customer-centric innovation program that delivers tangible benefits;
- Reviews the proposed program for the 2024-29 period; and
- Outlines a series of recommendations to improve the functioning of the NIP and NIAC.

Table **5** outlines each of these recommendations and Ausgrid's response.

Table 5 Ausgrid's Response to Independent NIAC Recommendations

NIAC Recommendation	Ausgrid's Response
The dashboard be enhanced by providing information about the size of the Ausgrid team working on a particular project	We will implement this recommendation in consultation with the NIAC during our 2023 meetings.
Change Ausgrid's Innovation & Improvement Framework so that PIRs flow into lessons	We will implement this recommendation in consultation with the NIAC during our 2023 meetings.

learnt in the 'Define & Design' stage	
NIAC members are invited to observe community engagement	We will implement this recommendation.
Ausgrid should explore further partnerships for innovation trials with academics and researchers such as for potential pilot or test sites or simulated modelling	We will implement this recommendation as part of our 2024-29 program.
This Innovation Workstream Program Collaboration should be expanded to include webinars with market bodies (e.g. Ausgrid's presentation on the DSO model)	We will implement this recommendation.
Ausgrid to share results from innovation projects at the ENA innovation conference in March 2024	We will submit an abstract for this conference focussed on the outcomes of our NIP.
Ausgrid needs to initiate some low-technology readiness level collaborative research programs with research partners.	We will implement this recommendation as part of our 2024-29 program.
Include technical performance improvements as part of accounting for customer benefits	We will implement this recommendation in consultation with the NIAC during our 2023 meetings.
Include CBA modelling approach and BCR values in the Potential Projects	We have implemented this recommendation within this document.

6. Looking Forward

6.1. Challenges & Opportunities Ahead

As we look ahead to the 2024-29 period, the challenges and opportunities for Ausgrid and the communities we serve have never been greater:

- Climate change means our poles, wires and other assets must be able to withstand more frequent and extreme weather conditions. At the same time, cyber-attacks are becoming more frequent and sophisticated. Both challenges present growing risks to the safety, quality, reliability and security of the services we provide.
- The transition to a low carbon economy is being spurred on by government commitments to net zero by 2050 and our customers' increased uptake of CER – such as rooftop solar, distributed batteries, and electric vehicles. Electricity networks like us are an essential platform for the transition to net zero. We need to be able to accommodate the growing uptake of CER and manage the increasingly complex energy flows this will create. This is both a significant challenge, and an exciting opportunity.
- The continuing evolution of digital technologies is expanding opportunities to improve our service delivery, provide innovative service offerings, increase our efficiency in resolving customer concerns, and make it simpler and easier for customers to interact with us.
- Economic conditions are worsening. Inflation is at its highest level for more than 20 years. Interest rates are rising and are expected to continue rising over the coming years. This will increase our borrowing costs, and place financial strains on our communities, increasing the drive to find more innovative and cost-effective solutions to both existing and emerging issues.

6.2. Investment Objectives

For the 2024-29 period, the NIP is designed to achieve the following specific objectives:

- Develop the capability to integrate new technology into the network to drive efficiency in energy distribution over the long term;
- Modernise the network to improve service levels and facilitate the adoption of new customer services, technology and equipment such as electric vehicles and flexible loads;
- Improve the resilience of customer energy supply in the face of a changing climate and increasing societal dependency on electricity; and
- Deploy enabling technology, devices and systems to facilitate the transition towards a less carbon intensive energy system including customer preferences to incorporate CER such as solar generation, electric vehicles and household batteries.

6.3. Customer Outcomes

In developing the NIP for the 2024-29 period, Ausgrid have engaged with customers and customer advocates across a variety of consultative forums including the NIAC, the Reset Customer Panel (**RCP**) and the VoC workshops. Some details on the NIP were also included in the Draft Plan that was released for consultation in August 2022.

Through a co-design process with customer advocates, we identified six key topics that will define our business into the future. These topics are summarised in **Table 6**. Of these, the NIP is particularly aligned to the Future Network, Sustainable, Resilient and Customer Experience themes.

Table 6 Key Themes for Ausgrid's Customers

Theme	Overview
Fair	• Intergenerational equity • No one left behind, where practical
Sustainable	• Lowering Ausgrid's carbon footprint • Facilitating the transition to net zero by 2050
Future network	• Creating shared value in the community • Encouraging CER across different geographic and customer segments
Customer experience	• Digitalisation of services • Quality of service and bespoke experiences and outcomes
Resilient	• Respond to climate change and changing community needs • Maintain safety, reliability and network security
Value for money	• Unlock additional value while keeping bills stable • Benefits from investments exceed the costs which will be incurred

These themes are highly aligned with the guiding principles for network innovation investment that we co-designed with the NIAC during the 2019-24 period.

6.4. Future Program Structure

To achieve our investment objectives, the NIP comprises a diverse range of investments which may evolve over time as technology matures and customer needs change. To manage the uncertainty associated with investment of this nature, Ausgrid will continue to prioritise the NIAC as a method of direct oversight into the program, in line with our approach in the 2019-24 period.

We have included an operational expenditure component to address both the lessons learnt from the 2019-24 period, and recent feedback from our customers through the RCP and the VoC research. This will enable us to:

- Select the most efficient options for customers, particularly in the technology domain, with the increasing trend towards Software as a Service (**SaaS**) and Product as a Service (**PaaS**) offerings; and
- Engage in ongoing research focused on community attitudes, expectations and preferences related to issues relevant to the Network Innovation Program, including solution options and equipment standards.

The program is structured to consider a range of technology maturity and transition that technology into business-as-usual. As such it encompasses both early experimental development through to the implementation of advanced pilots of new technology as they progress through the maturity phases.

By their nature, most of these technologies are not at the level of maturity that enables accurate and detailed estimates of unit costs and overall project costs at early project stages. To ensure optimum outcomes are achieved, we will continue to utilise our innovation and improvement framework to design, assess, develop and measure the benefits of these programs to deliver greater customer and shareholder value.

6.4.1. Network Innovation Investment Principles – Revised

In September 2022, we undertook an exercise with the NIAC to review and re-prioritise the Network Innovation Investment Principles to ensure that they are still fit for purpose. Firstly, the principles were discussed at a committee meeting. During this time, it became clear that a number of the principles, such as 'Maintain Safety for Employees & Community' could likely be adjusted to become 'gates' that all projects must first meet, rather than principles. The committee members were asked to rank the remaining principles against each other using the same method as when their weighting was first determined. This resulted in further discussion about the suitability of the principles, and it was decided that they should also be tested more broadly at the VoC workshops. Following the VoC workshops, the

principles were once again tested with the NIAC in December 2022, allowing the principles and their associated weightings to be finalised as shown in **Table 7**.

Table 7 Revised Network Innovation Investment Principles

Prioritisation Principle	Weighting
Accelerates decarbonisation	28%
Improves resilience	18%
Lowers costs for customers	18%
Improves fairness	18%
Improves safety for employees & the community	17%

6.4.2. Ausgrid's Innovation Governance – Revised

In line with the recommendations from the PIR, we have incorporated a third type of project into our Innovation Governance, Research & Development (**R&D**), which was previously specifically out of scope for the NIP. The definition developed, to be used alongside the previously defined 'trial' and 'pilot' is:

- **R&D** – R&D supports the development of long-term plans and strategies. This stage will identify appropriate technologies that will enable positive customer outcomes and deliver improvements and efficiencies in network operation and management. Technology and service concepts will be explored in accordance with company and customer technology adoption principles and developed in a way that demonstrates their ability to deliver value to customers and shareholders. This stage will identify the need for a trial(s) and develop a scope to deliver appropriate learnings and subsequently increase the confidence in decisions related to potentially deploying these technologies and services.

6.4.3. Program Workstreams

A key learning from Ausgrid's current innovation program has been that the pace of development in the electricity sector, and associated technologies, is accelerating. This requires a flexible and adaptable program, one that is able to pivot as challenges emerge and new solutions are required to address those challenges.

Our response to this has been to develop the FY25-29 innovation program as an evolving portfolio of projects, rather than a list of specific projects to be delivered over a 5-year period. Nine key focus areas will be targeted for the benefits they will provide to end consumers, separated into three workstreams. A range of potential projects have been investigated and evaluated using Ausgrid's cost-benefit analysis (**CBA**) methodology to develop the broad scope of these workstreams, however it is expected that specific projects within those focus areas will be developed as needed in line with changes to technology, customer priorities and emerging issues over the regulatory period. The three workstreams are aligned with Ausgrid's business drivers.

6.4.3.1. Safe, Intelligent Networks

This workstream will develop technology and capability within Ausgrid to better plan, maintain and operate the network. This includes:

- Developing and testing new field assets that deliver affordable, safe, reliable and sustainable energy for our customers;
- An uplift in our capability to use the increasing volumes of data collected by customers, metering providers, and our own assets, to understand and adapt the current state and performance of the grid.

Our proposal for the 2024-29 period involves greater focus on identifying network faults and incidents in order to continue to advance our capability to deliver safe and reliable electricity. This investment will also assist in reducing bushfire risk in rural areas and lower costs for consumers through reduced breakdown expenditure.

We will increase our focus on developing the control and intelligence for optimising network operation in real time under both normal and contingency scenarios. This includes concepts such as exploring the viability of dynamic ratings and the pre and post incident re-configuration of the network to minimise constraints and maximise utilisation of existing assets.

We will also continue to develop our ability to use visual and spatial information to improve decision making and rapidly identify existing and emerging defects on the network. Our plan has a focus on developing data-driven systems which provide real-time visibility and adaptability of the grid, and modernising our core secondary system protection, communication and control devices to enable greater flexibility in the face of increasingly variable customer requirements.

Key priorities include:

- Develop predictive capabilities to identify emerging asset faults, outage incident hot spots and the location of safety hazards from both real time monitoring, light detection and ranging (**LIDAR**) and photogrammetry, and historical incident data;
- Develop network state estimation and forecasting capability to drive improved operational performance and more efficient long term capital expenditure through optimum planning;
- Increase utilisation of the network through dynamic ratings and real time optimisation of network topology through remotely operable switches;
- Modernise assets such as more advanced relays and communication and control systems within substations. This includes establishing capability for systems such as Conservation Voltage Reduction and more responsive Under Frequency Load Shedding (**UFLS**) schemes, and to manage reverse power flow;
- Establish viability of modern switching technology in place of traditional manually operated switch points to improve worker safety and network performance;
- Research related to standards, design and deployment of modern assets in light of changing community expectations, such as underground pillars that do not compromise safety, affordability or reliability outcomes.

6.4.3.2. CER Support & Enablement

This workstream within the NIP is intended to complement our broader CER Integration Program, and is focused on the trialling of new, untested technology that helps integrate, improve utilisation of and support more CER to connect to the Ausgrid network. This will ensure that customers can utilise our network as a platform to safely, efficiently and equitably enable CER, thus meeting the needs of customers and stakeholders and helping to enable customers to extract more value from their assets.

As part of our proposed 2024-29 NIP, two key focus areas have been identified for further development. These include developing capability for local autonomous networks, using customer and network technology in concert to improve local network performance and developing capability to allow local neighbourhoods to isolate for periods of time following incidents on the wider network.

We will look at whether economically efficient integrations of CER into network assets can be achieved to maximise societal benefits for our communities. This would include further integration of batteries or EV charging facilities into standard network structures such as poles, substations or network pillars.

This workstream will also explore technology to reduce emissions from our network operations and embodied carbon in our assets, including low loss transformers and cables, and alternatives to sulfur-fluorohexide (**SF6**) switchgear.

6.4.3.3. Community Resilience

This workstream is focused on the trialling of new, untested technology that helps to increase the resilience of our network and our customers to severe weather events and other incidents such as bushfires. Climate change is having a significant impact on economies and societies across the globe. Seven of the world's hottest years have occurred in

the last decade and there is growing evidence to link an increase in frequency and intensity of extreme weather events, including heatwaves, windstorms and low-pressure systems (e.g. East Coast Lows), to anthropogenic climate change.

Ausgrid's role in resilience is to consider a spectrum of solutions to address identified climate risks to our network and to the communities we serve. Ausgrid's role in responding to the impacts of a changing climate is informed by our impact assessment, our stakeholder engagement, and the AER's published resilience note. The AER's view is that resilience related funding is accommodated by the NER where it seeks to achieve network service level outcomes (maintenance of reliability, safety, and network security).

This workstream within the innovation program is intended to complement our Climate Resilience Program. Our key priorities for this workstream include development of mobile response capability using new fuels such as hydrogen, continuing our development of microgrid technology and other new fringe of grid approaches. It will also include trialling new technology to monitor and alert for environmental conditions which may impact assets such as extreme weather and fire starts.

7. Program Options

To develop the recommended program, a pool of potential project ideas across the different workstreams was developed in consultation with customers and subject matter experts. We then estimated costs and benefits for these projects and developed several program options considering the maturity of particular technology or concepts, the deliverability within the current organisational operating model, and the appetite and direction from stakeholders including the RCP, NIAC, and Ausgrid's Board and Executive. The options presented broadly represent a spectrum between a large scale but high-risk program and moderate but more deliverable versions with different weighting towards more, or less mature technologies. NPV analysis was undertaken for each option to assist in determining the recommended choice. These options were consulted with the NIAC and the VoC workshops.

7.1. Cost Assumptions

NIP costs are derived from a bottom-up estimates of potential constituent projects. These projects were identified through research, internal workshops and discussions with subject matter experts, resulting in an initial pool of approximately 100 concepts, which was subsequently refined down to 41 project ideas. For each project an estimate of unit cost and unit rate is determined based on prior experience of similar projects or devices.

This bottom-up development includes a high-level classification of project type, such as primary system assets (e.g. cables or switchgear), secondary system assets (e.g. relays or sensors), IT or Operational Technology (**OT**) systems. This breakdown has been used to inform typical labour cost splits and asset lives at an aggregate level. Variable overheads have also been included in this analysis.

Opex costs consider the expected uplift in maintenance required for field assets, as well as SaaS subscriptions and back-end data/communication costs. They are incremented in line with the expected deployment of field device volumes and/or IT/OT system commissioning. It also includes our commitment to expand collaborative R&D funding in collaboration with universities, industry bodies and the wider industry to assess community needs and expectations around CER, resilience and the grid, and ensure that the program continues to address emerging issues relevant to our customers.

7.2. Cost Benefit Analysis

Cost benefit analysis of the program was conducted at both a project and workstream level. During options analysis, an initial assessment by subject matter experts was conducted to exclude projects and concepts which weren't considered feasible or beneficial, in a qualitative sense.

Following this, a cost benefit model was developed based on Ausgrid's Value Framework, to assess at a project level the estimated benefits for each project, either at a widget level or whole of project level. The analysis included consideration of benefits such as:

- Probabilistic safety benefits including risk of shocks, bushfires, injury and property damage;
- Capex efficiency across both augex and repex expenditure;
- Opex efficiency benefits in field response; and
- Market benefits, including unserved energy, wholesale pricing, emissions and energy losses.

Benefits were incrementally applied based on the expected degree of development and deployment of the various projects within the scope of this program. This means that projects for device rollouts only considered benefits relating to trial or pilot volumes, rather than broad network-wide benefits.

As there are close relationships between the objectives and outcomes of the NIP and those of the Climate Resilience and CER Integration programs, considerable effort has been undertaken to ensure a cohesive alignment between each. In particular, this has ensured that benefits and costs are appropriately allocated and not double-counted. One key outcome of this alignment being that the Customer Energy Curtailment Value (**CECV**) has been excluded to reduce the risk of benefit overstatement within the NIP.

Once the annual benefits for each project were calculated, the annual benefit cost ratio (**BCR**) was calculated, and the expected BCR over the expected life was estimated using a NPV calculation. At this stage, a 50% multiplier was added to the project cost to account for the uncertainty and factor in the higher risk of project failures, cost over-runs or lack of benefits realisation due to the innovative nature of these projects. This approach has resulted in a conservative BCR for each project over the life of the asset. Projects were then ranked by BCR and program options developed through the inclusion of projects based on different criteria, which provided the most favourable customer outcomes for each approach.

7.3. NPV Analysis

Once the scope of each program option had been defined, workstream level NPV analysis was undertaken using Ausgrid's standard NPV modelling process, with aggregated costs and benefits at a workstream level. The NPV timeframe used was either 5 years (for IT system projects) or 15 years (for network device projects). The delivery of projects and realisation of benefits was phased over time at the workstream level and estimations. The workstream NPV was then calculated over the expected lifetime. Sensitivity to cost and various benefit categories was undertaken to assess the robustness of the NPV benefits, which in all cases remained NPV positive. The NPV outcomes of this process are shown in **Section 7.4**.

7.4. Options Overview

Table 8 outlines each of the program options that were analysed, including a description, as well as the forecast capex, opex and resulting NPV. The principal difference between the four options is the size and breadth of the portfolio of projects that is undertaken. The recommended option for the 2024-29 period is Option 3 based on quantitative analysis demonstrating that it has potential to unlock significant economic benefits compared to the 'do nothing' option. Feedback from the VoC workshops has indicated a preference for Ausgrid to deliver significant ongoing investment in Network Innovation similar to Option 2, however, care has been taken to balance the need to continue investment in innovation with the ability to successfully deliver and embed the required level of broad business change of such a large program.

Table 8 Overview of Program Options ($m, real FY24)

Option	Description	Capex	Opex	NPV
Option 1: Do Nothing	• Cease Network Innovation Program and undertake traditional network investment only.	$0	$0	$0
Option 2: Full NIP	• Undertake 100% of identified projects and all customer research across the three workstreams in order to maximise the total benefits. • This results in a proposed program that has a split between 60% trials and 40% pilots.	$82.3	$5.4	$70.4
Option 3: Optimised NIP	• Undertake approximately 60% of identified projects and customer research across the three workstreams, prioritising those that have the largest expected cost benefit. • This results in a proposed program that has a split between 70% trials and 30% pilots.	$49.5	$5.0	$81.8
Option 4: Maximised breadth of NIP	• Undertake approximately 70% of identified projects and customer research across the three workstreams, prioritising the largest breadth of Network Innovation trials. • This results in a proposed program that has a split between 80% trials and 20% pilots.	$59.5	$5.1	$79.8

7.4.1. Option 1 – Do Nothing

This option involves ceasing the NIP, and not progressing trials and pilots aimed at integrating new, untested technology into business-as-usual operations. Network investment options will be limited to those traditionally available until such times as leading-edge technologies become more widely available and generally accepted as viable options to solve network issues and constraints. In this situation, Ausgrid would have to leverage the experiences of other distribution networks and model the applicability to our network in order to determine if new technologies and systems would be of benefit to our customers and the network. The expenditure assumptions for this option are shown in **Table 9**.

Table 9 Option 1 Expenditure Assumptions ($m, real FY24)

	FY25	FY26	FY27	FY28	FY29	Total
Capex	-	-	-	-	-	**-**
Opex	-	-	-	-	-	-

The NPV of this option is $0 due to the lack of investment in the NIP. Over time, this is likely to result in an unquantified dis-benefit in other network investment programs as they will be slower to ensure that the safest, most efficient and most reliable options are implemented in a timely manner. Over the medium term, the lack of innovation may result in our ability to efficiently maintain our obligations under the National Electricity Objective (**NEO**) relating to the quality, safety, reliability and security of supply, particularly in the face of rising input costs and increasing compliance obligations.

7.4.2. Option 2 – Full NIP

Option 2 involves delivery of the entire portfolio of identified Network Innovation projects and all customer research across the three workstreams, thus creating a maximised program. Under this option a number of projects are unlikely to provide net economic benefit noting however that this is subject to uncertainty. Forecast benefits related to avoiding customer energy curtailment have not been included in the analysis.

Although this option produces significant potential economic value, it also carries a moderate level of deliverability risk to due to the scale of the program, relative to the program in the 2019-24 period (which is approximately half the size). There is also inherent risk in delivering a large number of untested and potentially complex projects in a short timeframe.

Our experience with the current NIP has demonstrated the following needs, which would require careful planning if a program larger in size to the current program was established:

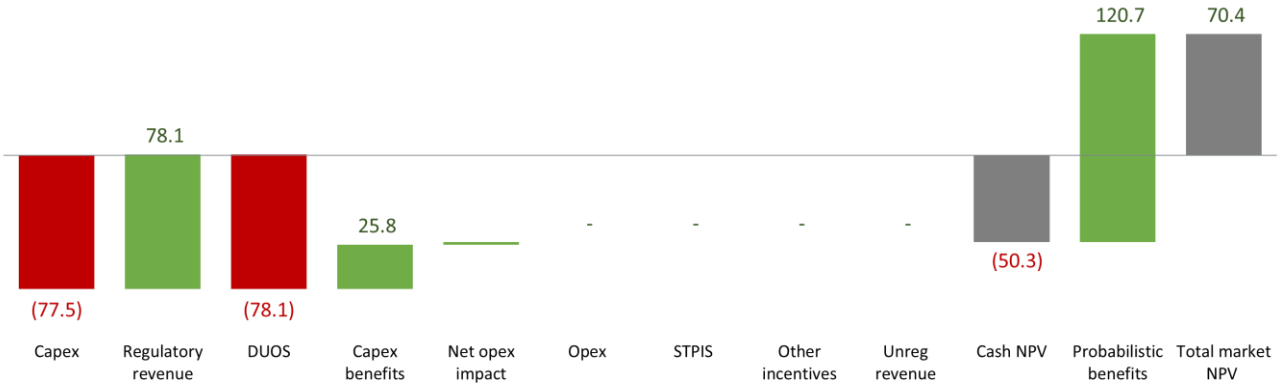
- Significant upfront engineering resources to assess, test, design and specify assets and systems;
- The ability to undertake dynamic, end-to-end work schedule management based on the need to adapt priorities more frequently as technology is tested and deployed;
- The ability to insert discrete innovation projects into the works program in shorter timeframes than traditional projects; and
- The ability to resolve the expected regulatory and technical challenges of particular projects in an expedited timeframe.

Despite the potential deliverability risks, this option was developed in response to customer feedback from the VoC workshops. In these workshops, customers have indicated a preference for a greater level of investment in Network Innovation projects that have potential to provide large, broad and ongoing customer benefits as long as the customer bill impacts are not significant, and that we continue to collaborate with other distribution networks in order to leverage the learnings of others (and vice versa). The expenditure assumptions for this option are shown in **Table 10**. The market NPV of Option 2 is shown in **Figure 3.**

Table 10 Option 2 Expenditure Assumptions ($m, real FY24)

	FY25	FY26	FY27	FY28	FY29	Total
Capex	$16.8	$16.4	$16.4	$16.9	$15.7	**$82.3**
Opex	$0.8	$1.0	$1.1	$1.2	$1.3	**$5.4**

Figure 3 Market NPV of Option 2 ($m, real FY24)



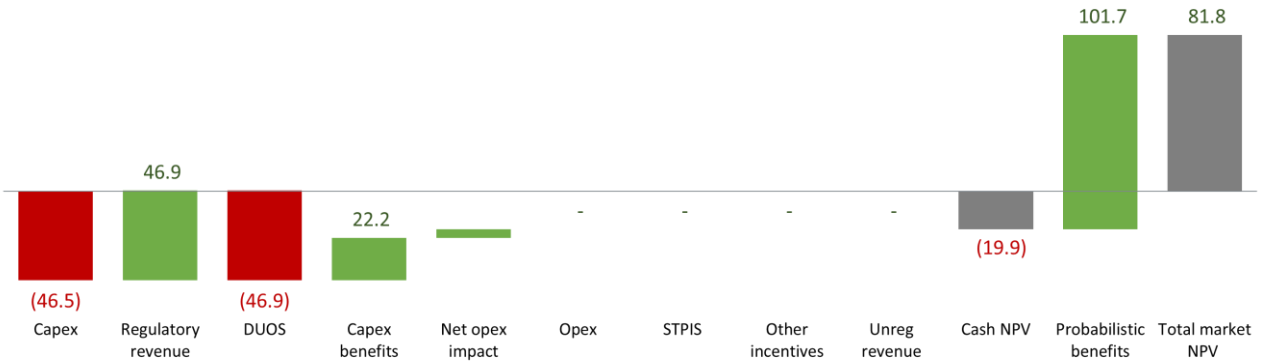
7.4.3. Option 3 – Optimised NIP

Option 3 involves delivery of a subset of the entire portfolio of identified Network Innovation projects and research across the three workstreams. This option results in a program that is similar in size to the program in the 2019-24 period and prioritises those projects which have the largest benefit to cost ratio. This approach ensures that the proposed portfolio is one that maximises value for money with a consistent delivery profile. The expenditure assumptions for this option are shown in **Table 11.** The market NPV of Option 3 is shown in **Figure 4**. Projects included in this option are outlined in **Section 9** of this document.

Table 11 Option 3 Expenditure Assumptions ($m, real FY24)

	FY25	FY26	FY27	FY28	FY29	Total
Capex	$10.7	$8.9	$8.6	$10.5	$10.8	**$49.5**
Opex	$0.8	$0.9	$1.0	$1.1	$1.2	**$5.0**

Figure 4 Market NPV of Option 3 ($m, real FY24)



7.4.4. Option 4 – Maximised Breadth of NIP

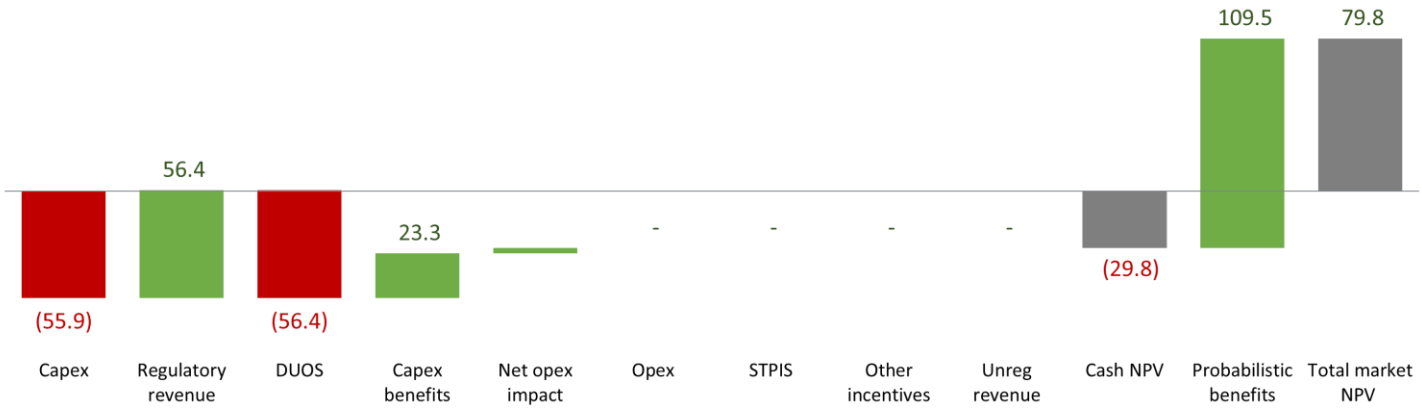
Option 4 involves delivery of a subset of the entire portfolio of identified Network Innovation projects and limited customer research across the three workstreams. This option results in a program that is larger in size of the program in the 2019-24 period and prioritises those projects which produce the largest breadth learnings from the Network Innovation projects. This option would allow us to test a large number of new technologies and systems in order to determine which provide the greatest benefit.

Similar to Option 2, although this option produces significant potential NPV, it also carries a moderate level of deliverability risk to due to the inherent risk in delivering a large number of untested and potentially complex projects in a short timeframe. The expenditure assumptions for this option are shown in **Table 12**. The market NPV of Option 4 is shown in **Figure 5**.

Table 12 Option 4 Expenditure Assumptions ($m, real FY24)

	FY25	FY26	FY27	FY28	FY29	Total
Capex	$12.1	$10.9	$11.4	$12.7	$12.4	**$59.5**
Opex	$0.8	$0.9	$1.0	$1.1	$1.2	**$5.1**

Figure 5 Market NPV of Option 4 ($m, real FY24)



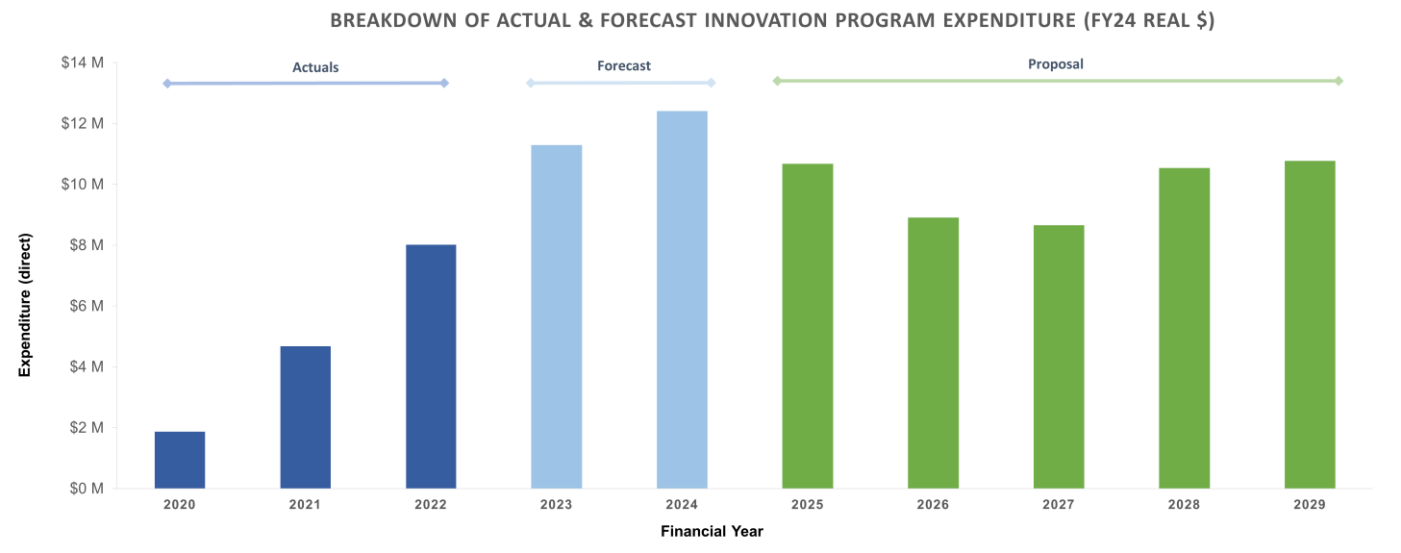
7.5. Recommendation

7.5.1. Recommended Option

The recommended option is Option 3. The forecast expenditure for this option compared with expenditure in the 2019-24 period is shown in

Figure 6. Option 3 is the recommended as it optimises the potential benefits whilst maintaining a program that is practically deliverable, as well as supporting the feedback of our customers in delivering a meaningful NIP in order to support improved services to customers in a safe, efficient and reliable manner.

Figure 6 Comparison of Expenditure for 2019-24 period & Recommended Option



7.5.2. Alignment to Strategy

The recommended option is included in Ausgrid's business plan and aligns to the current Corporate, Network and Asset Management strategies. Delivery of the proposed program will also help us to meet our corporate objectives of Thriving Communities, Delivering Net Zero and Optimised Assets & Operations.

7.5.3. Program Delivery Risks

The key risks of the program (shown in **Table 13**) relate to delivery risk and technology selection. The program structure is designed to mitigate these risks by allowing for engagement at various stages throughout the program and associated project lifecycles, enabling the projects to be selected and adapted to the best available information and resources within industry.

Table 13 Program Delivery Risks

Risk Category	Description	Inherent Risk Level	Mitigation Plan	Residual Risk level
Key Resources	Due to the extensive use of new technologies and their application to the energy network environment skilled and capable resources may be difficult to obtain and/or retain.	High	Early engagement across a variety of projects with a range of lifecycle stages to ensure continuity of key resources and enable the establishment of longer-term skills within Ausgrid and relationships with key partners	Med
Technology Selection	The selection of appropriate technologies has the potential to require	High	Early and in-depth technology assessment, including discussion with other companies within industry will allow the most	Low

Risk Category	Description	Inherent Risk Level	Mitigation Plan	Residual Risk level
	additional investment or render a project unviable		available information and enable the best possible technology selection.	
Partner Selection	The selection of appropriate partners to provide a balance of agility and financial stability to avoid abandoned investments	Medium	Careful selection of partners that have sufficient customer base or commitments and/or short engagements to enable continuity of agile and skilled project delivery or advice despite a changing and competitive energy landscape.	Low

7.5.4. Program Assumptions

The key assumption is that project selection will remain dynamic prior to and throughout the 2024-29 period. Other program assumptions are shown in **Table 14**.

Table 14 Program Assumptions

Type	Description
Resourcing	Appropriate resources will be sourced and available to deliver the selected projects
Commitment	That customer advocates remain available to provide guidance into the selection of projects and delivery of the program through the Network Innovation Advisory Committee.
Priority	Moderate to High
Scope	The selected projects including feedback from customer advisory groups

7.5.5. Program Dependencies

A number of currently selected projects in the preliminary list require modern integrations to core Ausgrid IT and OT systems. A program dependency is that these systems remain available to successfully complete the projects and leverage inherent functionality in these systems to avoid additional activities to replicate functionality.

7.5.6. Business Area Impacts

The range of projects within the NIP are likely to have impacts in the majority of business areas, however specific focus and resourcing will be required by Asset Data & Systems, Engineering, Transmission Substations (Advanced Technicians) and System Control.

The areas of the business in which additional resources will be required are those with already tightly constrained resource pools. Common to all options is the need for resources to both undertake engineering and systems design, development and assessment at the front end of projects, and specialised field and systems resources to undertake installation, deployment and commissioning tasks.

8. Appendix – Program Achievements

This section provides an overview of the key projects that have been undertaken to date, the direct expenditure for each (as at 31 December 2022), project outcomes and the benefits observed.

8.1.1. Advanced Voltage Regulation

Sub-Project	Overview & Outcomes	
Statcom Trial Phase 1	**Expenditure**	$0.41m
	Project Overview	Ausgrid's ability to manage voltage fluctuations within allowable tolerance limits is becoming more challenging as CER penetration levels increase. The purpose of this project was to trial the use of new low voltage (**LV**) regulation technology to better manage voltage fluctuations on Ausgrid's LV network and improve its ability to host CER connections. Ausgrid has selected to trial Static Compensators (**STATCOMs**), which operate by injecting capacitive or inductive current to lower or raise voltage levels to within allowable limits. The scope of Phase 1 was to install three sets of three remotely configurable single phase STATCOMs in areas of the network with known voltage fluctuation issues and significant levels of CER penetration.
	Project Outcomes	The installation and commissioning of this new technology at the three sites in 2021 and 2022 was successful and the units are currently under operational evaluation. When examining the technical output of the STATCOM units it was observed that they were consistently successful at correcting the voltage to be within the acceptable range, as well as ensuring that the voltage was consistently at a level that would create headroom for additional CER to be installed at that location. In one of the trial locations, it is estimated that the installation of the STATCOM has created enough headroom to allow 80-100% CER penetration in the future, from a current penetration level of 40%. We have found that the installation of an LV STATCOM is already comparable in cost to traditional investments to resolve voltage related capacity issues in certain scenarios, and that long term reductions in power electronics costs are expected to further entrench this advantage. The technical and cost outcomes means that this type of technology is likely to progress from trial to being part of the 'business as usual' network investment toolkit in the next Regulatory Period.
	Customer Benefits	This project has a number of direct customer benefits including a reduction in customer bills where voltage is reduced to acceptable levels, with the ability for customers to both connect more, and get more value from their CER in these locations.
Statcom Trial Phase 2	**Expenditure**	$0.50m
	Project Overview	This phase of the STATCOM project explores additional use case scenarios, including use of LV STATCOMs to support wide area voltage regulation and hosting capacity improvements. It also represents the pilot phase of this technology deployment, ensuring that the devices are ready for business as usual through development of appropriate standards and systems.

Sub-Project	Overview & Outcomes	
	Project Outcomes	This project is still in the early delivery phase with commissioning expected over the end of 2022 and early 2023. The outcomes are expected to lead to business as usual readiness for deployment of STATCOMs as an alternative to more costly traditional network augmentation as needs arise.
	Customer Benefits	Customers will benefit from improved customer voltages, which will reduce solar curtailment and increase CER hosting capacity from the existing network at lower cost than traditional network augmentation.
Adaptive Voltage Regulation Trial	**Expenditure**	$0.03m
	Project Overview	The adaptive voltage regulation trial aims to test the viability and benefits of conservation voltage reduction (**CVR**) for the customer and Ausgrid across network voltage levels. Phase 1 of the trial consists of a static implementation and desktop analysis, with potential site upgrades, to demonstrate the benefits provided to customers. This phase will heavily rely upon smart meter data and attempt to determine the best application of CVR where voltage control is available at multiple network levels. Phase 2 of the trial will test the viability of implementing a dynamic voltage regulation profile at the Zone Substation. This stage may include the installation of new relays and well as the development of multiple voltage regulation (**VR**) schemes to be implemented to create the dynamic set point range to manage the voltage fluctuations seen across the network as a direct result of a high penetration of CER such as roof top solar.
	Project Outcomes	The project is at early implementation phases. Field tests have successfully demonstrated the relationships between zone VR and end customer experience. This information is now being used to develop end-to-end system settings at the trial locations.
	Customer Benefits	Customers will benefit from improved customer voltages, which will reduce solar curtailment and increase CER hosting capacity from the existing network at lower cost than traditional network augmentation.
Pole Mounted Battery Trial	**Expenditure**	$0.15m
	Project Overview	This project will deploy a technology trial of pole-mounted batteries at up to three locations (subject to assessment of use cases at specific sites) for a period of two years to ascertain maturity and capability of the equipment to deliver network support benefits.
	Project Outcomes	This project is still early in the implementation stage – battery units have been ordered from the manufacturer and exact deployment locations are being determined.
	Customer Benefits	Pole top batteries can provide network support which will allow greater CER hosting capacity and reduced solar curtailment. For specific types of networks a battery may be the most economical outcome, as well as potentially offering broader market benefits ultimately leading to reduced network costs.

8.1.2. Network Insights Program

Sub-Project	Overview & Outcomes	
Distribution Monitoring & Control – Enable Remote Switching Capability	**Expenditure**	$3.30m
	Project Overview	As the penetration of customer CER such as solar and EVs increases, the visibility and control of the distribution network becomes increasingly important. Remote operability of network equipment ensures that decisions on network management can be implemented fast, and response time to network incidents can be decreased. This project enables the remote switching capability on distribution substations, whilst ensuring that visibility is maintained. This capability will also help enable the implementation of self-healing network initiatives utilising the ADMS in the future. Capability is realised through the commissioning of control functionality in existing equipment, or the installation of controllable switchgear in high benefit locations.
	Project Outcomes	Approximately 6.5% of distribution substations are now enabled for remote switching and online monitoring across the Ausgrid network.
	Customer Benefits	Customers will benefit through lower costs and easier connection of CER through the greater visibility of network constraints and limitations that this equipment will give Ausgrid.
Distribution Monitoring & Control – System Integration for Visibility	**Expenditure**	$0.39m
	Project Overview	This project is complementary to other Distribution Monitoring & Control projects and facilitates the back-office integration of visibility data being provided by the field devices into core operational and analytical systems.
	Project Outcomes	This project is now complete with operational and engineering data now available within Ausgrid's systems including within the new Advanced Distribution Management System (**ADMS**).
	Customer Benefits	Customers will benefit through lower costs and easier connection of CER through the greater visibility of network constraints and limitations that this equipment will give Ausgrid.

8.1.3. Fringe of Grid Optimisation

Sub-Project	Overview & Outcomes	
Stand Alone Power System	**Expenditure**	$1.17m
	Project Overview	With the improving economics of small-scale generation, there is an opportunity to look at where this generation would be more cost effective than maintaining a connection to centralised generation through the wider distribution and transmission networks. For remote and difficult to access customers, or customers in areas where there are significant risks such as bushfires, a local Stand Alone Power System (**SAPS**) may provide a better individual and societal outcome than maintaining costly traditional connections for those remote customers. Ausgrid intends to undertake a trial of SAPS systems to demonstrate the technical feasibility, customer experience and regulatory changes required to deliver the most cost-effective supply to those customers at the edge of the interconnected network where the costs and risks of connecting to this network outweigh the benefits – in that those customers could be better served by local generation to save costs for all consumers.
	Project Outcomes	To date Ausgrid has developed the technical specifications, designs and operating model, in conjunction with our supply partner, to commence a small trial of SAPS in locations across the Hunter Valley. The field trial of these units will commence in Q4 2022.
	Customer Benefits	Where SAPS are installed, customers will benefit from improved reliability and resilience. The broader customer base will also benefit through a reduction in bushfire risk, through the removal of mains that traverse bushfire areas, and lower costs as areas of network with high 'cost to serve' are removed.

8.1.4. High Voltage Microgrid Trial

Sub-Project	Overview & Outcomes	
River Communities	**Expenditure**	$0.03m
	Project Overview	Ausgrid supplies electricity to a number of communities who live along major river waterways within our franchise area. These communities often have limited access (many are boat only) and typically experience worse than average supply reliability. This was highlighted in storm events such as the February 2020 and July 2020 storms during which communities in the Hawkesbury experienced significant and extended duration outages. Initial investigations into the Hawkesbury River Communities found that innovative solutions such as microgrids and SAPS could potentially improve the reliability and resilience of supply. More detailed investigation found that this was not economically feasible, and that SAPs and microgrids were not applicable solutions in these areas due to constraints on space, solar access and site access. Investigations in this area of the network are continuing.
	Project Outcomes	It was chosen to not proceed with this project.
	Customer Benefits	Intended customer benefits of any future projects in this area of the network would be to increase the reliability and resilience of customer supply in these unique areas.
LV Microgrid Project	**Expenditure**	$0.33m
	Project Overview	Ausgrid is intending to trial a low voltage microgrid in the township of Merriwa. The objective of a microgrid is to provide a resilient power supply to isolated communities in the event that their main source of electricity supply is cut-off or damaged. The option proposed for this trial comprises solar, battery and a back-up generator. A control system will coordinate the generation resources to enable a seamless transition between grid connected and islanded modes, with customers connected to the microgrid only experiencing a momentary outage.
	Project Outcomes	Procurement for suppliers is currently underway. Community focus groups and council and community briefing sessions have been undertaken, resulting in some changes to the planned scope.
	Customer Benefits	If successful, this trial will enable a resilient power supply to the Merriwa community in the event of planned or unplanned outages, or major events that could isolate the town such as bushfires. This will be achieved by maintaining power to certain essential services in the town, which will benefit both Merriwa and neighbouring areas.

8.1.5. Advanced Electric Vehicle Charging Platform Trial

This project has not yet commenced.

8.1.6. Grid Battery Trials

	Overview & Outcomes	
Community Battery Trial	**Expenditure**	$6.05m
	Project Overview	Ausgrid is investigating the potential for locally based community batteries to offer both a novel way to provide access to energy storage for customers with solar PV systems, and a competitive alternative to traditional local network augmentation. Battery sharing would offer both greater economies of scale and the diversity benefit of a shared asset potentially saving customers and the community more than they would achieve if they invested individually. In addition, battery sharing could contribute to reduce power quality issues on the network from CER, by maximising solar hosting capacity, maintaining voltages within acceptable tolerances and frequency control. A trial project is underway to demonstrate the viability of community batteries at three locations. The benefits to be confirmed in this trial are: • Identify costs & benefits for solar and non-solar customers; • Test ways to offer solar customers storage-as-a-service; Test the ability to address network constraints (i.e. support during peak demand times (phase 1A), maintain voltage within limits (phase 1A); and frequency control under sudden disturbances (phase 1B); • Assess the feasibility to access additional revenue streams from market arbitrage (phase 2A) and ancillary services Frequency Control Ancillary Services (**FCAS**) (phase 2B) and; • assess the feasibility of commercial models and operating arrangements.
	Project Outcomes	**Customer, Community and Engagement** • Highly motivated local communities, with over 60 customers signed up to the trial, with 56 customer measurement installed. • Developed a customer application, which displays credits, facilitates payments and helps customers understand their solar production and energy consumption patterns. First payment commenced in Jan 22, for Q4 21. • Informed and engaged all three levels of government and relevant industry stakeholders. • Retail Market Partner Agreement in principal (pending signing), with a motivated participant. **Deployment** • Installed and commissioned three Community Batteries (including traffic barriers and noise testing). • Connected the three Community Batteries to the network. Running multiple use cases i.e. schedule and volt-var. • Designed, built and installed metering and switchboards (including enhancing the kiosk). **Cybersecurity** • Approved detailed requirements and architecture for connecting the Community Batteries to the network though both the OT and IT environments.

	Overview & Outcomes	
		Safety and Environmental • Fire engineering and traffic safety surveys conducted at all sites. • Designed, built and tested noise attenuation panels. • Developed specific Safe Work Method Statements **Project Management and Governance** • Developed and implemented successful innovation enabling project management and governance practices. • Core team building strong subject matter expertise in this space.
	Customer Benefits	This project has provided customers with a new and innovative way to access energy storage without the upfront costs of installing their own battery. This type of community-based technology also allows an increase of customer CER to be connected to the local network and can help facilitate a range of innovative customer services and pricing such as virtual power plants, dynamic pricing and dynamic operating envelopes.

8.1.7. Portable All-in-One Off-Grid Supply Units

This project is still in early planning and market engagement phases and has not materially commenced.

8.1.8. Self-Healing Networks

	Overview & Outcomes	
Castle Cove Automation Trial	**Expenditure**	$0.1m
	Project Overview	This project involved the development of a local autonomous network scheme utilising remote monitoring and control devices to locate and isolate network faults and restore un-faulted portions of the network autonomously. The trial was focused on two 11kV feeders in the lower North Shore of Sydney.
	Project Outcomes	This trial was terminated due to poor equipment performance, unreliable operation, and a strategic shift to focus on a centralised control scheme rather than local autonomous networks. The concept will be revisited following the successful commencement of Ausgrid's new control system, the ADMS. It did provide valuable lessons about ensuring suppliers have on-shore support and product expertise (significantly impacted due to COVID-19 travel restrictions) as well as identifying some of the key challenges and operational requirements for the implementation of remote switching and network automation, which will be valuable for future centralised deployments.
	Customer Benefits	The implementation of autonomous networks will improve customer reliability and reduce network operating costs by reducing the number of field patrols and manual switching required to restore the network after faults and storms. These benefits are also applicable to any centralised schemes developed, utilising the ADMS.

8.1.9. Dynamic Load Control

	Overview & Outcomes	
Solar Soak Trial	**Expenditure**	$0 (NIP component only)
	Project Overview	In August 2021, Ausgrid commenced a trial with a metering co-ordinator (**MC**) to trial a 'solar soak' controlled load hot water schedule, Using the load control facilities through the smart meter, the MC adjusted the switching schedule to turn the hot water heating supply on during the middle of the day when solar PV production is highest. Shifting load to this part of the part alleviates network issues caused by high CER export, in turn increasing the CER hosting capacity of the network.
	Project Outcomes	The trial successfully shifted a large amount of customer hot water load from the night-time to the middle of the day without adverse impact on the customers hot water heating performance. Ausgrid have now included a 'solar soak' controlled load schedule in our standard options for customers with a smart meter.
	Customer Benefits	More choice and control for customers for their hot water heating. In the longer term, this approach will improve the CER hosting capacity of the network, meaning that customers can connect more solar. It is also expected that customers may save approximately $23 per year due to wholesale energy savings.

8.1.10. Asset Condition Monitoring

Sub-Project	Overview & Outcomes	
Smart Meter Data Phase 1 & 2 – Neutral Integrity Monitoring & Basic Visibility	**Expenditure**	$1.02m
	Project Overview	The smart meter data project involved market engagement, system development and analytical software acquisition to trial the use of smart meter data in a range of use cases. The focus of these phases involved basic power quality data to provide greater network visibility, allowing improved modelling of network performance as well as identification of defects associated with the neutral circuit of a customer connection.
	Project Outcomes	This phase of the project has successfully introduced smart meter data into Ausgrid's systems and processes on a sample set of meters, supporting regulatory modelling of network hosting capacity and preparing the foundation for greater use of data in coming phases and as a BAU capability in the 2019-24 period. It has also had practical success in identifying a number of serious safety hazards and emerging defects in the network through the detection of poor neutral connections at approximately a dozen properties.
	Customer Benefits	This trial has demonstrated the ability to proactively detect safety issues, reducing the risk of electric shocks for customers. It has also improved Ausgrid's understanding of network hosting capacity to facilitate lower cost integration of customer CER.
Smart Meter Data Phase 3 – Advanced Services	**Expenditure**	$0.05m
	Project Overview	This project is in early design phases to expand the scope of the previous smart meter data trial phase and trial more advanced services such as real-time meter enquiry capabilities.
	Project Outcomes	The expected outcomes include more efficient field response to outages and improved customer experience through better understanding of the state of the network following outages.

Sub-Project	Overview & Outcomes	
	Customer Benefits	Improved customer reliability and more accurate information about outages to assist customer enquiries.
High Accuracy Loop Impedance Meter	**Expenditure**	$0.01m
	Project Overview	The purpose of this project is to develop and trial a High Accuracy Loop Impedance Monitor (**HALIM**) to assess the condition of the neutral conductor in low voltage cables that are susceptible to neutral conductor degradation over time (such as CONSAC cables). This will significantly improve asset condition monitoring so that CONSAC and similar cables are not replaced prematurely, and likewise are not left until they have failed in service or degraded to the point where they present a safety hazard. Results from such a device will complement results obtained from other technologies also under investigation for neutral integrity monitoring, such as smart meters. Smart meter analysis in other networks has been useful in detecting deteriorated or broken service main neutrals. However, so far, no concrete results have been achieved in determining the rate of degradation of the backbone distributor neutral. The high accuracy that can be achieved from a HALIM will provide the ability to calibrate and check results achieved from smart meters. This calibration has potential to add significant value to the smart meter analytics, whilst efficiently minimising the deployment of HALIMs across the network.
	Project Outcomes	This project aims to develop an accurate neutral impedance monitor with the precision required to detect defective neutrals on a distribution network level. This will assist with prioritisation of capital replacement programs related to aging distribution cables. To date, a device has been successfully prototyped and is soon to commence in-field testing at selected locations.
	Customer Benefits	Deployment of these devices on key feeders will improve customer safety by reducing shock risk, as well as reduce long term costs through better prioritisation of capital investment to replace these types of distribution cables by allowing a more condition-based replacement process.
Contact Voltage Detection System Trial	**Expenditure**	$0.23m
	Project Overview	Ausgrid is partnering with a company, Osmose, to trial technology on the network capable of detecting stray electric fields due to asset defects. The aim of using electric field detection technology is to identify defects with potential safety or maintenance consequences in the underground network – which may otherwise go un-detected until a public or worker incident occurs. This trial will capture new information about the state of buried assets and enable Ausgrid to assess the merits of this technology in future maintenance programs.
	Project Outcomes	An initial trial of this technology in April 2022 detected a metal streetlight standard that was energised at 246V due to an exposed metal screw inside the streetlight housing.
	Customer Benefits	Improved safety outcomes by proactively identifying network assets with contact voltage issues. This system also has potential to reduce network losses, which are ultimately passed through to customers.
Travelling Wave Protection Relay Trial	**Expenditure**	$0.14m
	Project Overview	This project aimed to test advanced sub-transmission relay technology to assess benefits of standardised deployment. These relays use advanced signal processing to identify 'travelling waves' which can be used to infer insipient defects on the feeder and determine fault location in the event a fault does occur. This has the potential to improve the efficiency of our maintenance and outage response processes. A trial

Sub-Project	Overview & Outcomes	
		installation has been undertaken in collaboration with Endeavour energy on a 66kV feeder between Carlingford and Hunter Hill in Sydney.
	Project Outcomes	A trial protection scheme has been successfully commissioned and is undergoing field evaluation. The results of this evaluation will inform the cost benefit of a wider deployment of this technology on other sub-transmission feeders in the network.
	Customer Benefits	Improved fault response times, potentially avoided outages and lower costs through more proactive identification and rectification of emerging defects before they result in asset failure.

8.1.11. Line Fault Indicators

	Overview & Outcomes	
Phase 1 – Modern device trials	**Expenditure**	$0.13m
	Project Overview	This project is designed to trial and pilot modern line fault indicators, including SCADA integrated devices, capable of providing real-time information to the ADMS. Key requirements also include technology that can be installed at a low cost with rapid installation techniques.
	Project Outcomes	To date a range of products have been laboratory tested, and one device is now undergoing initial field trials.
	Customer Benefits	Improved reliability and service restoration during outages, especially remote customers with below average reliability. Lower costs through more efficient field response processes.

8.1.12. Distribution System Operator Trials

These Distribution System Operator trials did not form part of the original scope of the NIP. The establishment of the Energy Security Board (**ESB**) in 2017 has highlighted the need for research and trials into two-sided market design to find effective and efficient ways of managing network capacity as well as ensuring that customers can make the most of their investments in CER. Key features of both of these projects include the low-cost approach and collaboration with multiple market participants.

Sub-Project	Overview & Outcomes	
Evolve Operating Envelopes Trial	**Expenditure**	$0.09m (NIP component only)
	Project Overview	The Evolve project was a collaborative project initiated by the Australian National University (**ANU**) and Zepben Pty Ltd, to develop the foundational understanding and technical capability to determine and deploy 'Distribution Operating Envelopes' (**DOE**). These DOE are critical to optimising network hosting capacity, reducing solar curtailment and supporting the transition to renewable energy. Ausgrid along with four other networks participated in the project to develop and test this technology.
	Project Outcomes	The project successfully developed DOE on key trial locations within the Ausgrid network, as well as generated significant learnings about the technical and social elements of applying DOE to customer connections. It has formed a key foundation in the development of Ausgrid's future distribution system operator systems architecture.
	Customer Benefits	DOE will ultimately allow customers to maximise their solar generation through optimising the use of the network, whilst maintaining degrees of equitable access for different customers in different network locations.
Project Edith	**Expenditure**	$2.02m
	Project Overview	This project is a collaboration with ANU and Reposit Power to demonstrate a decentralised and cost-effective way of managing network capacity in a growing two-sided market, where services are bought from distributed resources such as rooftop solar and electric vehicles to deliver cleaner, cheaper, and reliable energy for all consumers. A key feature of Project Edith is that both Ausgrid and Reposit Power will aim to leverage as much of their existing systems and process as possible to set out a practical pathway for the industry to mature over time. It will do so using the systems developed by Project Evolve, as well as new dynamic pricing capability to signal to customers and market participants the optimum times to produce and share energy from CER.
	Project Outcomes	Project Edith will test models that addresses distribution network constraints in a decentralised way and maximises the value customers get from their home solar and battery systems in energy markets.
	Customer Benefits	Improved solar hosting capacity and economic utility from their CER investments.

9. Appendix – Potential Projects (Option 3)

Workstream	Project Title	Maturity	Est Capex (FY24 real $m)	Est BCR
CER Support & Enablement	Low loss transformer & reactor trials	Trial	$1.7	4.56
	Low loss cable and line designs	Trial	$1.7	4.56
	Smart meter advanced functionality systems	Trial	$0.9	4.90
	Low embodied carbon asset trial - SF6 alternatives	Trial	$0.8	3.43
	Feeder level load shedding capability	Pilot	$2.1	2.36
	Grid Batteries (Zone/STS scale)	Trial	$4.2	1.61
	Low embodied carbon asset trial - Polypropylene cables	Trial	$0.8	1.43
Safe, Intelligent Networks	Digital substation trials	Trial	$0.5	9.14
	Phasor Measurement Units (PMU) trials	Trial	$0.5	11.64
	Network high accuracy neutral integrity monitors	Pilot	$0.1	5.73
	Trial ultra-sonic discharge detection devices	Trial	$0.5	2.62
	Dynamic protection relay trials	Pilot	$2.6	1.97
	Kiosk SCADA-linked EFIs (Retrofit)	Pilot	$5.3	1.95
	Wires down detection device trials	Trial	$6.3	1.57
	Distribution and transmission line defect detection sensors	Trial	$4.2	1.22
	Network Sectionalising and Optimisation Engine - provide various forms with outcomes similar to FLISR	Trial	$1.1	13.88
	Controlled load management system	Trial	$0.5	8.44
	Advanced Load Information System	Trial	$1.0	4.91
	Network State Estimator	Trial	$2.1	2.73
	Dynamic Ratings Calculation System	Trial	$1.1	3.31
	Defect Identification trial - Photo analysis AI	Trial	$0.5	2.60
	Mobile contact voltage detection pilot	Pilot	$2.8	2.49
	Data driven Fault Prediction Intelligence System	Trial	$1.1	1.60
	Closed Loop Voltage Regulation and Optimisation Control System	Trial	$2.1	3.15
	Smart Meter Enquiry OT integration systems	Pilot	$1.1	1.09
Community Resilience	Substation Fire Detection Systems	Trial	$0.3	4.37
	Local weather stations	Trial	$0.3	3.89
	MV cable Partial Discharge monitoring	Trial	$1.1	2.24
	Mobile hydrogen units for emergency response	Trial	$2.4	1.57