31 January 2023

Attachment 5.8.e: Network digitisation program

Ausgrid's 2024-29 Regulatory Proposal

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

Ausgrid

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1. Executive summary

This document describes the case for investment in the Network Asset Digitisation Program. It has been developed as a continuation of the existing program to deliver ongoing value to Ausgrid's customers and stakeholders, such as government agencies. The program's key deliverable is the ongoing currency of the digital twin and strengthening of functionality and services delivered by Ausgrid's Asset Digital Twin. This Network Digitisation program consists of three interdependent aspects:

- **Data collection** – the acquisition of new and highly accurate network data using the latest technology to reducing ongoing acquisition costs and enabling incorporation of this data into a comprehensive digital twin,
- **Drones and bushfire surveillance** – the replacement of a fleet of network data acquisition sensors, including drones, at end of life to maintain a sensor fleet capable of acquiring network asset data as required,
- **Asset Digital Twin** – a comprehensive physics-enabled, engineering grade 3D interactive digital model of the Ausgrid network assets built up from captured lidar and geospatial information, increased connectivity and integration between many existing corporate systems to provide greater information access to customers and insights to ASP's and Ausgrid to improve the services provided to customers.

The refresh of the Asset Digital Twin with updated asset data following construction by ASPs, Ausgrid or alteration by other utilities will enable cost efficiencies within network planning, design, works delivery and directly for customers through streamlined connection services and government, developer and utility construction planning.

These benefits are achieved by utilising design tools within the Digital Twin that provide greater speed and consistency for internal and external ASP's designs and other stakeholders that will reduce the design timeline and provide improved quality through automated design checking reports.

There will also be improvements in the visibility and accessibility of asset data within multiple platforms from the 3D interactive digital twin, 2D geographic systems, high-definition imagery, asset databases and reporting systems to provide greater insights which allows for more informed decision making at all levels within the organisation.

These improvements include the use of LiDAR and high-definition imagery for early identification and repair of asset defects outside the normal inspection cycles, improved vegetation encroachment management, simulation of climate impacts, including flooding, to better plan incident response and enhance unplanned outage analysis. These improvements will have benefits for community safety and network supply reliability for customers.

This Network Digitisation investment also enables Ausgrid to implement transformational activities that will continue to place downward pressure on network prices into the future.

Three investment options have been considered with varying levels of benefit. These are:

- **Option 1: Replace existing sensors/drones & maintain advanced capture services** (bushfire areas only) – includes replacement of existing sensors/drones at end of life, ongoing use in annual bushfire season preparation activities, maintaining existing data processing arrangements and updates of this data into the Digital Twin (with minor and ongoing functionality enhancements),

- **Option 2: Target & extend advanced capture services & access to Digital Twin** – in addition to Option 1, this option includes updates to asset data following construction works by ASPs, Developers or Ausgrid and at least 3 yearly capture of non-bushfire area assets with the use of an additional mobile sensor, enhancements to streamline data processing and to the Digital Twin to improve ASP design review processes and quality, and more timely provision of asset information to third parties for related construction planning and works.

- **Option 3: Continuous advanced capture services & access to Digital Twin** – in addition to Option 2, this option includes the annual data capture of the whole of Ausgrid's overhead network with an expanded sensor fleet to manage this additional capture volume and further resources to streamline data processing and reduce reliance on third parties.

Option 2 is the selected option as it presents the highest net benefits with limited delivery risk.

The table below provides a summary of the Network Asset Digitisation program discussed in this business case. It demonstrates that the preferred option and subsequent program of work, if approved, would continue to deliver benefits from existing data investments and deliver net benefits of $26.5 million.

Executive summary							
Key Objective(s) of the program	The purpose of the Network Asset Digitisation program for the 2024-29 regulatory control period is to ensure Ausgrid's asset data remains current and does not depreciate as changes occur across the network. It will continue to capture the necessary asset data that is integrated across systems and strengthen Ausgrid's Asset Digital Twin. This will be achieved through streamlined mass data acquisition utilising emerging technologies, including improved automated data extraction and live streaming capabilities from mobile sensors such as uncrewed aerial vehicle (UAV) and vehicle-based systems.						
Customer benefits	• Manage the increase in bushfire inspection and replacement scoping activities for increasing bushfire risk area with limited/no cost and lower dependance on third parties. • **Early detection of degraded assets or tree encroachments which will** reduce asset safety risk and improve network reliability for customers. • Deliver timely information to the customers improving customer experience allowing workers and customers to redirect effort to more productive activities. • **Reduced** time for **equipment repairs reducing unplanned and planned outages to customers**. • Ongoing access for ASPs to efficiently design in system or download available information to conduct efficient overhead line designs. • Greater engagement with external stakeholders providing shared data sets and finding mutually beneficial arrangements to share other data between entities.						
Regulatory requirements	• Final Report of the NSW Bushfire Inquiry 30 July 2020 – Recommendation 18 (awaiting implementation) • 2022 Flood Inquiry Volume One: Summary report 29 July 2022 – Recommendation 28 (Supported in principle – further work required for implementation planning)						
NPV calculations	NPV of $26.5M benefits from investment of $15.33M costs over FY25-FY29						
Expenditure forecast (FY24 Real $)	**($m)**	**FY25**	**FY26**	**FY27**	**FY28**	**FY29**	**Total**
	CAPEX	$2.71	$3.26	$3.27	$2.73	$3.35	**$15.33**
	OPEX	$0.77	$0.79	$0.79	$0.79	$0.82	**$3.96**
	Total	**$3.49**	**$4.05**	**$4.07**	**$3.52**	**$4.17**	**$19.29**

Note numbers may not add due to rounding of annual contributions.

All NPV calculations in this paper have been made with a WACC of 3.44%.

2. CONTEXT

2.1. Background

Ausgrid's existing LiDAR data acquisition involves an annual LiDAR collection in bushfire prone regions. The primary objective of the annual LiDAR data collection is to identify vegetation encroachments into the network clearance envelope, so defects can be remediated prior to the commencement of the bushfire danger period. Every three years, the annual LiDAR is supplemented with High-Definition photographs of the overhead network assets within these regions to identify asset hardware defects. These activities form part of Ausgrid's ongoing operational maintenance program which has increased from 25% to 30% (approximately 13,500 km) of Ausgrid's overhead network in recent years.

Throughout the 2019-2024 regulatory period under the existing Network Asset Digitisation program Ausgrid has expanded the LiDAR collection to cover overhead network assets not within bushfire prone areas to gain 98% overhead network coverage. This uplift was undertaken to obtain the necessary data to deliver the current Network Asset Digitisation program objectives, primarily focused on identifying hazardous network assets and rectification activities.

Further benefits have been found by using UAVs to assist in surveying and data acquisition of Ausgrid's assets which reduces the need for a crewed aircraft, reducing the safety risk to staff, contractors and the public.

Ausgrid's Digital Twin is a physics-enabled, engineering grade 3D interactive digital model of Ausgrid's overhead network assets with the data that underpins each of the following use-cases established and progressing within the 2019-24 Network Digitation program.

- Increased revenue capture from third party assets installed on Ausgrid assets.
- Improving capital efficiency by reducing the effort associated with planning and design activities for volumetric programmes of work.
- Increasing network reliability and reducing network risk (outages, fire-starts, maintenance callouts) by identifying and prioritising the installation of LV spreaders.
- Reducing capital and operational expenditure associated with managing vegetation encroachments.
- Reducing operational expenditure by optimising vegetation management cycles

The Ausgrid Asset Digital Twin will continue to improve the visibility and accessibility of data by combining and linking information between multiple platforms from the 3D interactive digital twin, 2D geospatial systems, high-definition imagery, asset databases and reporting systems. The derived datasets are establishing the foundation to deliver the blueprint to enable the next generation of system and application-agnostic data modelling. Ausgrid is also collaborating with other Australian DNSP's to explore other benefits and functionality that could be incorporated into our Digital Twin.

2.2. Problem/opportunity

The advanced data collection of highly accurate 3D network data provides a significant opportunity to strengthen and expand the functionality and services delivered by Ausgrid's Asset Digital Twin. These services are provided for both internal Ausgrid use and also direct to customers and their ASPs. This opportunity is primarily focused in three areas as described below:

- **Data collection** – the acquisition of new and highly accurate network data using the latest technology to reducing ongoing acquisition costs and enabling incorporation of this data into a comprehensive digital twin,
- **Drones and bushfire surveillance** – the use of modern advanced sensors to acquire network data (including highly accurate measurements of distances, temperature and colour) has the ability to increase the number of use cases that can be leveraged from existing to optimise existing processes and also develop new or improved customer and stakeholder information services.
- **Asset Digital Twin** – a comprehensive physics-enabled, engineering grade 3D interactive digital model of the Ausgrid network assets built up from captured lidar and geospatial information, increased connectivity and integration between systems can provide greater information access to customers and insights to ASP's and Ausgrid to improve the services provided to customers.

The refresh of the Asset Digital Twin with updated asset data following construction by ASPs, Ausgrid or alteration by other utilities will enable cost efficiencies within network planning, design, works delivery and directly for customers through streamlined connection services and government, developer and utility construction planning.

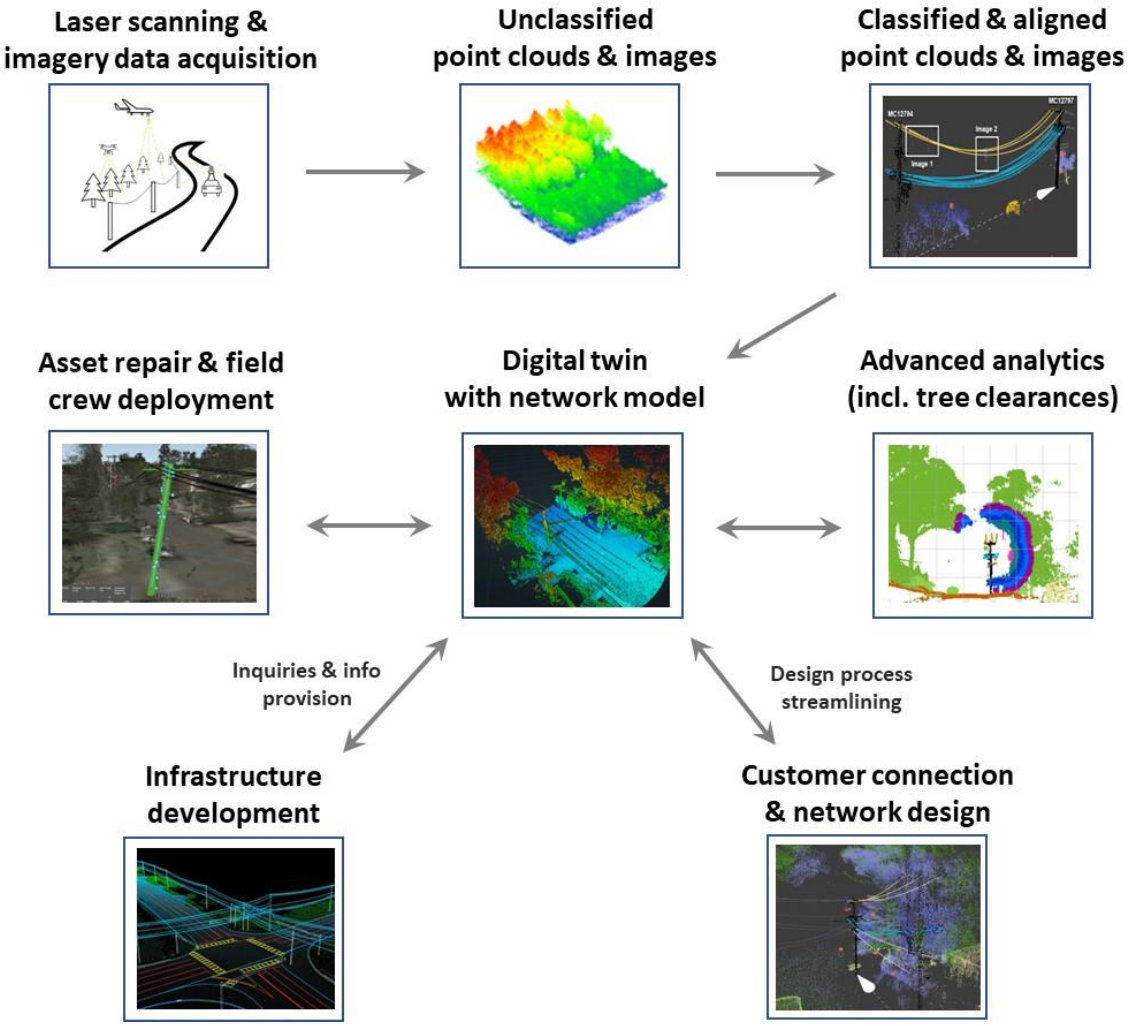
These benefits can be achieved by utilising design tools within the Digital Twin that provide greater speed and consistency for internal and external ASP's designs and other stakeholders that can reduce the design timeline and provide improved quality through automated design checking reports.

There will also be improvements in the visibility and accessibility of asset data within multiple platforms from the 3D interactive digital twin, 2D geographic systems, high-definition imagery, asset databases and reporting systems to provide greater insights which allows for more informed decision making at all levels within the organisation.

These improvements may include the use of LiDAR and high-definition imagery for early identification and repair of asset defects outside the normal inspection cycles, improved vegetation encroachment management, simulation of climate impacts, including flooding, to better plan incident response and enhance unplanned outage analysis. These improvements will have benefits for community safety and network supply reliability for customers.

An overview of the data process and functionality delivered by the Network Digitisation program is shown below in **Figure 1**.

Figure 1 - Overview of Data collection & Digital Twin Use Cases



Further detail on the opportunities in each of these three key program areas and how they relate to the data process and digital twin functionality is described below.

Data Collection

Ausgrid manages asset information to enable efficient and effective business operations. Over time, changing technology, grid complexity and customer expectations provide an opportunity for improvement in business processes and practices surrounding the management of this information.

Ausgrid records and processes asset information into asset management systems from:

- over 5 million recorded assets.
- over five hundred thousand inspections/site visits annually; and
- hundreds of measurements per day from nearly a million actively monitored network points.

Information from these assets and their inspections and monitoring devices is currently collected through both automated and manual processes, and there is an opportunity to improve the efficiency, accuracy and use of the information collected.

Information requirements are also refined over time, resulting in data gaps across the complete set of asset classes. These information gaps often limit cost effective preventative action being taken and reduce opportunities for efficiency improvements and result in greater contingency considered or even run to failure strategies, resulting in an increased overall cost.

To improve the implementation of current asset management strategies, works management processes and investment decisions a greater level of asset information detail and quality is required to uplift insights into areas of opportunity. Significant costs are associated with traditional data collection programs generally prohibiting their implementation. Due to these constraints data collection has generally been undertaken opportunistically and often only for a new requirement or in response to an event such as a catastrophic asset failure.

Ausgrid's network assets are continually being augmented, repaired and modified. Without a corresponding data collection program asset data becomes out-of-date, no longer reliable and data dependant processes are compromised. Technology such as Light Detection and Ranging (LiDAR), panoramic imagery and processing, 3D modelling, image recognition, machine learning algorithms and capture techniques present the opportunity to develop more comprehensive and accurate data sets at significantly reduced costs.

These data sets enable leading insights and analysis to allow for justifiable cost-effective preventative action to prevent equipment running to failure which could result in a loss of supply to customers, fire ignition or safety incident.

To protect existing data investments and continue enabling these leading insights, there is a need to manage Ausgrid's asset data including the replacement of out-of-date LiDAR and imagery data.

Drones and Bushfire Surveillance

Traditional data capture methods for Ausgrid's current Network Digitisation program and Ausgrid's Bushfire season preparation activities is undertaken externally through contracted services using manual techniques, Mobile LiDAR Scanner (MLS) or captured via crewed aircraft.

The use of crewed aircraft presents an ongoing safety risk that newer technologies such as Unmanned Aerial Vehicles (UAVs) can significantly mitigate. There has historically been significant cost involved by having these captures undertaken externally however, the availability of and commoditisation of suitable sensors, coupled with new capture methods now makes internal delivery a viable economic option, reducing the cost and risk to deliver both programs.

Ausgrid has been testing a blended delivery model (internal and contractor delivery) for LiDAR and aerial imagery capture covering both the Bushfire season preparation activities and the Network Digitisation program. This has resulted in Ausgrid reducing the impact of growing bushfire prone area and building its own capability with a fleet of LiDAR sensors for both vehicle and UAV acquisition platforms.

Business-as-usual delivery for data acquisition for parts of the bushfire season preparation activities with the use of Ausgrid's fleet of UAVs and Mobile LiDAR Scanner (MLS) unit is forecast for the foreseeable future. Ausgrid's management of the existing fleet of UAVs and associated sensors including the replacement of working fleet of UAVs (1x large, 5x medium and, 30 small - replaced every 2 years[1]) and sensors at end of life will continue to improve the effectiveness of inspections and provide greater ability to replace network assets just in time.

The fleet of sensors (and UAVs) requires ongoing investment to maintain and replace equipment to continue to realise the existing identified efficiencies. To maximise the use of these sensors there is an opportunity to utilise an expanded fleet across both the bushfire preparation activities and Network Digitisation program.

Ausgrid has already seen an increase in the area declared as bushfire prone land and subsequent electricity network from 25% to 30% over the past 5 years. This increased volume of work to manage Ausgrid's ever increasing bushfire risk, along with supply chain cost increases, rise in price for aircraft fuel, increased climate impact and abnormal weather events are all aspects where alternative methods are demonstrably more cost effective for mass data acquisition and reduce Ausgrid's carbon footprint in a sustainable manner.

Ausgrid also conducts network patrols and damage assessments post major weather events. This activity is manual and time-consuming and is often limited by restricted access. The use of UAVs and mounted sensors with local Ausgrid personnel presents an opportunity for rapid recognisance on the network, reducing outage times for customers and network reconstruction costs.

Asset Digital Twin

Ausgrid's Digital Twin consists of a physics-enabled, engineering grade 3D interactive digital model of the Ausgrid network assets built up from captured lidar and geospatial information. The system and processes that support this digital twin consist of streamlined mass data acquisition and increased connectivity and integration between existing corporate systems including the Digital Twin.

A Digital Twin is a virtual model designed to accurately reflect a physical object. Ausgrid have established in the 2019-24 period a foundational digital twin. With the rapid evolution of computing,

[1] Based on ATO tax life

sensor and high-definition photo technology, Ausgrid has utilised a number of existing large datasets and catalogues to provide data security, network and asset status and defect identification.

Ausgrid also has existing 2D geographic information systems (GIS) of the network, asset databases and reporting systems to provide data integrity, asset information and measure network performance. Ausgrid's Asset Digital Twin presents the opportunity to integrate and link existing systems, improve and automate processes and data handling. This will put information in the hands of those that can realise its benefits and provide greater accessibility to customers and other community stakeholders.

The Asset Digital Twin helps supports network integrity and resilience planning through:

- Improved asset information accuracy and detail delivering more reliable information to those that need it,
- Improved access to information from multiple platforms, reducing siloed and duplicated data sets via increased platform connectivity and the management, moderation and curation of data,
- Delivery of digital modelling and whole of network analytics for poles and wires including the calculation of mechanical loads on all network poles providing a new input into the prioritisation of pole replacements,
- Providing integrated planning tools to streamline the design process for both internal and ASP designs,
- Identifying required asset interventions to workers sooner and opportunities to remediate multiple asset defects with a single work package and reducing safety risk,
- Delivering timely supply interruption information to the customer improving the experience allowing workers and customers to redirect activities to other productive tasks,
- Using LiDAR for early identification of asset defects or vegetation encroachments outside the normal inspection cycles, minimising customer disruption and reducing long term costs,
- Delivering 3D simulations of climate impacts, such as flooding and extreme wind events to better prepare the network when the opportunity arises to avoid extended supply interruptions, and
- Providing greater insights and visibility of information for tasks such as unplanned outage analysis or network designs with linkage and mapping between electrical network data, asset information, 2D and 3D geospatial information and imagery.

The Asset Digital Twin facilitates a common base for information to be presented with lower ongoing costs and improved transparency. For example, the inclusion of smart meter power quality data will be able to be utilised in conjunction with other network asset data without the need to build a separate user interface for the data to be consumed. The use of an aligned model will also enable the rapid integration of asset information between systems reducing long term costs for customers. This includes but is not limited to retirement of legacy systems, such as overhead line design tools and bespoke geospatial viewers.

This program justification recommends integrating, where required, various data sources (internal and external) to Asset Management and geospatial systems for a streamlined user experience to rapidly access, analyse and visualise asset information in addition to the rapid sharing of information with government agencies as required.

2.3. Compliance obligations

In January 2020, the Premier announced the establishment of the NSW Bushfire Inquiry to make recommendations in relation to bush fire preparedness and response. LiDAR data and high-definition photos and the collection platforms such as drones and car-mounted cameras, used to collect data through Ausgrid's Network Digitisation are referred to as remote sensing in this report.

The report identified there is a need to "…*push available technologies harder, especially fire science, remote sensing and data science and artificial intelligence*…". The report goes on to make several recommendations, in particular Recommendation 18 (see appendix A) whereby owners/managers of assets in bush fire prone land are required to provide on an annual basis detailed asset information such as pictures with GPS locations (including information/metadata with quality control certification).

In March 2022, the Premier established the NSW Flood Inquiry to make recommendations in relation to planning and preparedness in response and recovery from the 2022 catastrophic flood events. Recommendation 28 (see appendix B) states that government is to ensure that "*essential services infrastructure (communications, water, power and sewerage) is situated as much as possible above the flood planning level".*

Ausgrid's Asset Digital Twin provides a foundational platform to support and provide greater insights to both these recommendations, however ongoing investment is required to integrate to external data systems and suitable access control to the critical infrastructure information that Ausgrid manages.

2.4. Investment objectives

This program is designed to achieve the following specific objectives:

- Reduced or avoided equipment repairs through early detection of degraded asset or tree encroachments, reducing unplanned and planned outages to customers;
- Improved tree scape with reduced trimming to 'just in time' trimming and office-based planning for long term solutions in densely vegetated areas;
- Reduced and shorter outages with early asset intervention prior to dangerous situations occurring;
- Reduced fire starts having the ability to cover increased bushfire danger areas with limited relative cost impact for bushfire season preparation activities and information sharing with NSW government and emergency services;
- Quicker response in significant events assessing storm and flood impacted areas and selective materials for response to restore the network and power to customers earlier;
- Reduced cost to connect with virtual world modelling for new connection designs, avoiding future rework with modelling tools to calculate sufficient clearance to buildings and trees;
- Improved customer safety with reduced high-risk assets where detection of emerging issues can be identified and resolved before impacting customers and the public;
- Develop the capability to integrate new data into the network asset data model to drive efficiency in data maintenance over the long term; and
- Modernise the network to improve service levels and facilitate the adoption of a single platform for internal and external design.

To achieve these objectives, the Network Asset Digitisation Program comprises a range of investments designed to evolve over time as technology matures. To manage the uncertainty associated with investment of this nature, Ausgrid will continue to prioritise the projects in line with our approach in the 2019-24 regulatory reset period.

We have included an operational expenditure component to address the maintenance and support of the new capabilities. No step change in opex allowance is being sought to accommodate this increase in cost.

To ensure the greatest economic value from these investments, Ausgrid utilises quantitative risk assessment to measure the expected risk reduction against the incremental cost, prior to determining whether to invest in each project within the program.

2.5. Customer outcomes

Through a co-design process with customer advocates, we identified six key topics that will define our business into the future. Of these, the Network Asset Digitisation program is aligned to Resilient theme in maintaining the safety and security of the network, also with a direct impact on Improved Customer Experience and Value for Money.

Table 1 – Themes Identified to Define the Business into the Future

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 DER 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 aligned with the guiding principles for Network Digitisation program investment. These principles have been used to guide the development and prioritisation of investment within this program.

The program specifically will improve value for money, enhance customer experience, improve resilience planning and enable a future network for the community Ausgrid serves.

It is expected through the regulatory period that resources and priorities will continue to be evaluated across the program to ensure that the core challenges and opportunities are being addressed in a way which maximises value to our customer and stakeholders.

3. OPTIONS

This section provides an overview of a select number of options which could credibly address the need to uplift and modernise Ausgrid's asset information, specifically the highly accurate spatial information for Ausgrid's overhead network. The net present value (**NPV**) associated with each option is also noted.

3.1. Overview of options

Three options have been considered, which are listed in the table below. The recommended option for the 2025-29 period is option 2 based on quantitative analysis demonstrating that it will unlock the greatest net economic benefits.

A 'do nothing' option was not considered a credible option and has been discounted from the table below. Failure to adequately address the information management requirements of the business, which this program delivers, puts embedded 'business as usual' processes at risk without building and resourcing alternate solutions. Doing nothing would undo efficiencies already being realised within Ausgrid and for customers.

Table 2 – Overview of Network Digitisation Program Options

Option	Description	NPV market
Option 1: Replace existing sensors/drones & maintain existing advanced capture services	This option includes the replacement of existing sensors/drones at end of life to support ongoing use in delivering half of the annual bushfire season preparation surveying activities. This includes the replacement of 1 large, 5 medium and 30 small scall UAVs, and 1 vehicle and 6 UAV mounted lidar and camera systems. The existing data processing arrangements and updates of this data into the Digital Twin continue as currently performed. This option also includes the establishment of new functionality in the Digital Twin and related systems to maintain efficiency in collection and presentation of data from field personnel to office users.	**$8.8m**
Option 2: Target & extend advanced capture services & access to digital twin	In addition to Option 1, this option includes: • Capture, processing, and updates to asset data following construction works by ASPs, building developers and Ausgrid, • Full data capture coverage of remaining areas at least 3 yearly with automatic processing and update of asset data with latest sensors and uplifted data model, • Manual network model quality assurance on high voltage lines and lines in bushfire areas, • Additional vehicle mounted LiDAR sensor and camera system, • Enhancements to streamline data processing and undertake half of the bushfire area LiDAR classification and vegetation analytics, • Streamline the design process with integration into the Digital Twin & enhance the automated design & approval processes • Integrations between Digital Twin and key enterprise systems, such as SAP and GIS, and • Enhancements to the Digital Twin and data model to improve ASP design review and provision of asset information to third parties for related construction planning and works.	**$26.5m**
Option 3: Continuous advanced capture services & access to digital twin	**In addition to Option 2, this option includes:** • Continual asset **data capture** and processing to maintain an enhanced network model in the Digital Twin with a currency of at least annual basis, and • Removal of hand-offs and key dependencies on supply chain processes for processing and analysis of asset data by leveraging available sensors/drones and systems. This greater level of asset data capture in this option will lead to greater identification of potential hazards and enhance the accuracy of network asset data for customer connection designs provided by ASPs (and Ausgrid) for construction. This option also requires a larger number of sensors/drones to achieve this greater level of asset capture and additional labour for data processing, quality assurance and analytics. This includes a 100% increase to the number of large and medium sensor/drones and an additional 33% for the number of small sensor/drones. The labour increase to support this volume of data capture and processing requires a 200% increase in the available pilots and data processing.	**$21.1m**

The principal difference between the three options is the frequency and scope of data collection which has a direct impact on the resource and equipment requirements driving the size of the investment.

A brief summary of the options and their expenditure within FY25-29 is shown in Table 3.

Table 3 – Financial summary of options analysis (FY24 Real $m)

Options	Description	Capex (FY25-29)	Opex (FY25-29)	Benefits (FY25-29)	OPEX benefit (FY25-29)	NPV (FY22 Real $)
Option 1	Maintain	$3.6m	$3.1m	$10.5m	$5.9m	$8.8m
Option 2	Extend	$15.3m	$4.0m	$51.0m	$9.4m	$26.5m
Option 3	Comprehensive	$26.4m	$11.8m	$57.6m	$16.4m	$21.1m

3.2. OPTION 1: Replace existing sensor/drones & maintain existing advanced capture

3.2.1. Description

Under this option, it is proposed to capture the surveying data required for 50% of the bushfire season preparation activities internally using Ausgrid's existing fleet of sensors, drones and vehicle mounted LiDAR and associated camera equipment. The remaining 50% of the bushfire season preparation scope will continue to be captured externally. This split strategy reduces the risk to delivery and reflects the current process implemented by Ausgrid' under its existing project to implement the use of drones with advanced sensors.

In the 2019-24 period Ausgrid's existing Network Digitisation program will establish the ability to run automatic LiDAR data classification and reporting on captured LiDAR data. This process is continually improving, however, the quality level has not reached what can be achieved through manual classification. Until this is proven to be equal or surpassing manual techniques, in this option Ausgrid does not propose to alter its existing approach to vegetation defect reporting for its bushfire season preparation activities whereby it is delivered through an external provider.

To continue to deliver the existing efficiencies of the bushfire season preparation activities the sensors, data capture equipment and fleet of supporting vehicles require capital investment to replace at end of life. The replacement of these assets has been calculated based on standard tax lives, although these assets may not remain in operation for this period. These include:

- 1 large scale Uncrewed Aerial Vehicle (UAV) with LiDAR sensor and high-definition optical camera,
- 5 medium scale UAV's with LiDAR sensors and integrated optical cameras,
- 30 small scale UAV's with integrated optical cameras, and
- 1 Mobile LiDAR Scanner (MLS) SUV mounted LiDAR unit with 4 digital high-definition optical cameras and 3D panoramic 360-degree camera

Additionally, minor enhancements to the Digital Twin are included in this option to improve functionality and minimise manual intervention.

3.2.2. Option 1 Assumptions

Option1 has been estimated based on the following assumptions:

1. Complements but does not include all existing labour associated with the bushfire season preparation activities,
2. Capital costs of drones covers both the bushfire season preparation activities and the network digitisation program,
3. The bushfire season preparation activities capture new asset details, this cost is capitalised,
4. Unit costs provided to Ausgrid in 2022 bushfire tender response for data capture and processing will remain the same,

5. Existing efficiencies delivered using drone will continue,
6. Using the vehicle-based LiDAR unit (MLS) and drones instead of flights reduces the consequence of multiple fatalities (2) in a 1 in 50-year event at $5m each, and
7. Continue 100% manual in person bushfire inspections on service mains & private mains.

Capital Cost and Scope Assumptions

$ million	FY25	FY26	FY27	FY28	FY29	Total
CAPEX	**$0.42m**	**$0.93m**	**$0.93m**	**$0.38m**	**$0.97m**	**$3.63m**

Operating Cost Assumptions

$ million	FY25	FY26	FY27	FY28	FY29	Total
OPEX	**$0.61m**	**$0.62m**	**$0.62m**	**$0.62m**	**$0.64m**	**$3.11m**

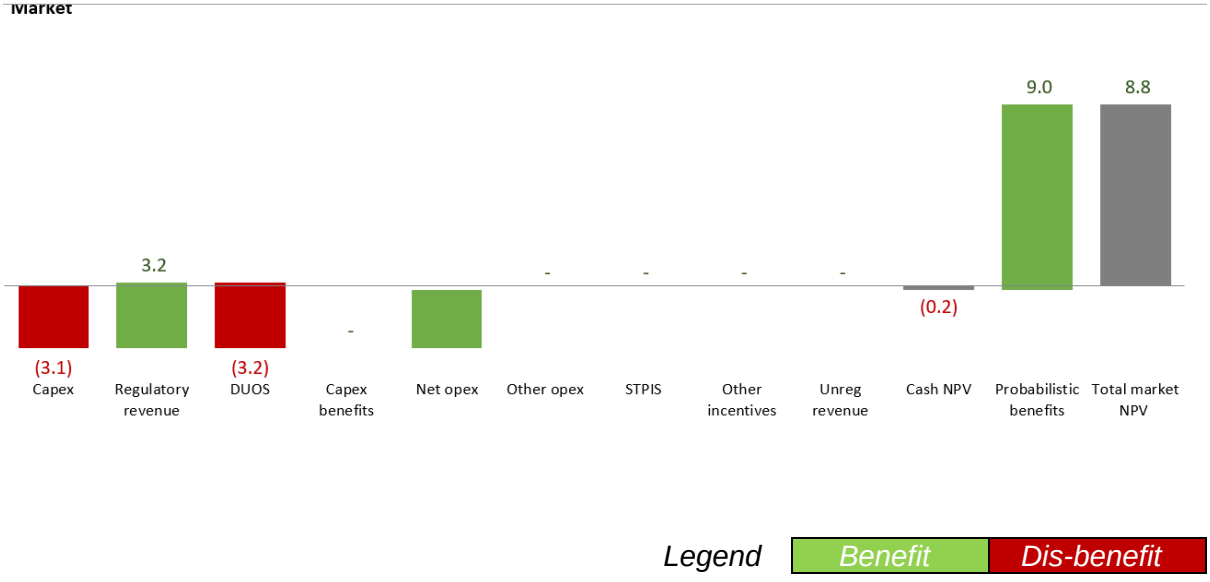
3.2.3. NPV analysis

The NPV analysis considered benefits across a broad value framework considering:

- Probabilistic safety benefits with reduced crewed aircraft accidents.
- OPEX reduction through internal delivery with advanced collection platforms.

These benefits were applied based on expected risk reductions from development and deployment of the various projects within this program option.

Market NPV of option ($' millions, real FY22)



Legend Benefit | Dis-benefit

3.3. OPTION 2: Target & extend advanced capture services & access to digital twin

3.3.1. Description

This option proposes to capture the data required for 50% of the bushfire program internally using Ausgrid's existing fleet of drones and vehicle mounted LiDAR and camera equipment. The remaining 50% of the program scope will continue to be delivered externally for both acquisition, data classification and reporting.

To ensure the data Ausgrid has previously invested in remains current and up to date, Ausgrid proposes to use an asset lifecycle approach to drive its data collection strategy. This will be triggered by changes to network assets as they are installed and removed from the network and integrated with Ausgrid's asset management system. This avoids unnecessary data collection on assets and surrounds which are not rapidly changing, or network augmentation is not planned. Ausgrid inspection programs will continue to be used to identify condition changes across the asset base, however a 3 yearly cycle of LiDAR data collection will be used to identify network replacement requirements and identify any network changes not flagged within Ausgrid's systems.

As described in option 1, in 2019-24 period Ausgrid's existing Network Digitisation program will establish the ability to run automatic LiDAR data classification and reporting on captured LiDAR data. This process is continually improving; however, the quality level has not reached what can be achieved through manual classification. In this option, until this is proven to be equal or surpassing manual techniques Ausgrid proposes to carry out manual classification and quality assurance internally. This will build experience and capability for the future while providing valuable feedback to refine the internal capture techniques.

It is proposed to carry out full manual classification internally for the internally captured data under the bushfire program. To balance internal resources over the course of the year it is reasonable to extend the internally delivered manual classification to data collected on new network assets and therefore establishing a suitable quality level of detail on the asset and its surrounds at the beginning of its lifecycle.

The identification of encroachments on the high voltage overhead network has the potential to improve network reliability at an impact magnitude higher than encroachments on the low voltage overhead network. Due to the economies of scale, it is proposed under this option to target further internal manual classification and reporting on the high voltage overhead network spans that are known to be vegetated.

In areas outside of the scope of the bushfire season preparation activities, newly constructed assets and high voltage overhead network, there is an opportunity to utilise the auto classification functionality in the digital twin system. This comes at a lower cost to deliver and while the quality is not as high as manual classification it still meets the quality levels required to maintain the base level dataset and identify network requiring capital replacement, such as failed cross arms. In some instances, a greater level of LiDAR data classifications maybe required to support a specific program. Where this is required, the cost will be incurred by the project and not funded by the Network Digitisation program.

Utilising the additional capacity in the existing sensor fleet and associated equipment (described in option 1) to deliver the data capture requirements of both the bushfire season preparation activities and non-bushfire scope detailed in this option. This option reflects the same requirement as option 1 to maintain and replace the existing fleet of sensors, vehicles, drones and associated equipment. This includes:

- 1 large scale Uncrewed Aerial Vehicle (UAV) with LiDAR sensor and high-definition optical camera,

- 5 medium scale UAV's with LiDAR sensors and integrated optical cameras,
- 30 small scale UAV's with integrated optical cameras, and
- 1 Mobile LiDAR Scanner (MLS) SUV mounted LiDAR unit with 4 digital high-definition optical cameras and 3D panoramic Ladybug 5+ 360-degree camera.

Ausgrid will expand and uplift its Asset Digital Twin through integration of systems and data. This will improve the visibility and accessibility of data across multiple platforms from the 3D interactive digital twin, 2D geospatial systems, high-definition imagery, asset databases and reporting systems. This will deliver a streamlined experience for staff, contractors and customers, providing the necessary high quality and up-to-date datasets needed to operate efficiently.

The increased data collection on assets requires the management of new and old data with only minimal additional handling and automation delivered by cross system functionality. This option will build upon related data analytics and architecture projects to leverage solutions that minimise manual data maintenance and management. The data integration through the asset digital twin conflates disparate datasets together presenting new insights and transformation opportunities to leverage.

This option addresses the need to integrate Ausgrid's geospatial and asset management datasets to the design process and systems. This will be achieved through a series of integrated tools and is one of the benefits of an asset digital twin. The digital twin allows multiple platforms to access different aspects of asset data, simplifying manual reporting and sharing asset data with key stakeholders. The timely delivery of information delivered through an integrated digital twin improves the customer experience, allowing workers and customers to redirect activities from manual data handling to more productive tasks.

The combination of separate datasets through the digital twin, the design tools provided within Digital Twin and the facility to automate aspects of the design and approval processes will streamline both the internal and external (ASP) design process. This will also enable a single point of data handling and further improve asset data management processes with automated asset system updates.

3.3.2. Option 2 Assumptions

Option 2 builds on from Option 1 and has been estimated based on the following additional assumptions:

- Bushfire inspections of service mains and private mains transition from 100% manual in person inspections to using LiDAR,
- Increase in LiDAR capture of vegetated spans and Digital Twin analytics provides for earlier detection of vegetation encroachments which facilitates early rectification to provide a reduction of unplanned outage events,
- Increase in LiDAR capture and Digital Twin analytics identifies high potential incidents such as low network and service mains providing customer and community safety benefits,
- Provides ASP design savings with Digital Twin access and automated certification, and
- Digital Twin will also address recommendation 18 from the NSW Bushfire Inquiry report and recommendation 28 from the NSW 2022 Flood Inquiry report

Appendix C provides a detailed list of the assumptions.

The costs of this option have been estimated based on initial estimates of each project, based on historical expenditure in similar equipment and associated labour and contracted services.

Capital Cost and Scope Assumptions

$ million	FY25	FY26	FY27	FY28	FY29	Total
CAPEX	**$2.71m**	**$3.26m**	**$3.27m**	**$2.73m**	**$3.35m**	**$15.33m**

Note numbers may not add due to rounding of annual contributions

Operating Cost Assumptions

$ million	FY25	FY26	FY27	FY28	FY29	Total
OPEX	**$0.77m**	**$0.79m**	**$0.79m**	**$0.79m**	**$0.82m**	**$3.96m**

Note numbers may not add due to rounding of annual contributions

3.3.3. NPV analysis

The NPV analysis considered benefits across a broad value framework considering:

- Probabilistic network risk benefits across aircraft accidents and community exposure to wires down events,
- Avoided outages on the network caused by network encroachments,
- OPEX reduction through internal delivery with advanced collection platforms and shared resource utilisation,
- Market benefits from customer unserved energy triggered by major weather events, and
- Automation through data integration and access.

These benefits were applied based on expected risk reductions from development and deployment of the various projects within this program option.

Market NPV of option ($' millions, real FY22)

Legend | *Benefit* | *Dis-benefit*

3.4. OPTION 3: Continuous advanced capture services & access to digital twin

3.4.1. Description

This option proposes to capture the data required for 100% of the bushfire season preparation activities internally using an expanded fleet of sensors, drones and vehicle mounted LiDAR and camera equipment.

An annual cycle of LiDAR data collection will be used to capture data across the non-bushfire prone areas to support all possible benefit realisation across the entire overhead network.

As described in option 1, in 2019-24 period Ausgrid's existing Network Digitisation program will establish the ability to run automatic LiDAR data classification and reporting on captured LiDAR data. This process is continually improving; however, the quality level has not reached what can be achieved through manual classification. In this option, until this is proven to be equal or surpassing manual techniques Ausgrid proposes to carry out manual classification and quality assurance internally. This will build experience and capability while providing valuable feedback to refine the internal capture techniques.

It is proposed to carry out full manual classification internally for data collected under this option covering the bushfire season preparation activities and network digitisation program.

To support the extended data acquisition activities described in this option there is a need to increase the extent of the sensors, drone fleet and equipment used for collecting the data internally. Details of the fleet and equipment requirements are identified as;

- 2 large scale Uncrewed Aerial Vehicle (UAV) with LiDAR sensor and high-definition optical camera,
- 10 medium scale UAV's with LiDAR sensors and integrated optical cameras,
- 40 small scale UAV's with integrated optical cameras, and
- 2 Mobile LiDAR Scanner (MLS) vehicle mounted LiDAR units with 4 digital high-definition optical cameras and 3D panoramic Ladybug 5+ 360-degree camera.

The scope of the Asset Digital Twin under option 3 is the same as option 2, however there is an increased resource and IT requirement to manage the volume of data being collected under this option.

3.4.2. Option 3 Assumptions

Option 3 builds on from Option 2 and has been estimated with the following additional assumptions:

- A greater increase in frequency and breadth of LiDAR capture of vegetated spans and Digital Twin analytics provides for earlier detection of vegetation encroachment which facilitates early rectification to provide a reduction of a greater number of unplanned outages,
- The increase in scope of LiDAR capture also increases the management, administration, logistics and coordination costs.

Appendix C provides a detailed list of the assumptions.

The costs of this option have been estimated based on initial estimates of each project and based on historical expenditure for similar equipment and associated labour and contracted services.

Capital Cost and Scope Assumptions

$ million	FY25	FY26	FY27	FY28	FY29	Total
CAPEX	**$4.60m**	**$5.68m**	**$5.70m**	**$4.61m**	**$5.84m**	**$26.44m**

Note numbers may not add due to rounding of annual contributions

Operating Cost Assumptions

$ million	FY25	FY26	FY27	FY28	FY29	Total
OPEX	**$2.32m**	**$2.35m**	**$2.36m**	**$2.37m**	**$2.43m**	**$11.82m**

Note numbers may not add due to rounding of annual contributions

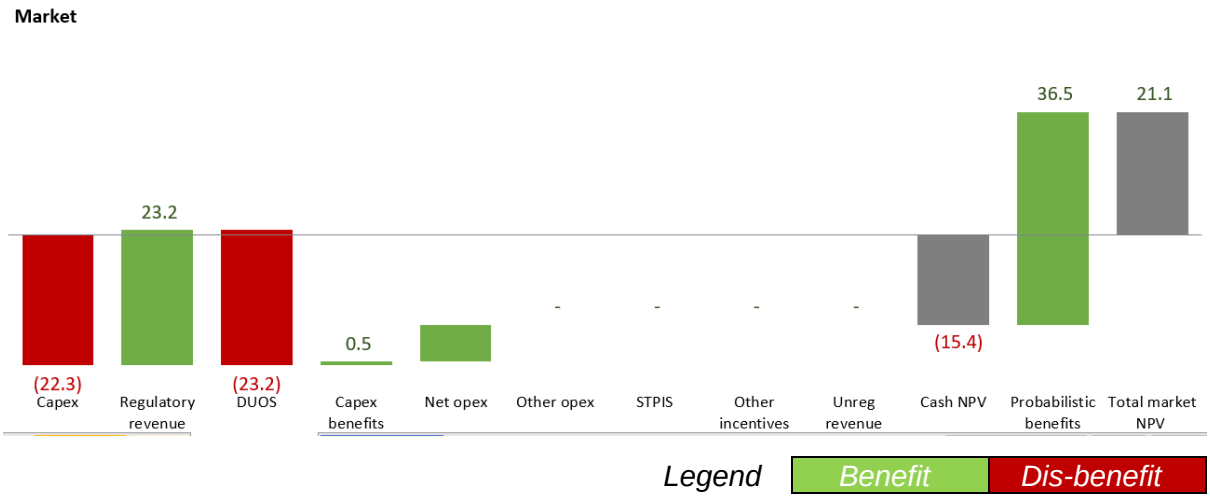
3.4.3. NPV analysis

The NPV analysis considered benefits across a broad value framework considering:

- Probabilistic network risk benefits across aircraft accidents and community exposure to wires down events,
- Avoided outages on the network caused by network encroachments,
- OPEX reduction through internal delivery with advanced collection platforms and shared resource utilisation,
- Market benefits from customer unserved energy triggered by major weather events, and
- Automation through data integration and access.

These benefits were applied based on expected risk reductions from development and deployment of the various projects within this program option.

Market NPV of option ($' millions, real FY22)



Probabilistic benefits were the primary driver for the positive NPV outcomes; however, the scale of benefits is not directly proportional to the investment and therefore is less favourable than Option 2. The opex and administrative support for this option is a significant driver of the NPV outcome.

4. RECOMMENDATION

4.1. Recommended solution

Recommended Solution

- Option 2 is the recommended Network Digitisation program as it presents the highest net benefits while presenting only a limited delivery risk. It achieves the objectives of the overall program which is aligned with industry and evolving technology to drive efficiencies and value for customers and stakeholders.

4.2. Alignment to strategy

The recommended option is included in Ausgrid's business plan and aligns to the current Corporate, Network, Asset Management and ICT strategies. It also meets the NER expenditure objectives, criteria and factors relating to prudency and efficiency of expenditure.

4.3. Program delivery risks

The key risks of the program relate to delivery risk and ongoing management of new technology. 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.

Risk #	Risk Category	Description	Inherent Risk Level	Mitigation Plan	Residual Risk level
01	Key Resources	Key resources not available to assist in design of future state or in testing the end product.	Medium	Plan and ensure that resources are available or that resources are backfilled.	**Low**
02	New Technology	If new technology is being introduced, the skillset might not be there to sufficiently support it after the program of work has completed.	Medium	Plan and ensure that skillset is developed to ensure that technology can be supported in the future.	**Low**
03	Scope Expansion	Expectation that the scope might include features that were not originally planned for might extend the timeline of the project.	Medium	Set scope expectations early on and define boundaries. If additional requirements arise, scope will be discussed through the appropriate investment governance mechanism.	**Low**
04	Costs	Project Costs are estimated based upon market knowledge in FY22 and costs could increase as the projects are executed in FY25-29.	Medium	Undertake Gate 3 Business Cases prior to executing each project within the program and revise costs with costs at the time of execution.	**Low**

Risk #	Risk Category	Description	Inherent Risk Level	Mitigation Plan	Residual Risk level
05	Key Resources	Availability of SME resources within local market - After effects of the COVID19 pandemic have caused a skill shortage locally and specialist resources may not be readily available.	Medium	Define resource requirements early and leverage existing relationships with strategic partners where the required skills cannot be found internally within the organisation.	**Low**
06	Licenses	Ongoing BVLOS approvals with CASA	Medium	Early engagement with CASA to amend Ausgrid's existing flight Operations Manual, compliance requirements and approvals.	**Low**

4.4. Program assumptions

The key assumption is that activities and expenditure will remain dynamic and be targeted at the highest benefit to customers and stakeholders throughout the FY25-29 period.

#	Type	Description
01	**Resourcing**	Appropriate resources will be sourced and available to deliver the selected activities. Specialist resources will also be identified to continue to deliver the advanced elements of the Network Digitisation program, such as the design and digital twin management.
02	**Priority**	Moderate to High
03	**Scope**	Project activities will continue to be evaluated and reprioritised based on at a least an annual planning cycle to achieve the greatest risk reduction from investment in each element of the program as part of the overall delivery.

4.5. Program dependencies

Several aspects of the Network Digitisation Program require modern integrations to core Ausgrid IT 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.

4.6. Business area impacts

The range of activities and program elements within the Network Digitisation Program are likely to have impacts in most business technology and data management areas. These areas will require additional resources to supplement existing capability to enable successful delivery.

Common to all options is the need for resources to undertake data architecture, engineering and systems design, development and data management. Key partners will be required to support the delivery. Early engagement with procurement groups and partners will be key to minimising overall program impact.

APPENDIX A: NSW Bushfire Inquiry Report 31 June 2022 – Recommendation 18

https://www.dpc.nsw.gov.au/assets/dpc-nsw-gov-au/publications/NSW-Bushfire-Inquiry-1630/Final-Report-of-the-NSW-Bushfire-Inquiry.pdf

Recommendation 18

That, in order to equip NSW RFS with comprehensive information on all structures and assets at risk of bush fire, Government ensures that:

- there is a single whole-of-government procurement and acquisition program for imagery and LiDAR and that Government accelerate the building of the State Digital Twin and associated Digital Workbench
- owners/managers of assets (apart from private homeowners whose information will be provided through local councils) in bush fire prone land are required to provide to the Digital Twin at least the following information/metadata with quality control certification on an annual basis (with annual census at least two months before the start of the fire season):
    - precise geolocation
    - description of asset including picture
    - value level
    - fire treatment on asset
    - Asset Protection Zone (APZ) details and how it is maintained
    - access details
    - what redundancy is available if relevant
    - any metadata requirements specific to the asset class
    - emergency contact and instructions on how to access where more information is held
    - any restrictions on data access and sharing.
- The Digital Twin must also be able to incorporate:
    - information about the hazard reduction results for road verges, fire trails, APZs and other defendable space
    - local information supplied by organisations such as local NSW RFS brigades

APPENDIX B: 2022 Flood Inquiry Volume One: Summary Report 29 July 2022 – Recommendation 28

https://www.nsw.gov.au/sites/default/files/noindex/2022-08/VOLUME_ONE_Summary.pdf

28. Recommendation – essential services and floodplain infrastructure

That, to minimise disruption to essential services (power, communications, water, sewerage) and to ensure flood infrastructure is fully serviceable before flooding, Government ensure:

- essential services infrastructure (communications, water, power and sewerage) is situated as much as possible above the flood planning level. And to minimise disruption to medical services, aged care services and the police, Government ensure hospitals, medical centres, nursing homes, aged care facilities and police stations are situated above the probable maximum flood level
- floodplain infrastructure (drains, levees, flood gates) items are all assigned to an appropriate lead agency which has responsibility for ensuring they are fully maintained and functioning especially when floods are likely.

https://www.nsw.gov.au/sites/default/files/noindex/2022-08/NSW_Government_Reponse.pdf

Government Response:

Supported in principle – further work required on implementation The NSW Government will ensure future essential services infrastructure development occurs above the flood planning level, where appropriate. Consideration will be given to how to encourage private sector essential infrastructure developers to take the same approach.

APPENDIX C: Assumptions of Investment Options

Option 1: Maintain existing drone & advanced capture services assumptions

Option 1 has been estimated based on the following assumptions:

1. Complements but does not include all existing labour associated with the bushfire program,
2. Capital costs of sensors, UAV/drones is for both the bushfire season preparation activities and the network digitisation program,
3. Where the bushfire season preparation activities capture new asset details not previous captured, the cost is capitalised,
4. Unit costs provided to Ausgrid in 2022 bushfire tender responses for data capture and processing will remain the same,
5. Existing efficiencies delivered using UAVs/drones will be maintained,
6. Using the vehicle-based LiDAR unit (MLS) and UAVs/drones instead of flights reduces the consequence of multiple fatalities (2) in a 1 in 50-year event at approximately $5m each,
7. Continue 100% manual in person bushfire inspections on service mains & private mains.

Option 2: Targeted advanced capture services & access to Digital Twin assumptions

Option 2 has been estimated based on the following assumptions:

1. Items 1-6 as per Option 1
7. Bushfire inspections carried out annually on service mains & private mains will be transitioned from 100% manual in person inspection to the same methodology as network inspections, using LiDAR.
8. Vegetated spans with the potential to impact on the network is consistent between bushfire and non-bushfire prone areas. 5% of spans historically surveyed have a close encroachment (A1 or A2 class on high voltage). Assuming 5% of these lead to an outage. In this option, with the network data acquisition coverage identifies 43 potential avoided events.
9. Vegetation related outage response time on Urban feeders is 2 hours and have an average of 600 customers per outage.
10. Number of events avoided on Rural feeders assumed to be less than half of Urban feeders. 20 avoided events.
11. Rural feeders have an average response time of 12 hours and an average of 50 customers per outage.
12. ASP design saving based on $2,000 per design with 2% benefit with Digital Twin access and automated certification
13. Safety in design reducing the number of high potential incidents from low mains (network and service mains). 30,000 replacements annually with a conservative estimate of identifying 1% through this program avoids 300 potential wires down per year, where 1 in 3 results in a high potential incident. Safety benefits calculated on 100 high potential incidents avoided.
14. Safety in design reducing the number of high potential incidents from condemned pole failures. Based on approximately 3,000 condemned poles and a conservative estimate of identifying 1% through this program avoids 30 wires down per year, where 1 in 3 results in a high potential incident. Safety benefits calculated on 10 high potential incidents avoided.
15. Investment in the Asset Digital Twin will also address recommendation 18 from the NSW Bushfire Inquiry report. This approach complements but does not include all labour associated with the bushfire program.
16. Investment in the Digital Twin will allow for identification of impacted areas and work towards addressing recommendation 28 from the NSW 2022 Flood Inquiry report

Option 3: Advanced capture services annually & access to digital twin assumptions

1. Items 1-6 as per Option 1
7. Item 7, 9, 11-16 as per Option 2
8. Vegetated spans with the potential to impact on the network is consistent between bushfire and non-bushfire prone areas. 5% of spans historically surveyed have a close encroachment (A1 or A2 class on high voltage). Assuming 5% of these lead to an outage. It is reasonable to assume that the increase of data collected by a factor of 3 under this option compared to option 2, is not directly proportional to the increase in number of potential events avoided to 129. Therefore, a more conservative multiplication factor has been applied of 1.2 resulting in an increase of 12 to 52 events avoided.
9. Number of events avoided on Rural feeders assumed to be less than half of Urban feeders. 20 avoided events. There has been no increase in number of events applied to Rural feeders due to the increased capture areas applies to non-bushfire prone areas where Urban and CBD feeder classifications dominate.
17. The increase in scope also proportionally increases the management, administration, logistics and coordination costs