# Data opportunities for smarter networks

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# Authors

ENEA Consulting is a strategy consultancy that maximises energy transition opportunities for public and private organisations globally. Through dedicated consulting services and pro bono support to NGOs and social entrepreneurs, ENEA is also committed to improving energy access, especially in developing countries.


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The views expressed herein are those of Energy Network Australia's members, collected through the stakeholder consultation process and do not necessarily reflect the views of ENEA Consulting.

# Executive summary

## Digitalisation and the future of electricity

Data is a key enabler of the digital transformation of businesses, and digitalisation is revolutionising multiple sectors of the economy. This includes the energy sector.

*Image: Ausgrid*

In this sector, network service providers (NSPs) — who are responsible for planning, building, operating and maintaining electricity networks – are becoming increasingly data-driven. This digitalisation is shaping network management to improve services and support the decarbonisation and decentralisation of the power system, in line with consumer expectations.

This project aimed to collect, identify and harmonise views on priority areas for data applications in the management of electricity networks.

### Data can help NSPs improve network management

Data improves the efficiency of network management and operations for a more affordable, reliable and safe electricity supply.

Technological improvements and declining costs are increasing the volume and availability of data to optimise electricity network management and real-time operations.

Technologies that capture new network information – like remote sensors – can provide NSPs with more accurate views of what is happening on their networks. Also, advancements in information communication technologies (ICT) mean NSPs can communicate and process data faster. Finally, cloud services and lower data storage costs facilitate the retention of large volumes of data. NSPs can then use this data to replace paper-based or manual processes normally prone to human error.

## Data can help NSPs meet the challenges of the energy transition

The decarbonisation and decentralisation of Australia's electricity sector involves the integration of large-scale renewable energy sources and distributed energy resources (DER). As the sector works through this transition, it faces various challenges. These include challenges for managing electricity networks at both the level of transmitting the energy, as well as at the level of distributing that energy to customers.

Some of the key transmission and distribution challenges – and how NSPs can use data to mitigate them – are briefly outlined below.

Effectively leveraging data can help NSPs work through these challenges and ultimately provide benefit to customers through the delivery of more sustainable, affordable, reliable and safe electricity.

### Transmission challenges

At the transmission level, traditional synchronous generators — including coal, gas and hydro generators — help stabilise the power system during unexpected faults or disturbances. However, the integration of large-scale intermittent renewable energy sources (large-scale wind and solar) means an increase in the use of non-synchronous power generation. This presents new challenges for managing power system security and reliability.

To meet such challenges, transmission NSPs (TNSPs) can use data to determine the true impact on the grid of this increasing share of non-synchronous generation. This can help them find ways of mitigating this impact and reducing the constraints currently placed on intermittent renewables.

### Distribution challenges

At the distribution level, the power system has historically been designed to deliver electricity from centralised generators to customers.

Now, with the rise of the energy prosumer (a customer who both consumes and generates electricity), there is an increase in the deployment of DER such as rooftop solar PV units. These generate electricity from the customer's side of the meter and create two-way energy flows that can cause local network challenges. These include power quality disturbances. Also, they sit on the low-voltage (LV) part of the network, a part DNSPs have not typically had to monitor.

Managing and rectifying the voltage variations now caused on this part of the network – and other challenges of adapting a traditionally one-way grid to manage more two-way power flow – is a growing challenge. DNSPs are increasingly relying on data to manage it.

### Emerging business models

To leverage data for network management, new business models and frameworks are also emerging, and these involve multiple energy market players.

A prominent example is the transition of DNSPs to a distribution system operator (DSO) model. A DSO uses real-time data to dynamically manage a network's assets and distributed systems (such as rooftop solar PV), to support their optimal use. This in turn can further support the delivery of affordable, reliable and safe electricity that is also low carbon.

> **Effectively leveraging data can help NSPs work through these challenges and ultimately provide benefit to customers through the delivery of more sustainable, affordable, reliable and safe electricity.**

*Image: Energy Queensland*

## This Energy Networks Australia project

In light of these challenges across the energy sector, data is becoming increasingly important in network management. NSPs, however, are at different stages of their digital transformations.

As such, this project was conceived by Energy Networks Australia to bring together a collective understanding on the current and future landscape of those transformations.

### Purpose and objectives

The project's main purpose is to identify the priority applications of data – both now and in the short to medium term – as well as their main benefits and challenges. Accordingly, there are three key objectives:

1. Identify data use cases common across NSPs, as well as their associated network and customer benefits
2. Outline key gaps and challenges to the development of these use cases
3. Provide recommendations to NSPs and the wider energy industry for facilitating data-driven networks.

This report is structured around these three main areas. Note that a use case is an application of data and analytics to improve business performance.

### ENEA Consulting's role in the project

ENEA Consulting was engaged by Energy Networks Australia to collect, harmonise and report current industry views on embedding data in electricity network management.

To inform the report's key findings, extensive stakeholder consultation with the electricity network industry was undertaken. Overall, 28 interviews were conducted with 44 stakeholders from 22 organisations, including TNSPs, DNSPs and third-party technology, data and service providers. This approach allowed for a range of viewpoints to be captured across a diverse and representative sample of the industry.

## Key findings

### Common data use cases and key benefits

Through the stakeholder consultation process, 22 data use cases were identified that can support the main business functions of NSPs, including network maintenance, operation, planning and regulation. These use cases allow for numerous benefits for NSPs and their customers.

Firstly, using data for more efficient network management allows NSPs to reduce capital and operational expenditure while maintaining a safe and reliable network. This then allows for affordability, reliability and safety benefits for customers.

Cost reductions can be passed onto customers through lower electricity prices, and customers also benefit from improved reliability and safety. Such benefits include reduced outage times and reduced shock risk.

Also, the data use cases that focus on DER integration can enable customers to maximise their investment in DER. For example, maximising rooftop solar electricity exports reduces the payback time for customers for such an investment. In addition, leveraging data to further integrate DER can have a positive societal benefit by reducing greenhouse gas emissions from electricity generation.

## Differences in the maturity of data use case development and implementation

NSP stakeholders conveyed differences in the maturity of data use case development and implementation. Factors that led to differences in the maturity of data uses include:

### 1. Smart meter deployment

Victoria is further advanced than other Australian jurisdictions in implementing use cases that require smart meter data. Victorian DNSPs have close to 100% network coverage of smart meters. Smart meter deployment is significantly lower in other jurisdictions, including where their deployment is subject to the Power of Choice (PoC) reforms. Under PoC, the rollout of smart meters is reliant on customers, retailers and metering coordinators.

### 2. DER penetration

Network locations with high penetration of DER are already experiencing capacity constraints. This means that DER-related use cases are more pressing for DNSPs in those areas. For example in South Australia, SA Power Networks is developing capabilities to perform LV network modelling and dynamic voltage control. Moving forward, more DNSPs are looking to implement data use cases that target the integration of DER. This can enable customers to gain greater value from their systems. For example, it can allow greater exports of rooftop solar generation.

### 3. NSP network arrangement

Whether an NSP is managing an urban or rural network may influence the use cases implemented or under development. For example, bushfire risk is a more pressing issue for NSPs located in bushfire-prone regional areas. Networks in rural or remote areas with higher crew dispatch costs may benefit more from use cases that target remote fault identification and optimising crew dispatch in response to faults.

### 4. NSP size

NSPs with a smaller customer base may be less able to implement use cases due to significant fixed up-front costs related to ICT expenditure.

### 5. TNSP or DNSP

DNSPs have limited visibility of what is occurring on the LV networks and tend to focus on use cases aimed at improving LV network visibility (such as power quality monitoring). On the other hand, TNSPs have good visibility of their entire networks. As such, they tend to focus on the improvement of core business activities, such as asset management use cases.

## Key gaps and challenges of common cases

Stakeholders identified various common gaps and challenges in implementing data use cases. These fall into the following five categories:

### 1. Data quality, consistency and integration

Data quality issues may arise due to the use of manual or paper-based processes, which can be subject to human error and time lag. Reliance on third-party data can also cause data quality issues because NSPs do not have direct control over third parties' data quality processes. In addition, third parties may provide data in an inconsistent format, which has implications for data integration systems. Finally, delays in data collection and processing can make it difficult to implement use cases that require real-time information.

### 2. LV network visibility, particularly where there is a low penetration of smart meters

DNSPs have limited visibility of the LV networks downstream of zone substations. Load and voltage data gaps are particularly prevalent in PoC jurisdictions, where smart meters' minimum services do not extend to power quality monitoring or real-time applications. In addition, smart meters may not always be located in areas where DNSPs can maximise the use of data (such as where constraints are occurring). Also, the cost of procuring smart meter data can prevent implementation of use cases at-scale.

### 3. Culture and organisational change

Business functions have to adapt their legacy processes to new technologies, systems and processes to fully benefit from data. Besides, it can be challenging to position the data analytics function within NSPs' organisations. Indeed, data use cases can involve numerous business units within an NSP, at the intersection of business and IT.

#### 4. Cybersecurity

NSPs are becoming increasingly exposed to cybersecurity threats. Historically, NSPs have relied on internal security capability systems to manage the security risks of electricity networks. As collaboration with third-party systems increase, new capabilities to manage cybersecurity threats are increasingly required.

#### 5. Developing business cases for ICT expenditure

Implementing new use cases will require expenditure in ICT to support new functionalities and capabilities. Developing businesses cases for ICT expenditure can be challenging if assessing use cases individually, so multiple benefits from different use cases may be required to justify ICT expenditure.

The Australian Energy Regulator's (AER) non-network ICT capital expenditure (CAPEX) assessment approach represents a positive first step in providing a consistent framework for ICT expenditure business cases. However, this study's interviewees raised concerns about the treatment of non-recurrent expenditure and the use of trend analysis and benchmarking to assess recurrent expenditure. They also raised concerns about potential double-counting of productivity improvements.

> **NSPs are becoming increasingly exposed to cybersecurity threats... As collaborations with third-party systems increase, new capabilities to manage cybersecurity threats are increasingly required.**

## Recommendations

Seven recommendations have been made, which were informed by the views of stakeholders. These include three recommendations for NSPs, three recommendations for energy governance bodies and governments and one recommendation for the wider energy industry.

### Recommendations for network service providers (NSPs)

#### 1. Build stronger internal capabilities to support digital transformation

NSPs' digital transformations will require new or more robust internal capabilities and tools to further embed the use of data in network management.

For example, stronger data analytics skills will be necessary to complement core business skills, develop data uses and maximise their benefits. Also, new digital platforms (for example, network analytics) that can integrate data from multiple and diverse sources and cater for increasing volumes of real-time data will be required.

Improving capabilities to manage cybersecurity will also be important given the increasing volume of data being exchanged between multiple parties and interfaces.

#### 2. Foster cultural change and intra-NSP collaboration

In addition to stronger internal capabilities, NSPs' digital transformations may also require a shift in organisational culture to adapt legacy processes to new technologies, systems and processes.

IT departments may need to transition part of their approach from traditional waterfall models to agile and iterative processes that are more suitable to the exploratory nature of some data-driven approaches. Also, internal collaboration between NSPs' business units can help them identify synergies between data use cases and further refine their digitalisation roadmap.

#### 3. Revisit business cases for data applications

As ICT solutions progress over time, NSPs may consider revisiting the cost-benefit analysis of technology-driven data use cases, for instance, every regulatory period.

Cost can be a barrier to the development and implementation of new use cases. However, rapid technological advancements and declining ICT costs can mean use cases not currently comparing well may have a positive net-benefit in the near future.

## Recommendations for energy governance bodies and governments

### 4. Assess the merits of increasing smart meter requirements during the next Power of Choice (PoC) review

The Australian Energy Market Commission may consider undertaking a cost-benefit analysis to assess the merits of setting a revised minimum standard of smart meter data available to DNSPs. The analysis could also look at increasing the minimum services required by smart meters and increasing the pace of smart meter rollout.

This is particularly relevant given smart meter data is becoming increasingly important for managing LV networks as DER penetration increases.

### 5. Consider developing cybersecurity guidelines in close consultation with NSPs

The Australian Government's Australia's Cyber Security Strategy 2020 outlines several initiatives to strengthen the management of cybersecurity risks by businesses that own and operate critical infrastructure assets.

The Government has indicated a preference for using existing standards and frameworks, such as building upon the Australian Energy Sector Cyber Security Framework (AESCSF). As part of this, the Australian Government and regulators may consider developing nationally consistent cybersecurity guidelines that reflect specific risks faced by electricity networks. This would benefit from close consultation with NSPs throughout the development process.

### 6. Consider undertaking further consultation on the non-network ICT CAPEX assessment approach

The AER may consider undertaking additional consultation to ensure the assessment approach is widely understood, considers concerns raised by DNSPs, and evolves with the industry and needs of customers.

Stakeholders raised several concerns with the AER's new assessment approach to ICT expenditure. These concerns included treatment of non-recurrent expenditure, the use of trend analysis and benchmarking to assess recurrent expenditure, and potential double-counting of productivity improvements.

## Recommendation for the wider energy industry

### 7. Accelerate the development and implementation of data use cases through knowledge sharing

Knowledge sharing between NSPs, technology developers, universities, governments and peak bodies can help maximise the use of data to drive benefits for both networks and customers.

#### Knowledge sharing between NSPs

Collaboration opportunities between NSPs have been initiated by Energy Networks Australia. Different NSPs, however, are at different stages of developing and implementing new data use cases. As such, sharing insights and experiences on what worked and what did not will help progress best practice.

#### Knowledge sharing across the energy industry

Further, expanding collaboration across the energy industry is particularly important for use cases designed to solve emerging issues or based on new business models (such as DER coordination). Also, industry collaboration can support the development of technical standards to ensure that data is being provided in a consistent and appropriate format.

# Contents



# 1 Study overview

## Digitalisation of the energy sector

The use of data is an integral component and key enabler of the digital transformation of organisations. In the energy sector, digitalisation is improving the efficiency of managing the electricity network environment. As well as allowing efficiency gains, data can be leveraged to address the challenges of transitioning to a low-carbon, decentralised power system.

### This project and report

Within this digitalisation context – and based on broad consultation with stakeholders across the sector – this project aims to identify priority data applications. It also aims to identify their benefits and implementation challenges.

### This chapter

To provide context for the report findings, this chapter covers some pertinent aspects of the current sector climate – including existing data concepts, initiatives and regulations. Specifically, it covers:

- The digitalisation and decentralisation of electricity networks (Section 1.1), including ongoing initiatives (Section 1.2) and relevant regulations (Section 1.3)
- The objectives of this project (Section 1.4) and the stakeholder engagement approach (Section 1.5).

# 1.1 Digitalisation is a key enabler of future electricity networks

Globally, digitalisation and automation are transforming entire sectors of the economy, including energy. In the energy sector, network service providers (NSPs[1]) are responsible for planning, building, operating and maintaining electricity networks. Technological improvements and declining costs are causing their network environments to become more data-driven. This presents opportunities to improve electricity network management as well as support the energy transition to a cleaner, decentralised power system.

## 1.1.1 Data for improved electricity network management

**The increasing availability of data is creating unique opportunities to improve network services and ensure a more affordable, reliable and safe electricity supply.**

NSPs are digitising historically paper-based processes such as customer connections. Also, new types of data are available through new technologies, which can provide a more accurate view of what is occurring on the networks. Examples of new technologies that capture new network information include Light Detection and Ranging (LiDAR), smart meters and smart inverters.

There have also been technological advancements in the systems required to communicate, process and store information. Telecommunications advancements – such as 4G, 5G, and Internet of Things protocols like mesh networks, Sigfox [1] and LoRaWAN [2] – enable more data to be communicated at higher speeds and lower cost. Also, high-performance computing and cloud computing services enable increasing amounts of data (that may also be communicated at higher frequencies) to be processed. Finally, the declining cost of data storage and the emergence of cloud services facilitate the retention of large volumes of data.

**NSPs can leverage the increasing volume and availability of data to optimise the way they manage their electricity networks.**

By replacing historically paper-based and manual processes prone to human error, for example, data can be used by NSPs to provide a more accurate view of their electricity networks. It can also enable real-time operation to improve network services.

Data-driven networks can improve customer outcomes through the delivery of affordable, reliable and safe electricity, and support the integration of intermittent renewables and distributed energy resources (DER).

## 1.1.2 Data for the energy transition

**New data uses will improve the ability of network businesses to meet the challenges of decarbonising and decentralising Australia's electricity sector.**

There is an increasing penetration of large-scale intermittent renewables (utility-scale wind and solar) and DER (rooftop solar, residential batteries and electric vehicles). This is creating new challenges for managing electricity networks at both the transmission and distribution levels.

### Increasing renewable energy and DER penetration across Australia

In 2019, renewable energy's contribution to Australia's total electricity generation was 24 per cent. In some states, such as South Australia, this figure is significantly higher than the national average, with renewables penetration at 52 per cent [3]. Over 21 per cent of Australian households have rooftop solar installed (almost 2.5 million installations as of June 2020) [4]. Also, the Australian Energy Market Operator (AEMO) forecasts that rooftop solar capacity could increase from 11 GW in 2021 to 24 GW in 2042 under its central scenario [5].

### Meeting the challenges of secure system operation

Australia's transition to a low carbon energy system comes with challenges for maintaining the secure operation of the power system. To be secure, the current power system requires both adequate system strength and inertia, which are typically provided by synchronous generators (such as coal, gas and hydro generators)[2]. Low system strength due to declining synchronous generation in certain areas results in difficulty managing power system voltage levels, electricity supply interruptions and protections systems not operating correctly.

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[1] There are two types of NSPs – transmission network service providers (TNSPs) and distribution network service providers (DNSPs). TNSPs manage the high voltage networks that transport electricity from centralised power stations to major demand centres. DNSPs manage the distribution networks, which transport electricity from the transmission networks to end-use customers at lower voltages.

[2] System strength refers to the power system's ability to maintain stable voltage levels during unexpected faults or disturbances. Areas of the power system that are not located near synchronous generators (such as coal, gas and hydro generators), or which have a high penetration of inverter-based generators (such as wind and solar), may have low system strength.

TNSPs, large-scale generators and AEMO all have a role to play in ensuring there is adequate system strength. For TNSPs, data can help manage system strength. A good example is the power quality information – particularly harmonics – that can be taken from synchronous machines such as pumps or generators. This can help TNSPs determine their contribution to system strength and ability to reduce constraints placed on intermittent renewables.

**How 'prosumers' are influencing network management, particularly on LV networks**

At the distribution level, there are limited network sensors between the zone substation and consumer connection points.[3] Until now, DNSPs have not had to monitor the LV networks because customer load was more predictable, and most supply issues occurred upstream, from large-scale generators.

However, the rise of energy prosumers (customers that both consume and generate electricity) and DER deployment is transforming the way distribution networks are managed. What was once the delivery of one-way energy flows from centralised generation to end-use customers is now a platform for bi-directional energy flows on the high and low voltage portions of the distribution networks. Also, as DER penetration increases, some sections of electricity networks are experiencing power quality issues (higher dynamic range of both low and high voltage levels).

Addressing the challenges of reverse power flows and power quality issues requires improved visibility of the LV networks. Leveraging data to improve network visibility will enable DNSPs to improve their ability to host increasing DER installations while maintaining safety and reliability.

**New business models**

Increasing decentralisation will require DNSPs to manage their networks more actively. New business models and frameworks are emerging to support flexible electricity networks. A prominent example is the Distribution System Operator (DSO) model.

A DSO uses two-way asset communication, facilitated by real-time data, to dynamically manage electricity networks and non-network assets. This supports the optimal use of DER and provides broader energy services and benefits to all customers.

## 1.2 Ongoing initiatives

**There are a number of collaborations underway within the context of data-driven networks, with a large share focused on the integration of DER.**

This project is complementary to other work already being undertaken by Australia's energy industry and governments to progress data use cases and address the challenges of decentralisation and decarbonisation. Most industry collaboration has focused so far on the integration of DER to improve customer outcomes and support the clean energy transition.

For instance, the Centre for New Energy Technologies (C4NET) delivers data-driven projects focused on data access and analytics to support DER uptake, reduce energy costs and inform evidence-based policy [6]. C4NET's members include start-ups, market operators, networks, regulators and policymakers.

There is also the Reliable Affordable Clean Energy for 2030 Cooperative Research Centre (RACE for 2030 CRC). The centre is an industry-led research effort to increase energy productivity and integrate DER to deliver better value for energy consumers. Research relevant to networks covers themes such as integration of electric vehicles, improving LV network visibility and optimising DER hosting capacity. Also covered are themes like local DER network solutions (such as microgrids and community batteries) and DSO roles [7].

Regarding DSO roles, specific projects have focused on the future capabilities required by NSPs to optimise the use of data to achieve network and customer outcomes. For example, the transitioning role of DNSPs will require real-time data to be collected and communicated for the coordination of DER.

Also, the joint AEMO and Energy Networks Australia Open Energy Networks (OpEN) project considers the transition of DNSPs to DSOs. In particular, the Interim Report *Required Capabilities and Recommended Actions* outlined that DNSPs will need to define network constraints or 'operating envelopes'. This is so that customers' DER operate within the physical constraints of the networks [8].

[3] DNSPs have limited visibility of their distribution networks below the zone substation. Visibility over higher levels of their distribution networks is obtained through their Supervisory Control and Data Acquisition (SCADA) systems. However, there is limited direct monitoring of loads and voltages on distribution transformers and LV networks, although some ad-hoc monitoring does occur. There is little information available at the customer level, such as loads and voltages and DER generation output (except in Victoria where smart meters are owned and controlled by DNSPs).

## 1.3 Relevant regulations

**Several regulatory reforms have been completed in Australia to empower customers and foster the utilisation of data in the power sector.**

Several regulation and rule changes driving the deployment of data collection technologies have been completed in recent years, and new frameworks are also emerging.

One prominent example is the use of metering technologies. In Victoria, the rollout of smart meters was mandated by the Victorian Government in 2006 and coordinated by Victorian DNSPs. More recently, in 2019, the Western Australian Government announced a state-wide smart meter rollout. This was part of its routine meter replacement as well as for new installations. Also as of 2019, the Northern Territory is in the process of rolling out smart meters on a new connection and replacement basis [9].

By comparison, the Australian Energy Market Commission (AEMC) developed the Power of Choice (PoC) reform. This came into effect in December 2017 and applies to Queensland, New South Wales, the Australian Capital Territory, Tasmania and South Australia. This reform aimed to develop competition through a market-led rollout of smart meters and associated services to improve consumer outcomes. Under PoC, retailers are responsible for deploying smart meters through the services of metering coordinators. DNSPs must then commercially negotiate with metering coordinators for access to smart meter data (for services other than billing) [10]. Following three years of application, a review of the PoC will commence late 2020.

More recently, regulations have focused on how consumer data is accessed and shared. The purpose of the Consumer Data Right (CDR), anticipated to commence in the National Electricity Market (NEM) in 2021, is to provide consumers with greater access and control over their data. The CDR will enable consumers to access their energy consumption data so they can choose, compare and switch their energy retailer with greater ease. It is also designed to empower consumers to choose from a range of products and services, including investment in energy-efficient appliances and DER [11].

Frameworks to facilitate the cost-benefit analysis of data use cases have also emerged. As electricity networks become more data-driven, information communication technologies (ICT) will increasingly become an integral component in delivering network services. To guide DNSPs on developing business cases for data uses and other ICT expenditure, The Australian Energy Regulatory (AER) recently published its preferred approach for assessing capital investments in ICT [12].

## 1.4 Objectives of this project

In light of the disruption happening across the energy sector, data use will become increasingly important to enable the further integration of DER and intermittent renewables. It will also be important for maintaining, operating and planning electricity networks. As such, this project aims to identify the priority applications for data both now and in the near to medium term future. It also aims to identify the use cases' main benefits and their development and implementation requirements.

The project objectives include:

1. Identify data use cases common across NSPs, as well as their network and customer benefits
2. Outline key gaps and challenges to the development of these use cases
3. Provide recommendations for facilitating data-driven networks.

This project has focused on collecting and harmonising the views of stakeholders based on commonalities. It acknowledges that each NSP may be at different stages of development and implementation across the use cases identified, reflecting the different contexts across jurisdictions.

*Image: Ausgrid*

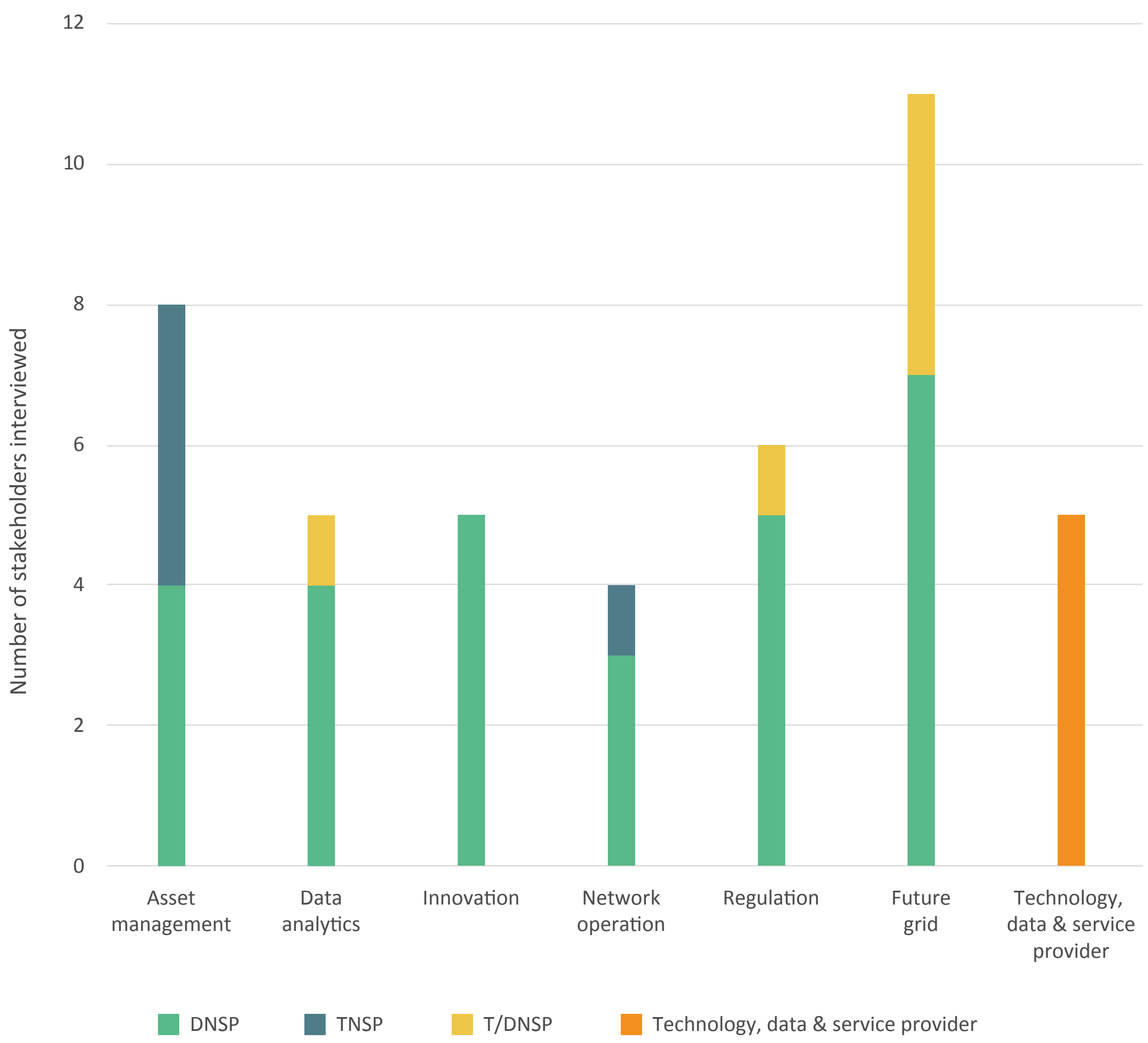
## 1.5 Stakeholder engagement approach

This study was made possible by insights from industry stakeholders, through an extensive consultation process. Stakeholder feedback was gathered through interviews, which included all of Energy Networks Australia's transmission and distribution network members and technology, data and service providers.

Given that all stakeholders will be using increasing volumes of data to deliver network services and improve customer outcomes, this approach allowed for a range of viewpoints to be captured.

Interviewed stakeholders were from a broad range of business units, including assessment management, data analytics, innovation, network operation, regulation and future grid. Overall, 28 interviews were conducted with 44 stakeholders from 22 organisations (see Figure 1). A list of participating stakeholders is in Appendix 1.

**FIGURE 1 — BREAKDOWN OF INTERVIEWED STAKEHOLDERS BY ROLE**



# 2 Current and future data use cases

Stakeholders identified 22 data use cases through the consultation process. While this is not an exhaustive list, these are the priority data use cases identified by stakeholders.

### This chapter discusses:

- The drivers and benefits of data use cases (Section 2.1)
- The maturity of these use cases across NSPs (Section 2.2).

While this project aims to cover DNSPs and TNSPs, most of the data use cases identified by stakeholders apply to DNSPs rather than TNSPs and leverage the use of smart meter data.

Image: Ausgrid

## 2.1 Drivers and benefits of data use cases

**Data use cases are driven by the improvement of NSPs' core business activities and further integration of intermittent renewables and DER to provide value across NSP customer bases.**

Firstly, NSPs can use data to support and improve their existing core business activities. These activities are broadly categorised under network maintenance, operation and planning. The use of data can allow for reduced capital and operational expenditure and translate to a more affordable, reliable and safe electricity supply for customers.

Secondly, NSPs can use data to better prepare for future disruption resulting from the energy transition. For example, they can use it to respond – in a cost-efficient manner – to new challenges related to the increasing penetration of intermittent renewables and DER. Such challenges could include power quality issues.

The 22 data use cases identified by stakeholders are described in the following sections. They have been grouped into four categories according to their main business function – network maintenance, network operation, network planning and regulation. (See Appendix 3 in this document for a more detailed description of the 10 use cases most cited by stakeholders.) Direct benefits for networks and customers are identified for each category. External benefits such as the reduction of greenhouse gas emissions are not considered.

Image: Ausgrid

### 2.1.1 Network maintenance

Use cases that fall under the network maintenance category (see Table 1 below) involve leveraging data to improve the inspection and monitoring of network asset conditions and ensure compliance. Data can be used to optimise network maintenance by identifying or predicting the deterioration of a network asset. Data can also be used to identify or predict non-compliances (for example, where vegetation encroaches on network assets) to optimise responses.

Benefits of network maintenance use cases include:

**Network:**

- Predicting asset deterioration or non-compliant assets enables NSPs to identify and respond to potential issues before they occur, reduce fault response time and increase asset lifespan
- The optimisation of network inspection and maintenance can reduce operational expenditure (for example, through lower inspection frequency)
- Network maintenance use cases can also reduce capital expenditure (for example, through the deferral of replacement expenditure).

**Customer:**

- Improving and optimising network maintenance can improve safety and reliability outcomes for customers
- A reduction in operational and capital expenditure translates to lower electricity prices.

**TABLE 1 – NETWORK MAINTENANCE USE CASES**

| Use case | Description | Main driver |
|---|---|---|
| **Advanced condition monitoring** | Monitoring and diagnosing asset conditions, allowing for improved and optimised inspection and maintenance strategies and contributing to increased network reliability. | MAIN DRIVER: Improvement of core business activities |
| **Risk-based maintenance optimisation** | Optimising asset maintenance and replacement strategies and improving network reliability based on condition monitoring and/or past performance data. | MAIN DRIVER: Improvement of core business activities |
| **Vegetation management using LiDAR** | Improved efficiency of vegetation management, including the use of modern technologies such as LiDAR and HD imagery. | MAIN DRIVER: Improvement of core business activities |
| **Bushfire risk management** | Assessing the network-related bushfire risk based on fault ignition likelihood and consequences. | MAIN DRIVER: Improvement of core business activities |
| **Neutral integrity monitoring** | Identifying or predicting neutral integrity failures to reduce customer shock risks. | MAIN DRIVER: Improvement of core business activities |

### 2.1.2 Network operation

Network operation use cases involve leveraging data to manage network availability and performance (see Table 2 below). Accessing real-time data can enable timely identification and response to faults, outages and performance issues.

Data can also enable better management of generation and demand and support the further integration of intermittent renewables and DER. This may be achieved through the identification and dynamic response to power quality issues and the coordination of DER to relieve local network constraints.

Benefits of network operation use cases include:

**Network:**

- Identifying outages and faults in real-time enables the optimisation and prioritisation of operational decisions and field crew resource allocation, which may lead to faster fault responses.
- Network operation use cases can reduce operational expenditure (for example, through reduced workforce effort on unplanned outages).
- Improved visibility of power quality information from generators and machines (such as pumps and motors) can help TNSPs determine their contribution to system strength. It can therefore potentially lower constraints placed on intermittent renewables.
- Demand response can also defer network augmentation expenditure.

**Customer:**

- Improving the identification of outages and faults enables customers to experience reduced unplanned outage time.
- Using data can improve planned outage times and DNSP communication with customers, by improving visibility of where customers are located on the network. This is particularly important for visibility of life support customers, which is a high priority for all DNSPs.
- Using data to manage DER integration can improve reliability and safety outcomes for customers while maximising their use of DER (such as PV exports).
- Reducing operational constraints and deferring network augmentation expenditure contributes to lower customer bills.

**TABLE 2 – NETWORK OPERATION USE CASES**

| Use case | Description | Main driver |
|---|---|---|
| **Outage management** | Identifying outages and providing real-time alerts to reduce outage time and improve overall energy reliability. | MAIN DRIVER: Improvement of core business activities |
| **Fault identification** | Identifying faults to enable faster maintenance responses and decrease the number of outages and fire starts. | MAIN DRIVER: Improvement of core business activities |
| **Demand response/management** | Reducing or shifting customer load with non-network solutions, which may lead to network augmentation deferrals. | MAIN DRIVER: Improvement of core business activities |

**TABLE 2 CONTINUED– NETWORK OPERATION USE CASES**

### Workforce optimisation

Optimising and prioritising field crew dispatch to improve logistics, enable quicker response times and target faults/outages more efficiently.

**MAIN DRIVER:** Improvement of core business activities

### Dynamic line rating assessment

Adjusting line ratings to reflect environmental conditions at a point in time (such as temperature) to maximise load or generation while maintaining safety and reliability.

**MAIN DRIVER:** Improvement of core business activities

### Operational load forecast

Forecasting assets' load or generation (in the case of large-scale renewable generation) for day ahead and intraday operational management.

**MAIN DRIVER:** Intermittent renewables/DER integration

### Power quality monitoring

Monitoring quality of supply to improve safety, reliability and visibility of system strength.

**MAIN DRIVER:** Intermittent renewables/DER integration

### Dynamic voltage control

Dynamically controlling voltage within the nominal range through smart meters and/or network sensors and actuators.

**MAIN DRIVER:** Intermittent renewables/DER integration

### DER coordination

Providing signals for the aggregated operation of DER to support local network conditions.

**MAIN DRIVER:** Intermittent renewables/DER integration

### System restart

Using real-time data to improve visibility of actual load on distribution networks (given embedded generation and DER) to reduce system restart challenges.

**MAIN DRIVER:** Intermittent renewables/DER integration

### 2.1.3 Network planning

Table 3 below shows the network planning use cases. These involve leveraging data to more accurately forecast future network operating conditions (e.g. long-term changes in load or generation) and coordinate these with network augmentation. These use cases can also improve new connection processes and support further DER integration.

Benefits of network planning use cases include:

**Network:**

- Optimising replacement strategies and augmentation projects can reduce capital expenditure by deferring or avoiding expenditure.
- Improving NSPs understanding of load composition (achieved through greater network visibility) can assist with power quality stability studies. This can help define transfer capability and technical operating envelopes with greater confidence.
- Improving or automating connection processes.

**Customer:**

- Reduced network expenditure can translate to lower electricity prices.
- Improving the connection process can result in improved customer experience (for example, faster rooftop PV installations).

**TABLE 3 – NETWORK PLANNING USE CASES**

| Use case | Main driver |
|---|---|
| **Long-term load forecasting**<br>Forecasting assets' load for network planning, managing new customer connections and future network configuration. | MAIN DRIVER: Improvement of core business activities |
| **New connections process improvement**<br>Improving or automating connection processes using historical behaviour and load data. | MAIN DRIVER: Improvement of core business activities |
| **LV network modelling**<br>Using AMI data to model LV network behaviour and aid in forecasting, connection approvals and DER integration. | MAIN DRIVER: Intermittent renewables/DER integration |
| **Long-term DER hosting capacity improvement**<br>Understanding the impact of DER to manage load and defer network augmentation investment. | MAIN DRIVER: Intermittent renewables/DER integration |
| **Phase identification**<br>Identifying phase connectivity between the customer and the electricity network to enable phase balancing and improve power quality, resulting in more optimised networks. | MAIN DRIVER: Intermittent renewables/DER integration |

### 2.1.4 Regulation

Use cases that fall under the regulation category (see Table 4 below) leverage data to meet the AER's requirements and could present opportunities for more cost-reflective pricing.

Benefits of regulation use cases include:

**Network:**

- Implementing more cost-reflective pricing can change customers' consumption behaviour and potentially defer the need for network augmentation.
- Providing clearer and easy-to-digest Regulatory Information Notices information can help NSPs benchmark their network performance.

**Customer:**

- Transparent and well-regulated networks lead to greater customer confidence.
- Greater cost-reflective pricing for different network activities can reduce electricity prices for all customers (through deferral of network augmentation or replacement activities).
- Altering one's own behaviour through price signalling can reduce one's average electricity bill (by encouraging electricity consumption when the lowest rate occurs).

**TABLE 4 — REGULATION USE CASES**

| Use case | Main driver |
| --- | --- |
| **Tariff structure**<br>Ensuring cost-reflective tariffs are set across the network for all customers. Flexible or dynamic tariffs for prosumers can provide signals that reflect the true cost of electricity supply. For example, price signals can encourage customers to consume electricity in the middle of the day to soak up PV generation. This can typically defer network augmentation required to support DER integration. | MAIN DRIVER: Improvement of core business activities |
| **Regulatory information notices**<br>Informing AER's determinations, monitoring outcomes against regulatory determinations and benchmarking network performance with data collected by the AER from NSPs. | MAIN DRIVER: Improvement of core business activities |

## 2.2 Maturity benchmark

The 22 use cases identified by stakeholders do not share the same level of maturity. This section details the implementation status of identified use cases and highlights the main causes of implementation differences across jurisdictions.

### 2.2.1 Implementation status of data use cases

Stakeholders were asked to identify use cases that are currently implemented within their business or that will be implemented in the next five to 10 years (nominally representing two future regulatory price reset periods).

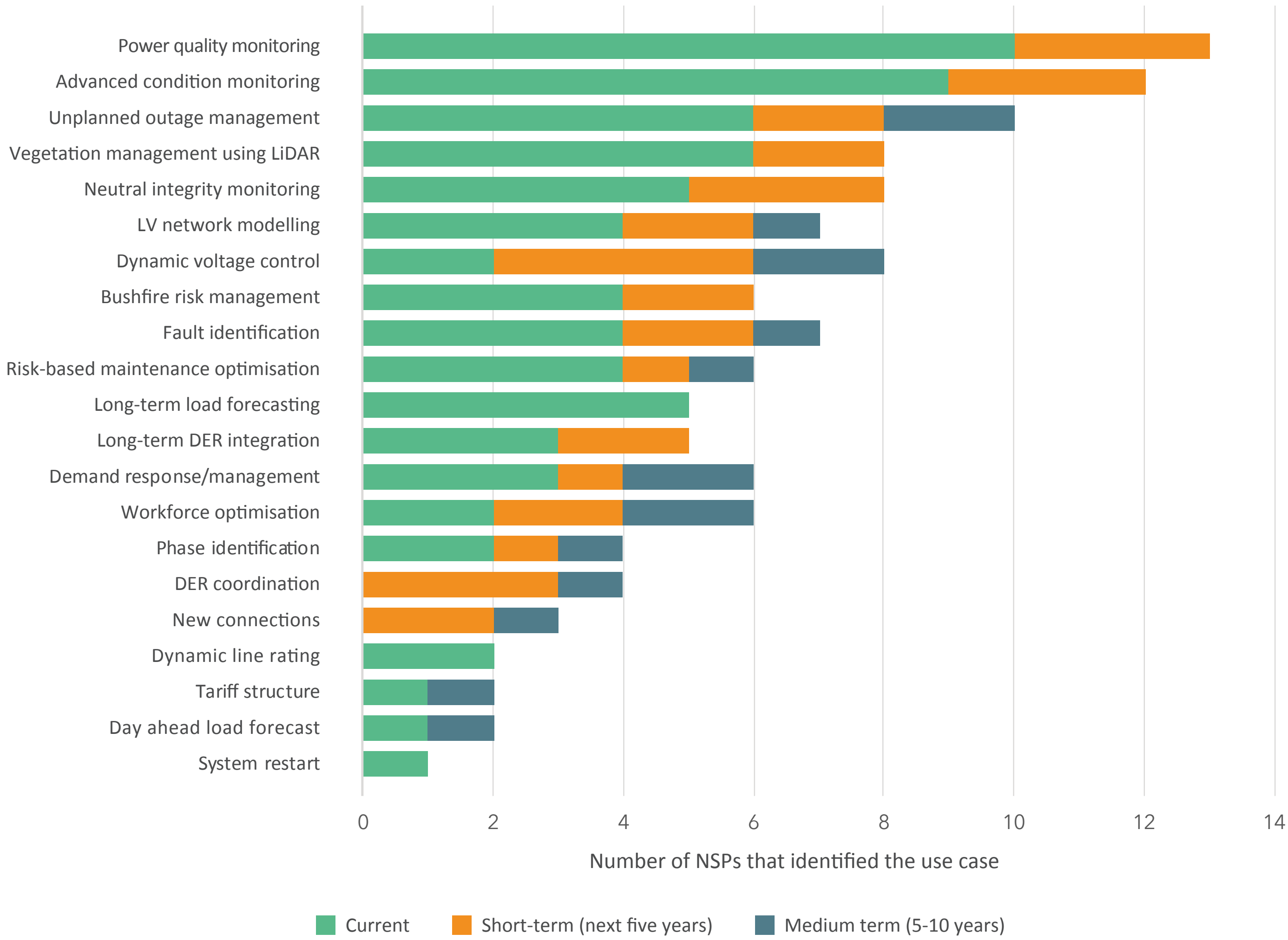
The 22 use cases identified by stakeholders have been ranked based on the number of use cases currently implemented or to be implemented within the next five years (see Figure 2).

The top 10 use cases are explored in further detail in Appendix 3 (including definition, data requirements and qualitative cost-benefit analysis). NSPs use a range of data sources, systems and models to manage their networks, the details of which are outlined in Appendix 2.

**Networks are focusing on network maintenance and operation use cases.**

In terms of network maintenance use cases, condition monitoring and vegetation management are the two use cases that most NSPs identified as currently being implemented. These were identified by more than half and one-third of NSPs, respectively. These use cases are driven by operating expenditure reduction and risk mitigation (such as bushfire risks). New inspection technologies such as LiDAR and HD photographic imagery are typically being leveraged to improve condition monitoring and vegetation management.

**FIGURE 2 – IMPLEMENTATION STATUS OF PRIORITY USE CASES IDENTIFIED BY STAKEHOLDERS**

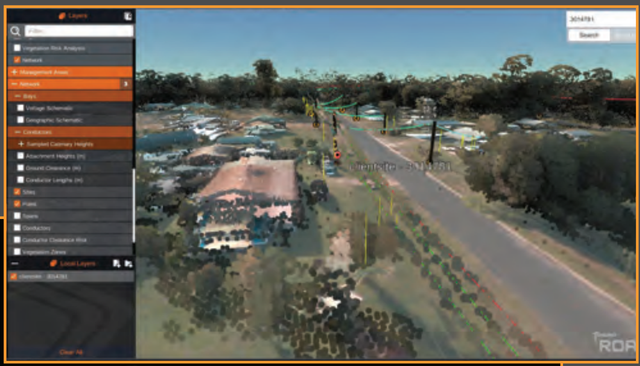


# Energy Queensland is using LiDAR technology for advanced vegetation management and condition monitoring.

Energy Queensland uses LiDAR technology to establish 3D geo-spatial representations of network assets for both vegetation management and asset maintenance. Data captured through annual LiDAR inspections enables the identification and measurement of network assets and surrounding objects including buildings, terrain and vegetation. Creating a virtual version of the physical network enables quicker and more accurate inspections. It also contributes to reduced maintenance and planning costs as well as increasing the safety and reliability of electricity supply [13].

To minimise risk of service disruption, electrocution and fires, Energy Queensland uses LiDAR analysis and network analytics to optimise its cyclical program for cutting vegetation. LiDAR technology has enabled the identification of conductor clearance issues and Energy Queensland has established a risk prioritised program to ensure compliance with minimum clearance standards [13].

*Image: Energy Queensland*



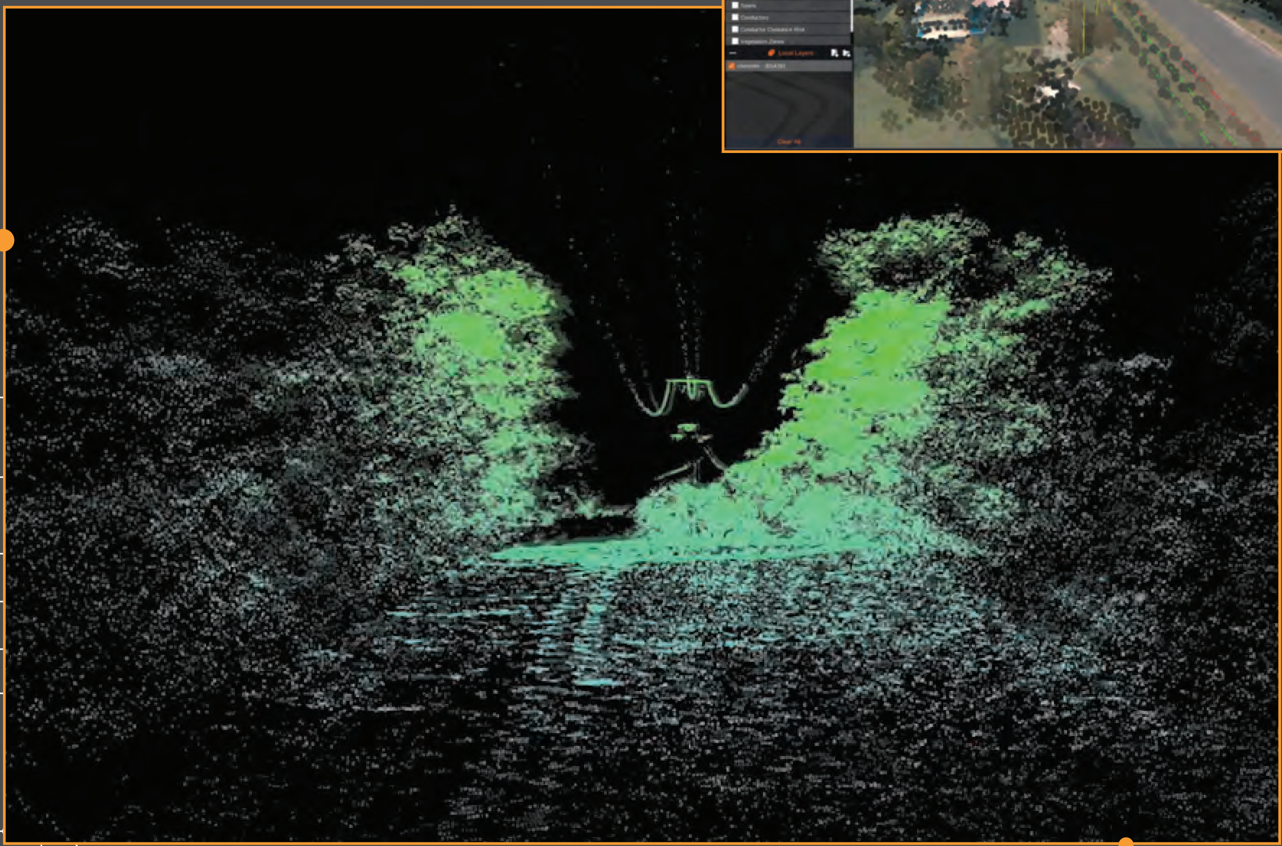


*Image: Ausgrid*

In terms of operation use cases, power quality monitoring and outage management were the use cases most identified by NSPs as currently being implemented. These were identified by more than half and one-third of NSPs, respectively. Notably, power quality monitoring has been implemented by all DNSPs in Victoria.

Planning use cases were less cited by NSPs compared to maintenance and operation. Long-term load forecasting was the most cited planning use case, with one-quarter of NSPs having implemented this use case.

### Dynamic voltage control and neutral integrity monitoring were identified as priorities for the next five years.

Dynamic voltage control is a key use case priority for network operation over the short to medium term (identified by almost half of DNSPs consulted). While DNSPs in Victoria have implemented dynamic voltage control, other DNSPs plan to implement this use case through procuring smart meter data from third-parties or installing power quality monitors.

In terms of neutral integrity monitoring, which is also enabled by smart meters, four out of five DNSPs that have implemented this are from jurisdictions where PoC does not apply. (PoC does not apply in Victoria and Western Australia.) However, over the next five years, DNSPs in other states also plan to implement smart meter-based neutral integrity monitoring.

### There will be an increasing focus on DER coordination in the short to medium term.

DNSPs did not report DER coordination as being implemented yet. However, approximately half of DNSPs consulted are planning to implement this use case in the short to medium term. This reflects the fact that they are expecting to take on new roles to further integrate DER. They also identified that the progression to a DSO will require such use cases to be developed over the coming years, but not in the short term.

*Image: Ausgrid*

### New South Wales and Queensland DNSPs are trialling DER coordination through the ARENA-funded evolve DER project.

The Australian Renewable Energy Agency (ARENA) and New South Wales Government funded evolve DER project is led by software developer Zepben in collaboration with industry and academia. DNSPs from Queensland and New South Wales are participating in the project, which aims to optimise the use of the network through DER coordination. Participating DNSPs include Energy Queensland, Endeavour Energy, Essential Energy and Ausgrid [14].

Through the use of new sensors and software capabilities developed through the project, DNSPs will have real-time visibility of how the network is behaving. For example, they will be able to see where there is congestion and where there is available capacity. DNSPs will trial using the software to send signals to DER to either increase or decrease their energy output to manage congestion on the grid. Dynamic DER operating envelopes enable customers to make the most of their investments in DER while also ensuring reliable and safe electricity supply for all customers [15].

**Stakeholder insights demonstrate a range in NSP practices.**

Based on the use cases identified by each stakeholder through the consultation process, the minimum and best practices in terms of the data utilisation were determined across NSPs. Of course, actual minimum and best practices relevant to a particular NSP will reflect their network type and the specific challenges being experienced (see Section 2.2.2).

For the purpose of this project, minimum and best practice have been framed within the context of number of use cases implemented. This reflects the differing maturity in digital transformation across NSPs.

Maximum maturity corresponds to NSPs with the highest number of use cases implemented or to be implemented. This typically includes a range of use cases aimed at DER integration and real-time applications, leveraging smart meter data (noting that only DNSPs use smart meter data).

On the other hand, minimum maturity corresponds to NSPs with the lower number of use cases implemented. It typically involves leveraging data to improve existing core business activities and respond to emerging challenges, but not in real-time (see Table 5).

**TABLE 5 — MINIMUM, TYPICAL AND MAXIMUM MATURITY FOR DATA UTILISATION**

| Minimum maturity | Typical maturity | Maximum maturity |
|---|---|---|
| **Current use cases** | | |
| A couple of priority use cases are implemented, including:<br>• Condition monitoring<br>• Power quality monitoring.<br>Power quality is not monitored in real-time at the LV level. There is no data or analysis of data to manage DER (lack of smart meter data). | Between three and five priority use cases are implemented, including:<br>• Condition monitoring<br>• Power quality monitoring<br>• Vegetation management<br>• Outage management<br>• Maintenance optimisation. | More than six priority use cases are implemented, out of:<br>• Condition monitoring<br>• Power quality monitoring<br>• Vegetation management<br>• Outage management<br>• Neutral integrity monitoring<br>• Bushfire risk management<br>• Dynamic voltage control<br>• Maintenance optimisation<br>• Fault identification.<br>Readily available smart meter data has enabled multiple use cases. There is a focus on real-time use of data to support DER integration.<br>Digital platforms have been implemented to support use cases. |
| **Short to medium term use cases** | | |
| Planned use cases include:<br>• Improving power quality monitoring<br>• Outage management.<br>Due to limited visibility/monitoring of the LV network, building digital twins will also be a focus. | Focus is on using smart meter data to generate actional insights, such as:<br>• Neutral integrity monitoring<br>• Fault identification<br>• Dynamic voltage control. | Planned use cases on further integrating smart meter data and/or real-time applications, including:<br>• Phase identification<br>• Dynamic voltage control<br>• DER coordination (aggregated operation of DER). |
| **Key data sources, systems and tools** | | |
| Networks gain data from:<br>• GIS (HV level)<br>• SCADA<br>• Connection agreements<br>• Field inspections.<br>Key tools include:<br>• Manual processes. | Networks gain data from:<br>• GIS (HV level)<br>• SCADA<br>• LiDAR<br>• Field inspections<br>• Smart meters (from limited deployment). | Networks gain data from:<br>• GIS (HV & LV level)<br>• SCADA<br>• LiDAR<br>• HD photographic imagery<br>• Field inspections<br>• Smart meters (from widespread deployment).<br>Key tools include:<br>• Automated processes<br>• Future software/tools include DERMS and ADMS. |
| There is limited monitoring and visibility of the LV networks, with minimal or no use of power quality data from smart meters. There is no data analytics team. | DNSPs have access to some/targeted smart meter data. Some power quality monitors are installed to aid in lack of smart meter data (in real-time). | DNSPs have access to power quality data from smart meters that have been widely deployed. |

### 2.2.2 Differences across jurisdictions

Stakeholder consultation highlighted differences in the maturity of data use cases (see Figure 3). The highest number of use cases has been identified in Victoria. Differences in use case deployment may be due to:

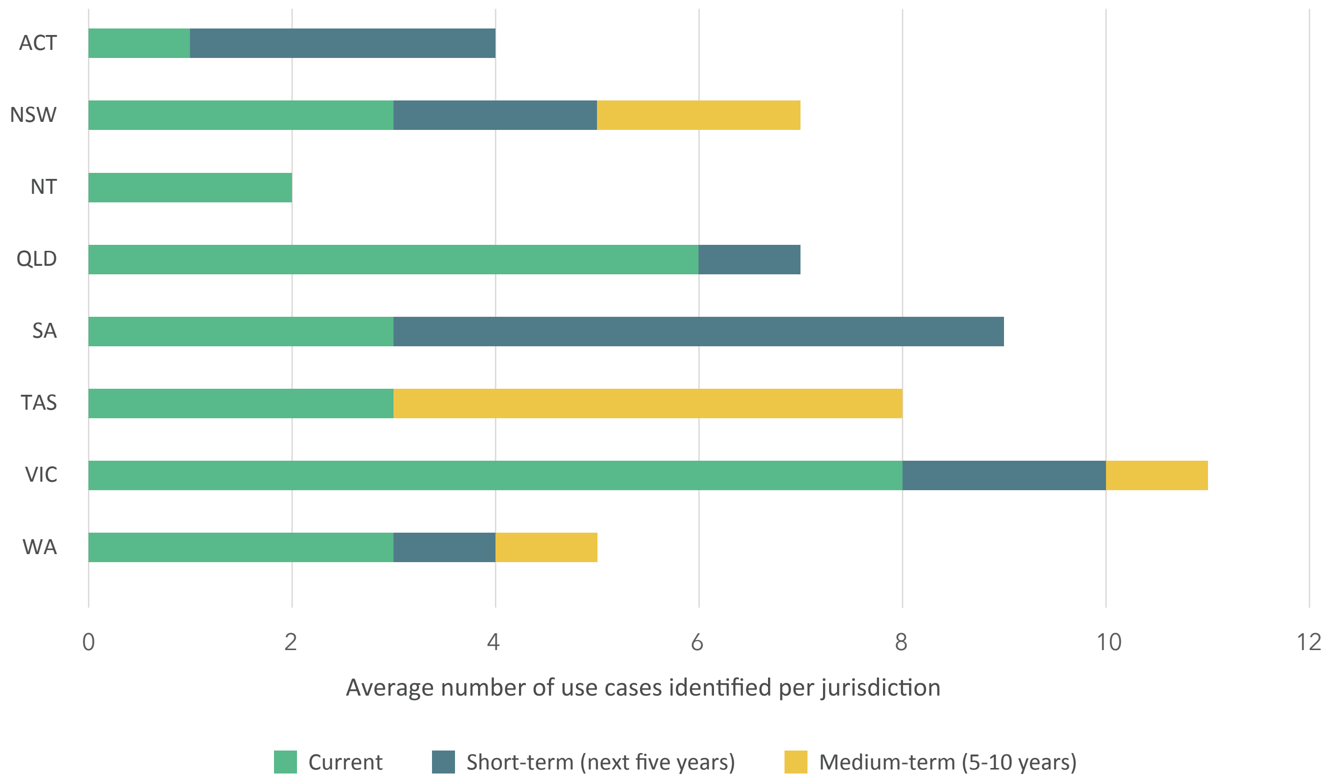
- Factors impacting smart meter deployment
- The level of DER penetration
- The location of NSPs (urban on rural)
- The size of NSPs (such as number of customers)
- The type of NSP (TNSP or DNSP).

**Use cases that require smart meter data are dependent on smart meter deployment, which differs between jurisdictions.**

The deployment of smart meters was mandated in Victoria in 2006 and coordinated by local DNSPs. As a result, DNSPs in Victoria have close to 100% network coverage with smart meters. This has allowed Victoria to be further advanced in implementing use cases that require smart meter data.

In other NEM jurisdictions, smart meter rollout is subject to decisions made by retailers and customers in coordination with metering coordinators (through the PoC). It was observed that the deployment of smart meters is relatively low outside Victoria, with a network coverage ranging from 15 to 18 per cent in some jurisdictions. WA and the Northern Territory announced state-wide rollout of smart meters in 2019.

**FIGURE 3 – AVERAGE NUMBER[4] OF USE CASES PER JURISDICTION**




[4] Average use cases per jurisdiction is based on the sum of use cases per implementation status divided by the number of NSPs interviewed as part of the stakeholder consultation process.

**United Energy is using smart meter data to provide demand response.**

United Energy participates in the Reliability and Emergency Reserve Trader (RERT), providing demand response within 10 minutes of notification from AEMO. United Energy's Distribution Demand Response Program uses voltage control devices to remotely reduce voltage levels at its 47 zone substations. It reduces these by an average of three per cent to deliver at least 30 MW of demand response [16].

By using smart meter data, United Energy is able to reduce the risk of voltage levels falling below the compliance level during demand response and negatively impacting customer appliances. Time-lagged voltage information (25-30 minutes) from United Energy's entire smart meter fleet is used to continuously inform and set boundaries of voltage reduction control systems. Using a data analytics engine, voltage information from customers is compared with regulatory voltage limits. This ensures that the magnitude of voltage reduction does not result in exceeding the complaint level [16].

The United Energy Distribution Demand Response Program has received $5.76 million of funding from ARENA [17].

**The development of certain use cases can be driven by challenges emerging on the networks, such as constraints due to high DER penetration.**

Some DNSPs are experiencing higher penetrations of DER on their network than others. This means that some use cases are more pressing for those DNSPs because constraints are already occurring. For example, DER penetration in parts of South Australia and southeast Queensland is significantly higher than the national average.

DNSPs are seeking to implement use cases designed to manage power quality issues arising from high DER penetration.[5] In South Australia for example, SA Power Networks (SAPN) is developing capabilities to perform LV network modelling and dynamic voltage control in response to DER penetration and related minimum demand issues.

*Image: Ausgrid*

[5] Some DNSPs have also received funding grants (such as from ARENA) that have enabled them to implement use cases proactively before significant power quality issues are occurring on their network.

### NSP location and network arrangement can influence the priority use cases for that NSP.

Whether an NSP is managing an urban or rural network may play a key role in the prioritisation of use cases. For example, bushfire risk is a more pressing issue for TNSPs and DNSPs located in bushfire-prone regional areas. In contrast, while DNSPs with networks predominantly located in urban areas still perform vegetation management, they may prioritise other use cases – such as fault restoration – over bushfire management.

### SA Power Networks is planning to use LV modelling to support power quality monitoring and dynamic voltage limits.

As part of its 2020-25 regulatory proposal, SAPN put forward a business case for expenditure to actively manage the integration of DER on its networks. SAPN has a high penetration of DER, with more than 1 GW of rooftop solar installed. To address voltage and thermal capacity issues arising from high DER penetration, SAPN currently applies static export limits (5 kW per residential customer) and reactive investigation and remediation works [18].

To improve customer outcomes, SAPN has proposed to improve the visibility of its LV networks to calculate the LV network hosting capacity and apply dynamic export limits to DER. Dynamic export limits mean that customers' PV exports may only be limited for a small proportion of the year and only when and where it is required. This will increase the value of customers' rooftop solar systems (both in terms of maximising exported electricity and greenhouse gas emissions reductions from renewable electricity) [18].

SAPN will assess the performance of every LV network based on a representative sample of around 10 per cent of its LV networks, which will be modelled in detail and actively monitored. Data will primarily be procured from third parties (such as smart meter data from metering coordinators). It will also require the implementation of an API for data transfer, and systems for data storage and processing of time-series voltage data [18].

The network arrangement can also impact the prioritisation of use cases. For example, remote networks may benefit more from use cases that remotely detect faults and outages and optimise crew dispatch. These use cases can indeed save significant time and labour costs when dispatching field crews to investigate outages in remote areas.

### The prioritisation of use cases may be influenced by the size of the NSP.

The size of the NSP (number of customers) can influence the implementation of certain use cases. Small, less resourced NSPs may face more challenging barriers due to the fixed up-front cost to develop the systems required. In this project, it was observed that smaller NSPs have on average implemented a smaller set of use cases (two out of 22 use cases) compared to the national average (four out of 22 use cases).

### The implementation of use cases can depend on whether the NSP is managing a distribution or transmission network.

DNSPs and TNSPs do not have the same challenges, which means the implementation of use cases is also different.

DNSPs have limited visibility of what is occurring on the LV networks. As such, some of the use cases aimed at improving LV network visibility (through smart meters) are only relevant to DNSPs.

DNSPs highlighted a growing interest in use cases that will be required to manage the increasing penetration of DER in the future (for example, DER coordination, LV network modelling and dynamic voltage control). A lot of these use cases are aimed at improved LV network visibility.

TNSPs already have good visibility of their networks due to historically well instrumented assets and well-established market rules. TNSPs mainly identified network maintenance and network operation as priority use cases. As such, their priority cases tend to be driven by core business activities, such as condition monitoring, vegetation management, outage management and power quality monitoring.

In terms of power quality monitoring, TNSPs are increasingly requiring information about synchronous machines connected to their network. This is in order to have a better understanding of system strength as synchronous generators retire and more intermittent renewables are connected to the grid.

# CitiPower and Powercor has implemented a bushfire risk management tool.

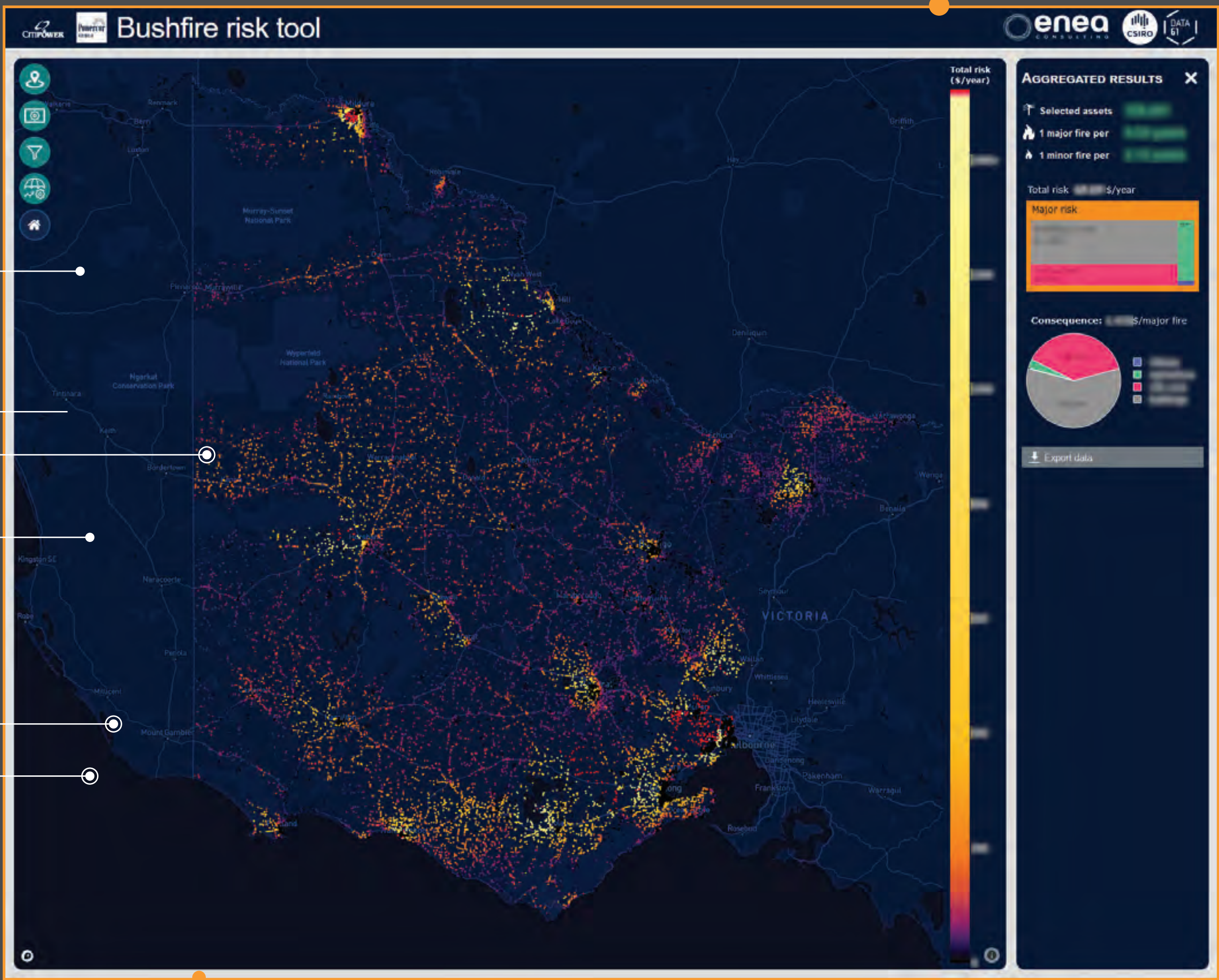



*Image: CitiPower and Powercor*

CitiPower and Powercor has implemented a bushfire risk management tool, which provides quantitative estimates of both the likelihood and consequence of a potential network-initiated bushfire. This is used to quantify the bushfire risk per pole and the overall bushfire risk of the network.

Asset attribute data (such as age and material), historical failure data and environmental data (such as weather and corrosion) are used to calculate the likelihood of fire start. The impacts of uncontrolled bushfires are modelled under different weather scenarios. Overlaying fire simulation results with agricultural and residential land parcels then allows CitiPower and Powercor to estimate the consequence of bushfires.

The results of the model are embedded into a web interface allowing CitiPower and Powercor to navigate the results, explore mitigation options and visualise bushfire simulations, giving insights on where to focus risk minimisation efforts.

# 3 Digitalisation gaps and challenges

Stakeholders identified a number of gaps and challenges in developing and implementing the use cases described in Chapter 2. Broadly, the gaps and challenges fit across five categories:

- Data quality, consistency and integration (Section 3.1)
- LV network visibility (Section 3.2)
- Culture and organisational change (Section 3.3)
- Cybersecurity (Section 3.4)
- Developing business cases for ICT expenditure (Section 3.5).

Some NSPs also raised challenges related to Regulatory Information Notices (RINs). Given this is not directly related to data use cases, this information has been summarised in Appendix 4.

## 3.1 Data quality, consistency and integration

Data quality is important for making accurate and timely decisions to maintain, operate and plan electricity networks. Data quality issues, such as inaccuracy and incompleteness, may arise due to problems with internal processes or reliance on third-party data.

### 3.1.1 Manual and paper-based data collection

**Manual or paper-based data collection processes can lead to data quality challenges, particularly in GIS.**

NSPs identified manual and paper-based processes to be a source of data inaccuracy. Data inaccuracies caused by human error during data collection via field surveys can create an inaccurate depiction of the network. Also, the time lag between when changes are made in the field and when the record is digitally updated can contribute to data quality issues.

As an illustration, few DNSPs have a complete, high confidence geographic information system (GIS) record of their LV networks. Information that has been manually collected can lead to missing or inaccurate asset data, including misidentified asset existence or location, attributes and settings. For example, the correct details of transformer capacity or tap setting may not be accurately recorded by field staff. Changes that are made in the field may also not be accurately reflected in GIS, contributing to legacy issues in data quality.

Cross-checking multiple data sources may improve data quality and identify gaps in stored information. As an example, GIS data can be cross-checked with LiDAR data, when available. Digital entry tools (such as tablets or cameras) can facilitate more accurate data collection through field surveys.

### 3.1.2 Use of third-party data

**Data quality issues may also arise when using third-party data, where data collected by NSPs is not audited.**

Stakeholders expressed that NSPs do not have control over third-party data quality processes, including how data is collected, maintained and verified. This can present a challenge in making decisions based on potentially inaccurate information.

An example highlighted by most DNSPs is that there are inaccuracies in DER data from connection agreements. The connection agreement process largely relies on assumed compliance. DNSPs do not have independent confirmation of what is installed, how it is being operated and if these details differ to the connection agreement. For example, DNSPs have identified differences between the capacity of PV systems installed and the capacity set out in the connection agreement.

The DER Register, launched on 1 March 2020, will go some way to improving visibility of DER. It can be leveraged to provide a centralised source of data for use cases that require information about DER, such as those for network operation (for example, power quality monitoring and coordinating DER). However, as it is a relatively static system that relies on the good-faith behaviour of multiple parties, its benefits still have inherent limits.

Third-party data quality might be improved by including quality assurance obligations in contractual agreements.

### 3.1.3 Integrating data systems

**The increasing volume of data collected by multiple parties presents challenges for integrating data systems.**

Data is increasingly being provided by multiple third parties to DNSPs. This includes metering coordinators that provide smart meter data in PoC jurisdictions and other parties that provide other information, including on irradiance and PV generation.

In some cases, multiple metering coordinators may be providing smart meter data to a single DNSP. This can create interface challenges when data is provided by multiple third parties in different formats and qualities. Technical standards may be required to ensure that data is provided in a consistent and useable format.

### 3.1.4 Communication and processing delays

**Delays in data collection and processing can prevent the implementation of use cases that require real-time information.**

Exchanging large volumes of data can also create integration challenges for communication systems and data processing. For example, problems in terms of data flows and data exchanges between systems and platforms can result in processing delays.

Such delays make it difficult to implement some use cases identified in Section 2 that require data to be communicated and processed in real-time. For example, one stakeholder highlighted a six-hour lag for receiving smart meter load data from the retailer. This makes it impossible to implement operational use cases such as dynamic voltage control and fault identification.

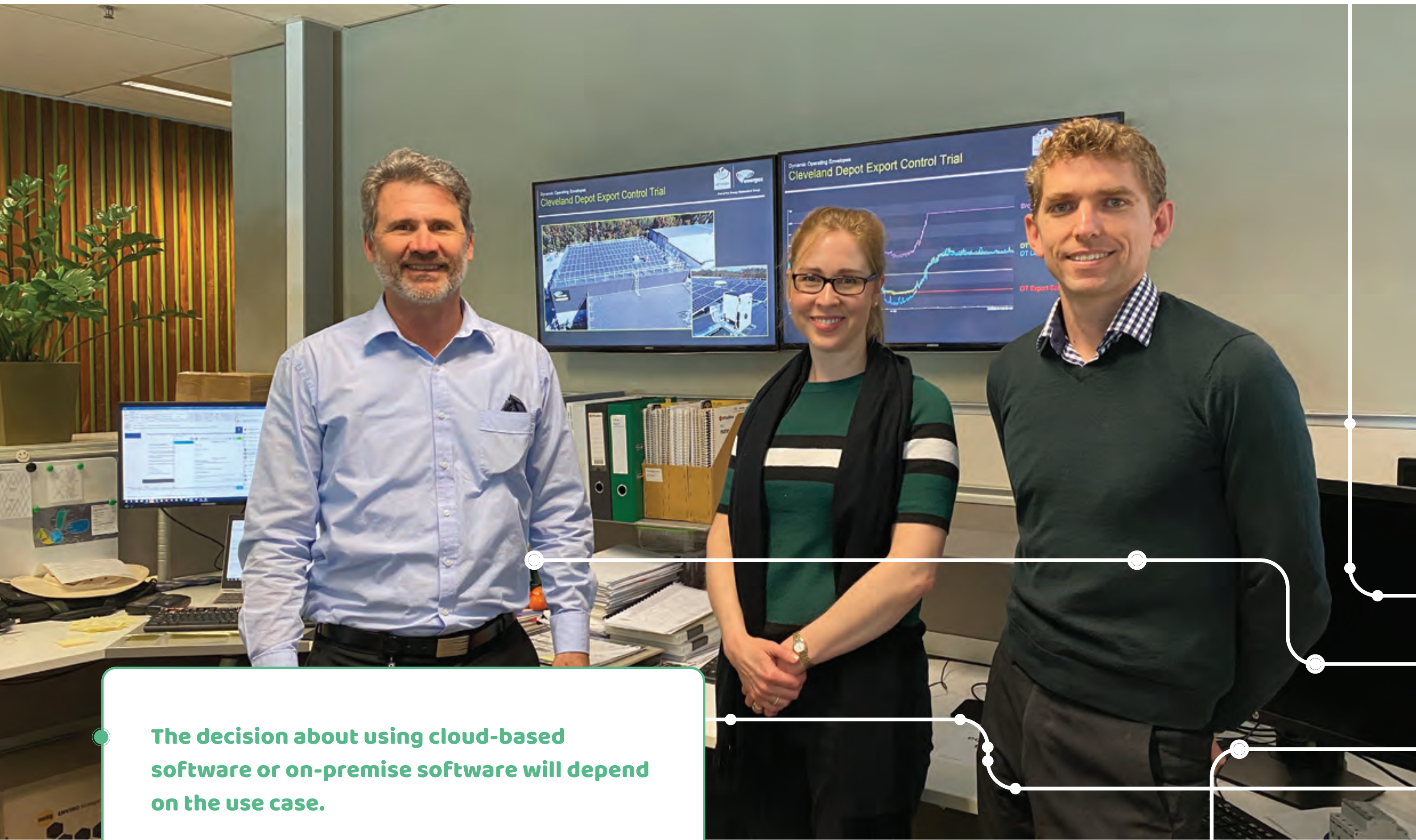



*Image: Energy Queensland*

**The decision about using cloud-based software or on-premise software will depend on the use case.**

Advances in high-performance cloud computing and development of cloud storage mean that in the future, it is likely that more applications will use cloud infrastructure. Historically, NSPs have used private IT systems and data storage on-premises. The decision about whether to use local servers or the cloud will depend on the type of data and how it is being used.

NSPs may continue to host operational data locally, such as SCADA data where systems are not connected to the internet and data is transmitted via NSPs' private communication networks. On the other hand, third-party data (such as PV irradiance data) may be cloud-based. It can therefore typically be communicated and integrated through an application programming interface (API).

Critical infrastructure legislation and licence conditions require that critical data be stored in Australia. Some NSPs highlighted that having to host data in Australia can be challenging where a lot of the large software and cloud providers are international companies.

## 3.2 LV network visibility

LV network visibility is a key issue identified by DNSPs, and improving LV network visibility can unlock multiple use cases. However, incorporating data provided by multiple third parties in different formats can be challenging.

This challenge is compounded by PoC, where DNSPs may be receiving smart meter data from multiple metering coordinators. DNSPs in states where the PoC applies (all NEM jurisdictions except for Victoria) also raised several challenges regarding accessing power quality data in real-time to implement smart meter data use cases.

### 3.2.1 Accessing data in real-time

**DNSPs are not always able to access voltage and load data in real-time.**

DNSPs have limited visibility of the LV network because, historically, most of the risks and potential issues affecting the power system originated upstream. Load data typically comes from the zone substation HV feeders via SCADA and there is limited power quality monitoring (load, voltage and current) below this level. Improving the visibility of the LV networks, for example, through the deployment of smart meters, can facilitate the management of changes occurring at the customer level due to DER deployment.

There are a variety of smart meters and smart meter configurations available in the market. As a result, there are a range of services and use cases they can offer. For PoC jurisdictions, the minimum services that smart meters must be capable of providing are set out in the National Electricity Rules and are mainly focused on billing functions. The minimum services include remote de-energisation and re-energisation, on-demand and scheduled remote meter reads and meter reconfiguration. In addition to energy measurements, most smart meters can also measure power quality. However, the minimum specifications under PoC do not enable DNSPs to access the data in real-time, which can assist operational purposes such as outage management [19].

In Victoria, Type 1 to 4 meters (which are used by large energy consumers) are subject to contestability. This means they are competitively provided and Victorian DNSPs do not have direct access to power quality information from these meters, if available. Where customers with Type 1 to 4 meters are located, Victorian DNSPs may have a 'blind spot' on their networks. Some Victorian DNSPs are seeking to install their own meters for these customers to improve network visibility.

### 3.2.2 Location of smart meters

**Smart meters are not always located in the areas where visibility is most needed.**

In jurisdictions where the PoC reforms apply, the smart meter rollout is reliant on the discretion of electricity retailers. At a minimum, retailers are only required to install smart meters in new developments, faulty meter replacements or upon customer request. This means that smart meter deployment can be sporadic and is sometimes not available in the locations where it would be most beneficial. Some DNSPs raised that this is particularly an issue when smart meters have not been installed where constraints are occurring.

A lack of concentrated smart meter deployments means that mesh communication networks cannot be used and DNSPs must rely on cellular communications, which can sometimes be unreliable.

### 3.2.3 Data procurement costs

**Cost of procuring smart meter data can prevent implementation of use cases at-scale.**

DNSPs in PoC jurisdictions do not have direct access to power quality data and must commercially negotiate with metering coordinators to procure it. DNSPs located in PoC jurisdictions identified that the cost of procuring smart meter data may prevent the implementation of smart meter-reliant use cases at-scale. Most DNSPs only procure the minimum power quality data necessary for trials.

The cost of purchasing smart meter data for ongoing trials is around $5 to $15 per smart meter per year. Based on the average number of customers per DNSP in PoC jurisdictions, this could cost between $5.8 and $17.5 million per year in operational expenditure.

DNSPs must individually negotiate with multiple metering coordinators for access to implement smart meter-reliant use cases. Given that each customer can only have one metering coordinator, it can be considered that their data is being managed by an unregulated monopoly. To reduce costs, some DNSPs have, in their regulatory proposals, proposed obtaining smart meter data from targeted areas of their network or deploying power quality monitors.

## 3.3 Culture and organisational change

**Integrating data analytics capabilities can result in organisational challenges.**

Digital transformation will require the development of new data analytics skills. However, a few NSPs mentioned that it can be difficult to determine where the data analytics function sits within their organisation (i.e. within business units or in a dedicated department). This is because data use cases can have a significant impact on all business activities – including operation, maintenance and planning. For example, LiDAR data can be used for both vegetation management and asset condition monitoring.

Another challenge highlighted was the lack of engineering background amongst data scientists. This can create issues in terms of communicating what data is needed, why it is needed and how it will be used, for example, for network planning purposes.

**In the future, the Consumer Data Right (CDR) could have an impact on accessing third-party data for network operation.**

In 2017, the Australian Government announced the introduction of the CDR in Australia. The purpose of the CDR is to provide consumers with greater access to and control over their own data. It grants consumers the right to access specific information that relates to them and to authorise the disclosure of that information to third parties.

Its intersection with the energy sector is to enable customers to choose, compare and switch energy retailers more easily. Information covered by the CDR includes:

- Identifiable customer information (such as contact details)
- The sale or supply of electricity to customers (including metering data and billing information)
- The retail arrangements relating to the sale of electricity.

Most NSPs in this study did not interpret the CDR as having a significant impact on the implementation of their use cases. As noted earlier, DNSPs may collect and/or purchase data from third parties such as retailers. An issue to highlight is that the CDR for energy should ensure that DNSPs are not prevented from accessing critical information that enables them to manage the networks efficiently.

Victorian DNSPs noted that they are best placed to provide the longest time series of data to the CDR process because Victorian DNSPs own the smart meters. For example, if a customer changes retailer once a year, the retailer can only provide meter data for one year. Whereas a Victorian DNSP can provide meter data for that premises for the whole time period. This may help ensure the people and organisations seeking to access the data receive the best information.

**The implementation of data use cases may also require a shift in culture**

Several NSPs identified that a shift in culture is required to support the digital transformation. Some departments may be resistant to incorporating new technologies, systems or processes into legacy processes that have been used for many years.

One example provided is that IT departments will need to adapt to more agile and iterative processes. Whereas traditionally software development has followed a sequential (or waterfall) project management approach, data analytics lends itself to more agile techniques that support its exploratory nature.

## 3.4 Cybersecurity

Cybersecurity is an issue of growing importance, particularly for businesses that own and operate critical infrastructure assets. To this point, the Australian Government recently published the Australia's Cyber Security Strategy 2020 [20]. As outlined below, stakeholder feedback in this study has indicated a need for new capabilities to manage cybersecurity threats, as well as mandatory practices for managing them.

### 3.4.1 Capabilities to manage cybersecurity

**New capabilities to manage cybersecurity threats are increasingly required.**

Although their occurrence is still limited, major cyberattacks can result in either prolonged and widespread outages across an electricity network or the release of confidential customer information. This can have significant economic and social consequences. For example, sophisticated cyberattacks that have occurred on critical infrastructure overseas have had huge impacts. In 2015, for instance, phishing emails with attached hidden malware blacked out approximately 230,000 households in Ukraine [21].

Interfaces with third parties are increasing – both at a system operations level and in terms of remote access for vendors. Also, increased information is being shared between operational systems and business systems. As such, cybersecurity is becoming a higher priority. In the medium-term, the increasing use of real-time, two-way communication to manage electricity networks can mean that the consequences of a potential cyberattack also increase.

## 3.4.2 Cybersecurity regulatory framework

**NSPs do not have a regulatory obligation, beyond licence obligations, to manage cybersecurity.**

NSPs understand that increasing the maturity of cybersecurity will be required moving forward. NSPs must comply with any cybersecurity requirements in their licence conditions that mandate that operational infrastructure is to be operated and controlled from within Australia. They must also comply with requirements that data is to be held and accessible solely within Australia.

The Australian Energy Sector Cyber Security Framework (AESCSF) was the first step in establishing a more tailored framework for managing cybersecurity in the energy sector. The AESCSF enables electricity market participants to assess, evaluate and prioritise their cybersecurity capability and maturity in a nationally consistent manner. However, using this framework is not mandatory [22]. With no regulatory obligation set out in the National Electricity Rules or in legislation, it may be difficult for NSPs to justify the costs associated with increasing cybersecurity measures.

This is likely to change in the near future, with the Australian Government proposing legislative changes in Australia's Cyber Security Strategy 2020. The proposed changes will introduce security and resilience requirements for critical infrastructure entities, including the energy sector.

The Department of Home Affairs has also released the *Protecting Critical Infrastructure and Systems of National Significance Consultation Paper*. The paper outlines a range of measures. These include establishing a positive security obligation for critical infrastructure entities and enhanced cyber security obligations for those entities most important to the nation. It also includes Government assistance to entities in response to significant cyber-attacks on Australian systems. It is important that consultation on these measures is undertaken in close consultation with NSPs in order to capture risks that are specific to electricity networks.

*Image: Ausgrid*

## 3.5 Developing business cases for ICT expenditure

Implementing new use cases will require expenditure in ICT to support new functionalities and capabilities. ICT expenditure has been a growing component of total expenditure (TOTEX) by DNSPs over recent years (see Figure 4).

### 3.5.1 Developing business cases

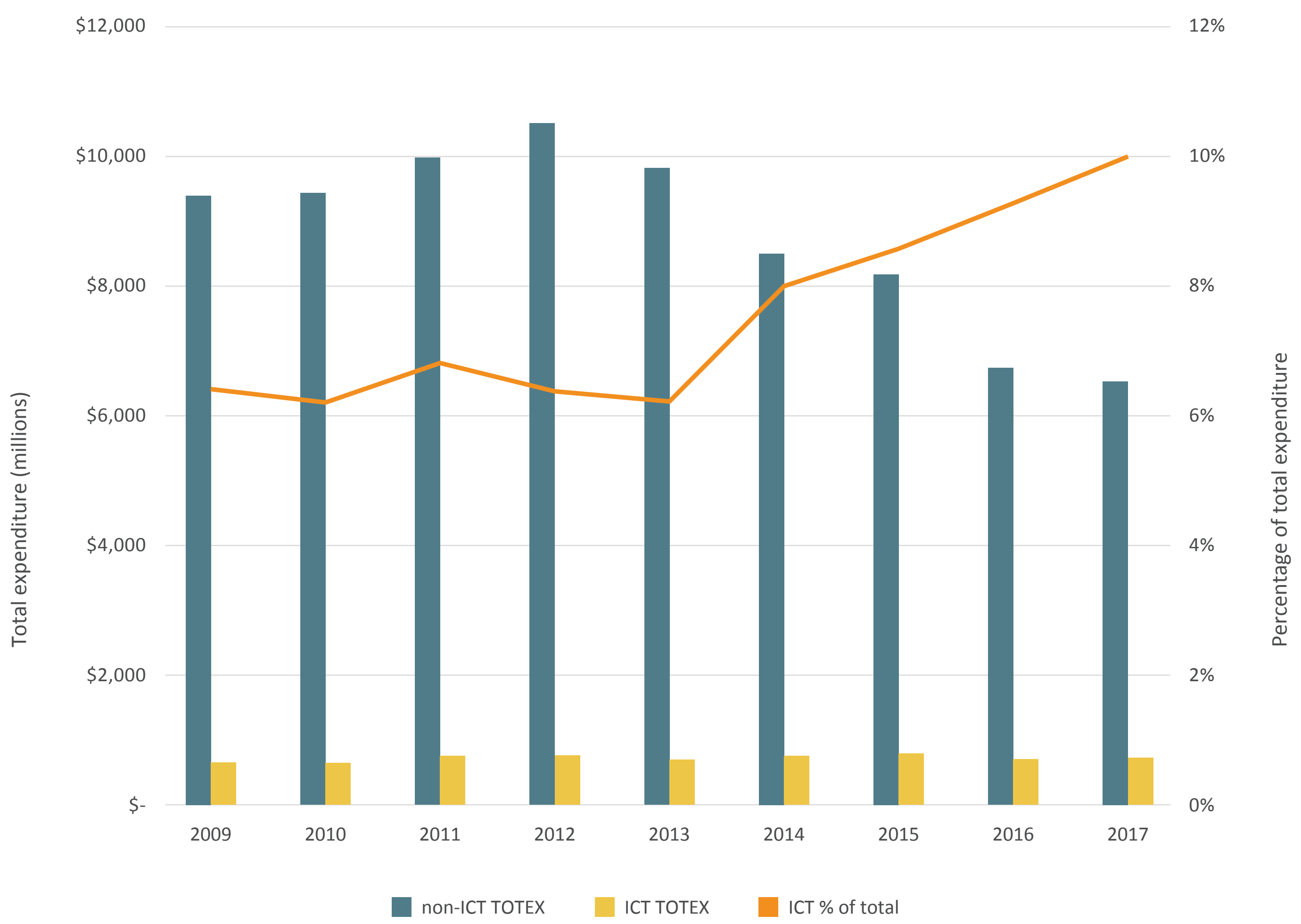
**Developing business cases for ICT investments can be challenging when assessing use cases individually, especially for smaller NSPs.**

Solutions to emerging challenges such as the integration of new data systems come at large fixed costs. Investments are required to build the end-to-end/back-end infrastructure to accommodate the communication and storage of the increasing data volume and to process time-series and/or real-time data. Investment may also be required to develop the digital platforms (such as data analytics platforms) enabling the various use cases.

It can be difficult to assign benefits to the investment required for the implementation of data use cases. ICT investment by itself does not generally result in direct benefits, rather it is the application of use cases that drives benefits. For example, investment to improve LV network visibility – such as the rollout of smart meters or procurement of smart meter data – can enable multiple use cases. These include LV network modelling, power quality monitoring, neutral integrity monitoring and outage management.

In addition, smaller NSPs identified high fixed costs to be a barrier to implementing some use cases. Indeed, ICT expenditure can be rather fixed (for example, the development of a digital platform), whereas the benefits generally depend on the number of customers. It can thus be challenging for small NSPs to develop business cases where fixed costs are being compared to relative benefits. Stacking the benefits from these multiple use cases (such as improved reliability and safety, reduced capital and operating expenditure) can improve the business case for ICT expenditure.

**FIGURE 4 – ICT AND NON-ICT EXPENDITURE ACROSS ALL DNSPS OPERATING IN THE NEM [23]**



### 3.5.2 AER non-network ICT capital expenditure assessment approach

**The AER non-network ICT capital expenditure (CAPEX) assessment approach does not adequately consider differences between network assets and ICT, which can create challenges for developing business cases.**

In November 2019, the AER published guidelines explaining the non-network ICT capital expenditure[6] assessment approach for DNSPs to use when preparing regulatory expenditure proposals. This assessment approach does not currently apply to TNSPs, although it may apply in the future. Interviewed DNSPs consider this assessment approach as a positive first step to assist in the development of business cases for ICT expenditure. However, DNSPs suggested that further consultation by the AER may be required to ensure that the assessment approach and its implications are widely understood.

In following the AER assessment approach, DNSPs highlighted challenges in relation to the treatment of non-recurrent expenditure, recurrent expenditure and productivity improvements. This included with respect to meeting requirements to:

- Predict when non-recurrent maintenance expenditure for ICT may be required. This is difficult given the different risk profile to network assets. For example, a network asset such as a distribution transformer degrades over an expected amount of time and the replacement CAPEX (the REPEX) can be predicted. Yet, the functioning of ICT may be binary (meaning it either is working or is not working) or software may become no longer fit for purpose (for example, due to upgrades in an NSP's digital platform).
- Assess recurrent ICT capital expenditure through trend analysis. This ignores an increasing ICT asset base as a result of non-recurrent expenditure in ICT infrastructure, system and tools to support the delivery of network services.
- Assess recurrent ICT capital expenditure benchmarking. This does not consider the fact that not every DNSP is starting with the same resources as its peers.

Also, there is an element of double-counting in requiring additional productivity adjustments for non-recurrent ICT capital expenditure, given that productivity improvements are largely achieved through ICT investments. The AER requires that non-recurrent ICT capital expenditure projects include a negative adjustment to operating expenditure to reflect reduced operating costs. However, the AER already applies an annual 0.5 per cent adjustment to operating expenditure to reflect productivity improvements.

[6] ICT capital expenditure can be recurring or non-recurring. Recurring ICT expenditure is related to maintaining ICT services, functionalities, capability and/or market benefits and occurs at least once every five years. Non-recurring ICT expenditure relates to maintenance expenditure that is not required every five years, costs incurred from a regulatory change or the acquisition of new or expanded ICT functionality or capability.

*Image: Ausgrid*

# 4 Recommendations

Seven recommendations have been made, which were informed by the views of stakeholders. These include:

- Three recommendations for NSPs (Section 4.1)
- Three recommendations for energy governance bodies and governments (Section 4.2)
- One recommendation for the wider energy industry (Section 4.3).

## 4.1 Recommendations for network service providers

### 1. Build stronger internal capabilities to support digital transformation

The digital transformation of NSPs will require new and/or more robust capabilities and tools to undertake data analytics and maintain cybersecurity.

Stronger data analytics skills will be required in NSP workforces to complement core business skills, develop data uses and maximise their benefits. Also, the transition from DNSP to DSO was identified by stakeholders as a key driver for building workforce capabilities over the next five years, to optimally manage an increasingly dynamic and distributed network.

New digital platforms (for example, network analytics) will also be required to implement future data use cases. NSPs highlighted the need for flexible and scalable tools that can integrate data from multiple and diverse sources and cater for the increasing volume of data. Platforms will also need to cater for more real-time data as DNSPs transition to a DSO role and seek to dynamically manage their networks.

Furthermore, the increasing volume of data exchanged between multiple parties and multiple interfaces is increasing the vulnerability of electricity networks to cyberattacks. NSPs highlighted that given its growing importance, they would like to improve their maturity in managing cybersecurity risks.

Building capabilities to identify and mitigate cyber threats is important to protect customer data and ensure safe and reliable network operation. This was also highlighted in *Australia's Cyber Security Strategy 2020* (published August 2020), which stated the need to improve baseline cybersecurity for critical infrastructure [20].

### 2. Foster cultural change and intra-NSP collaboration

In addition to stronger capabilities, digital transformation may require a shift in organisational culture.

Some departments in network businesses may be resistant to adapting their legacy processes to new technologies, systems or processes. Several NSPs identified the need for a shift in culture to support the digital transformation and embed the use of data to improve the efficiency of managing networks holistically. IT departments may particularly need to transition from traditional waterfall models to agile and iterative processes that are more suitable for data-driven developments.

Further internal collaboration between an NSP's business units may also be required to support their digital transformation. A few NSPs, for example, highlighted the challenge of positioning the data analytics function within their organisation. This is because while data analytics involves the IT department, it can serve all business activities. As such, internal collaboration between business units would typically help NSPs identify synergies between data use cases and further refine their digitalisation roadmap. This could include, for example, the fact that LiDAR data can be used for both vegetation management and asset condition monitoring.

As has been successfully used in other industries, such as retail, establishing a Chief Data Officer (CDO) could also help position the data analytics function and its role within NSPs. Depending on the maturity level of the NSP, the CDO can take responsibility for data integrity. They can also take ownership of the development of data uses cases and collaboration between business units and IT, to help break down silos.

### 3. Revisit business cases for data applications

The rapid pace of ICT developments may result in specific investment decision-making processes. As ICT solutions progress over time, NSPs may typically consider revisiting the cost-benefit analysis of technology-driven data use cases, for instance, every regulatory period.

NSPs use cost-benefit analyses to inform the prioritisation of data use cases and develop regulatory proposals. As such, cost can be a barrier to the development and implementation of new use cases. However, ICT solutions progress at a faster pace than historical network solutions, so data use cases that do not currently compare well in a cost-benefit analysis may have a positive net-benefit in the future. Technological advancements and declining costs may thus enable NSPs to implement new data use cases.

A recent example of this is the declining cost of LiDAR technology. It has led half of the DNSPs consulted in this study to integrate LiDAR surveys into their vegetation management and broader asset management strategies. One NSP also mentioned that declining sensor costs could further help NSPs monitor LV networks in the future.

## 4.2 Recommendations for energy governance bodies and governments

### 4. Assess the merits of increasing smart meter requirements during the next Power of Choice (PoC) review

The AEMC may consider undertaking a cost-benefit analysis to assess the merits of revising the minimum standard set of smart meter data available to DNSPs. This analysis could complement a stakeholder consultation process.

#### Expanding the minimum set of data made available to DNSPs

Smart meter data is becoming increasingly important for managing the LV networks as DER penetration increases. However, under current PoC arrangements, DNSPs must commercially negotiate with metering coordinators for access to power quality data (such as voltage), in addition to consumption data. The cost of accessing power quality data was stated by most DNSPs in PoC jurisdictions as a key barrier to implementing some data use cases. This translates to a higher number of use cases implemented in Victoria compared to PoC jurisdictions.

Expanding the minimum information made available to DNSPs could improve outcomes for customers by enabling DNSPs to implement use cases such as dynamic voltage control and neutral integrity monitoring. A comparison of the benefits of such use cases and the costs under current arrangements of an expanded set of smart meter data will ensure that any decision supports the best outcome for consumers.

Increasing the minimum services that smart meters are required to provide in PoC jurisdictions may also provide additional benefits through the implementation of use cases. Currently, the minimum specifications do not support power quality monitoring or real-time network operations such as demand management, fault identification or DER coordination. Increasing the minimum specifications will enable customers to benefit from such use cases (e.g. maximised DER, improved affordability, safety and reliability in dynamic networks).

#### Increasing the pace of smart meter rollout

In addition, the AEMC may wish to consider the merits of increasing the pace of the smart meter rollout. Under PoC, at a minimum, retailers are only required to install smart meters in new developments, for faulty meter replacements or upon customer request. Several DNSPs highlighted that the rollout of smart meters is happening too slowly. They also highlighted that the lack of visibility, or opportunity to purchase data to improve visibility, is preventing the implementation of several use cases. Increasing the requirements for installing smart meters (such as with new PV installations, as is the case in New South Wales) may speed up the rollout. This would nevertheless need to be carefully weighed against the increased cost to customers.

### 5. Consider developing cybersecurity guidelines in close consultation with NSPs

A nationally consistent approach to cybersecurity is preferred and this is being addressed as part of *Australia's Cyber Security Strategy 2020.* The *Protecting Critical Infrastructure and Systems of National Significance Consultation Paper* by the Department of Home Affairs proposes to establish an overarching risk-based regulatory framework, supported by industry co-developed security standards.

The AESCSF was a first step in developing a framework for assessing, prioritising and improving cybersecurity capability and maturity. Government may wish to consider developing the AESCSF further with extensive consultation with NSPs and may build on overseas cybersecurity frameworks and regulations for critical infrastructure. These cybersecurity frameworks and standards must consider trade-offs between costs and vulnerability as well as differences between protecting customer privacy and operation of the networks.

### 6. Consider undertaking further consultation on the non-network ICT CAPEX assessment approach

The AER may consider undertaking additional consultation to ensure that the non-network ICT CAPEX assessment approach is widely understood and considers challenges and concerns raised by DNSPs.

While stakeholders highlighted the assessment approach as a positive first step, several challenges and concerns were also noted. Specifically, DNSPs consider the assessment approach to treat ICT assets like network assets, despite the risk profile being very different.

Key challenges relate to the treatment of non-recurrent expenditure, the use of trend analysis and benchmarking to assess recurrent expenditure and potential double-counting of productivity improvements. Through further consultation, any challenges or misinterpretations of the assessment approach may be managed.

## 4.3 Recommendation for the wider energy industry

### 7. Enhance the development and implementation of data use cases through knowledge sharing

Through collaboration and knowledge sharing, the broader energy industry can maximise the use of data to drive customer benefits.

#### Knowledge sharing between NSPs

Collaboration and sharing insights across NSPs about the new business units or capabilities related to data developments can enable the efficient implementation of use cases. Such collaboration opportunities between NSPs have been initiated by Energy Networks Australia.

Sharing insights and experiences in implementing new data use cases (i.e. what worked, what did not) will also be important to ensuring that use cases maximise the opportunities and benefits to networks and customers. For example, DNSPs in Victoria could share learnings on smart meter-based use cases with DNSPs outside Victoria and help them develop their business cases. Through the stakeholder consultation process of this project, several trials for implementing data use cases were also highlighted. Sharing insights between trial proponents will also help progress best practice of data-driven networks.

Also, rather than just focusing on knowledge sharing, NSPs could strive to work on a consistent roadmap for digital transformation. The objective of such a roadmap could be to converge on a common status of implementation based on an agreed timeframe.

#### Knowledge sharing across the energy industry

Expanding collaboration across the energy industry (including NSPs, technology developers, universities, governments and peak bodies) can enable further development and implementation of data use cases to benefit networks and customers. This is particularly important for use cases designed to solve emerging issues or based on new business models (such as DER coordination). There are already examples of projects that involve multiple parties working on DER-related data use cases. These include the ARENA evolve DER project [14] and the ARENA Distributed Energy Integration Program (DEIP) [24]. However, there are few examples of industry collaboration outside DER-related projects.

In addition, industry collaboration can support the development of technical standards to ensure that data is being provided in a consistent and appropriate format. DNSPs may thus wish to collaborate with third-party data providers to develop technical standards.

# Glossary of terms

| | |
|---|---|
| **Ad hoc** | Not a specific data system, depends on the data collected. |
| **AEMC** | Australian Energy Market Commission |
| **AEMO** | Australian Energy Market Operator |
| **AER** | Australian Energy Regulator |
| **AMI** | Advanced Metering Infrastructure, a combination of a network of smart meters and the telecommunication infrastructure used to collect data from the meters. |
| **ARENA** | Australian Renewable Energy Agency |
| **Asset attributes** | All attributes pertaining to network assets (e.g. type, age, condition, material, etc.). |
| **Asset connectivity** | Network relationship between assets on the network (e.g. which poles are on which lines). |
| **Asset data** | Data relative to network assets. |
| **Asset location** | Geographic coordinates of network assets. |
| **CAPEX** | Capital expenditure |
| **CIS** | Customer Information System, a customer relationship management application allowing customisation of the database dynamically, with custom fields. |
| **Customer attributes** | Attributes pertaining to network customers (e.g. address, tariff, installed PV capacity, other DER, etc.). |
| **Customer data** | Data relative to network customers. |
| **Customer load** | Electric load and power quality measurement metered per customer. |
| **Data system** | System where the data is stored. |
| **DER** | Distributed energy resources |
| **DMS** | Distribution Management System, an IT system capable of collecting, organising, displaying and analysing real-time electric distribution system information. It is used in the DNSP control room. |
| **Electric load** | Active (MW) and reactive (MVAR) power measured at different levels of the network. |
| **ERP** | Enterprise Resource Planning, suite of integrated applications used to collect, store, and manage data from different business activities. |
| **External data** | Data collected by third parties not specifically for the operation of an electricity network. |
| **Geographic features** | Geographic segmentation of the territory, usually based on administrative boundaries (postal codes, statistical areas, local government areas, etc.). |
| **GIS** | Geographic Information System, a framework providing the ability to capture and analyse spatial data. |
| **ICT** | Information communication technologies |

| | |
|---|---|
| **Land fuel** | Geographic information regarding ground fuel, used to simulate bushfire propagation. |
| **Land use** | Geographic information of the use of land per cadastral parcel. |
| **LiDAR data** | Light RADAR, three-dimensional mapping of assets and their environment, which can be used for asset management for instance. Three main sources of LiDAR are used: terrestrial, planes and drones. |
| **Live fault data** | Real-time information about faults on the network. |
| **OMS** | Outage management system, a computer system used to assist in the restoration of power and record outage events data. |
| **OPEX** | Operating expenditure |
| **Outage/fault data** | Historical faults and outages, including for instance the cause, duration, and number of customers off supply for an outage. |
| **New tech uptake** | Uptake of new technologies such as rooftop PV, batteries and electric vehicles. |
| **Population uptake** | Forecast of population at different granularity levels. |
| **Power quality data** | Voltage, power (active and reactive), frequency and harmonic distortion of the electric signal. |
| **PV generation** | Customer photovoltaic (PV) generation cannot be measured with their smart meter and comes directly from the PV system's inverter. |
| **SCADA** | Supervisory Control and Data Acquisition, a system of software and hardware elements allowing businesses to control processes, monitor, store and process real-time data, and interact with physical devices. |
| **Smart meter** | A device that digitally records information such as electricity consumption, voltage, current and power factor. This information can be sent remotely without requiring it to be read manually. Smart meters can also be remotely switched on and off and notify electricity distributors when a customer's power is out. |
| **Use cases** | An application of data and analytics to improve business performance. |
| **Weather data** | Data recorded by automatic weather stations across the network. |

# Appendix 1 — List of stakeholders

As part of the stakeholder consultation process, 28 interviews were conducted with 44 stakeholders from 22 organisations. All of Energy Networks Australia's members were interviewed. In addition to DNSPs and TNSPs, third-party technology, data and service providers were also interviewed to provide complementary insights.

**TABLE 6 — LIST OF ORGANISATIONS THAT PARTICIPATED IN THE STAKEHOLDER CONSULTATION PROCESS**

| Organisation | Stakeholder type | State |
|---|---|---|
| **1. Ausgrid** | DNSP | New South Wales |
| **2. AusNet Services** | DNSP & TNSP | Victoria |
| **3. CitiPower and Powercor** | DNSP | Victoria |
| **4. ElectraNet** | TNSP | South Australia |
| **5. Endeavour Energy** | DNSP | New South Wales |
| **6. Energy Queensland** | DNSP | Queensland |
| **7. Essential Energy** | DNSP | New South Wales |
| **8. Evoenergy** | DNSP | Australian Capital Territory |
| **9. Horizon Power** | DNSP & TNSP | Western Australia |
| **10. Jemena** | DNSP | Victoria |
| **11. Power & Water** | DNSP & TNSP | Northern Territory |
| **12. Powerlink** | TNSP | Queensland |
| **13. SA Power Networks** | DNSP | South Australia |
| **14. TasNetworks** | DNSP & TNSP | Tasmania |
| **15. Transgrid** | TNSP | New South Wales |
| **16. United Energy** | DNSP | Victoria |
| **17. Western Power** | DNSP & TNSP | Western Australia |
| **18. Landis+Gyr** | Technology, data & service provider | — |
| **19. Mondo** | Technology, data & service provider | — |
| **20. Solar Analytics** | Technology, data & service provider | — |
| **21. Solcast** | Technology, data & service provider | — |
| **22. Zepben** | Technology, data & service provider | — |

# Appendix 2 — Data types, systems and models

A range of data types, systems and software are required to implement different use cases. Thus, this appendix is divided into the following sections:

- Data categorisation
- Types of data per use case category
- Data systems and models

## Data categorisation

Data can be divided into five broad categories (see Table 7):

1. **Asset data** includes information about network assets collected from a range of sources including monitoring devices, field surveys and equipment providers. Asset data can be static (such as asset attributes) or dynamic (such as LiDAR data).
2. **Network operation data** includes dynamic information provided by network monitoring devices.
3. **Customer data** can be both static (such as connection agreements) and dynamic (such as customer load) and can be provided by meters, connection agreements and third-party data providers.
4. **Financial data** includes revenue and billing information.
5. **External data** is data not directly linked to assets or customers such as weather data and land use data.

**TABLE 7 – KEY DATA CATEGORIES, SYSTEMS AND SOURCES IDENTIFIED BY STAKEHOLDERS**

| Data system | Example data | Data source |
|---|---|---|
| **Asset data** | | |
| Enterprise Resource Planning (ERP) system | Asset attributes<br>Work order data | Equipment providers<br>Field surveys |
| Outage Management System (OMS) | Outage and fault data | Network monitoring devices<br>Smart meters<br>Customer calls |
| Geographic Information System (GIS) | Asset location<br>Asset connectivity | Field surveys<br>Photographic imagery |
| Ad hoc | LiDAR data | LiDAR surveys |
| **Network operation data** | | |
| Supervisory Control and Data Acquisition (SCADA) | Electrical load | Network monitoring devices |
| Distribution Management System (DMS) | Live fault data<br>Power quality data | Network monitoring devices<br>Smart meters |
| **Customer data** | | |
| Meter Data Management System | Customer load | Interval and smart meters |
| | Large-scale generation load | Smart meter |
| Customer Information System | Customer attributes | Connection agreements |
| Ad hoc | PV generation trace | Third-party data provider |
| **Financial data** | | |
| Enterprise Resource Planning (ERP) system | Revenue<br>Cashflows | Procurement<br>Billing |
| **External data** | | |
| Ad hoc | Weather data | Weather monitoring devices<br>Third parties or government (Bureau of Meteorology) |
| | Land use data | Government |
| | Population growth<br>New technology uptake | Third parties or government |

## Types of data required per use case category

Some data sources are key for most use cases. As shown in Table 8, in some instances, different use cases will leverage the same data. For example, power quality data and customer data (such as PV generation) are key for future network operation and planning use cases. Also, live fault data is used by network maintenance and network operation use cases. Finally, asset data (especially GIS data) is relevant to all categories.

While some asset data (such as date of installation or rating) can be static, NSPs also use dynamic and time-series data to manage their networks. Data may be measured at different intervals (such as every five or 30 minutes) and provided at different rates (such as in real-time or daily). The data specifications will depend on the use case:

- Some network operation use cases require smart meter data in (near) real-time (such as fault identification, demand response and dynamic voltage control).
- Some network maintenance use cases (such as vegetation management and condition monitoring) can receive data less frequently given it may be months before the data is used.

**TABLE 8 – MAIN DATA TYPES PER USE CASE CATEGORY**

| Data type | Network maintenance | Network operation | Network planning | Regulation |
|---|---|---|---|---|
| Asset data | • Asset attributes<br>• Asset location<br>• Outage and fault data<br>• LiDAR data<br>• Asset condition | • Asset attributes<br>• Asset location<br>• Asset connectivity<br>• Outage and fault data<br>• LiDAR data | • Asset location<br>• Asset connectivity | • Asset attributes<br>• Asset location |
| Network operation data | • Live fault data | • Electric load<br>• Power quality data<br>• Live fault data | • Power quality data | |
| Customer data | • Customer attributes | • Customer attributes<br>• Customer load<br>• PV generation | • Customer attributes<br>• Customer load<br>• PV generation | • Customer attributes<br>• Customer load<br>• PV generation |
| External data | • Weather data<br>• Land use data | • Weather data | • Weather data<br>• Population growth<br>• New technology uptake | |

**TABLE 9 – DATA SPECIFICATIONS FOR TIME-SERIES DATA**

| Use case category | Measurement interval | Update rate |
|---|---|---|
| Network maintenance | — | Monthly/yearly |
| Network operation | 10s – 5 min | Real-time/hourly/daily |
| Network planning | 5 – 30 min | Monthly |
| Regulation | 5 – 30 min | Monthly/yearly |

## Data systems and models

In order to enable data use cases, different data processing capabilities are required. Examples include:

- **Optimisation models** use data to maximise the efficiency or minimise the cost of a decision or process. For example, an optimisation model can be used to optimise the logistics of field crew dispatch in response to a fault identification to reduce outage time.
- **Risk quantification models** identify the level of risk of a decision based on a number of inputs. For example, a bushfire risk management tool can assess the likelihood and consequence of fire start based on location, pole type, vegetation growth and temperatures.
- **Machine learning techniques** for advanced monitoring and modelling capabilities to further improve use cases. Machine learning techniques enable a software system to learn from data for improved analysis to draw greater insights (such as load forecasting). Machine learning techniques can also be used to further improve asset maintenance use cases such as vegetation management. For example, a training dataset may be fed into a classification algorithm to train the algorithm how to classify inputs.
- **Power flow models** are used to model the flow of electricity through an energy system and allow an estimation of power quality (e.g. voltage and current) based on network characteristics, consumption and generation data. Power flow models can enable the building of a digital representation of a physical asset, system or network. These models can be used to assess power quality issues on portions of the network that do not have sensors and determine networks DER hosting capacity.

Some DNSPs are implementing new software that is similar to a distribution management system (DMS) but integrates multiple systems (such as DMS, OMS and SCADA). Such software enables efficient network operation and further integration of DER. Examples include:

- **Advanced Distribution Management System (ADMS)**: A software platform that supports the planning and operation of distribution networks by managing, controlling and visualising and optimising the network. ADMS enables better linkages between systems.
- **DER Management System (DERMS)**: A software platform that supports DNSPs in organising the operation of aggregated DER to support local network conditions. A DERMS is used for the coordination of DER.

Moving forward, additional data systems and digital platforms may be required. Digital platforms enable data analytics and collaboration across parties or business areas to optimise decisions about network operation and investment.

# Appendix 3 – Data use case fact sheets

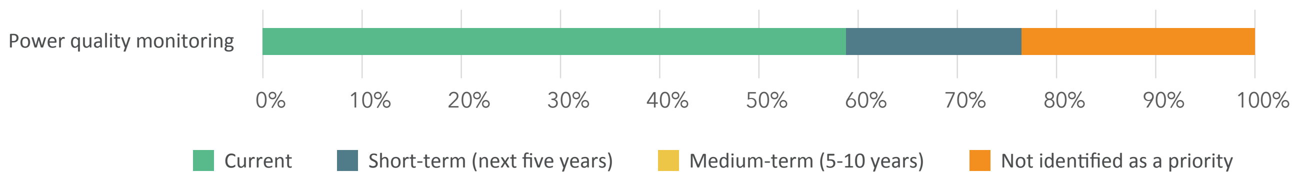
## Power quality monitoring

### Use case description and maturity

| | |
|---|---|
| ***Business unit*** | Network operation |
| **Definition** | Power quality monitoring is the process of gathering and analysing power quality data such as voltage, current and reactive power. This enables NSPs to identify and report on power quality issues. Power quality issues can typically arise due to increasing intermittent renewables and DER penetration. Identifying power quality issues is a prerequisite to developing mitigation options. Both DNSPs and TNSPs undertake power quality monitoring. The increasing penetration of intermittent large-scale renewables can cause issues on the transmission networks (e.g. system strength, inertia) while growing DER can cause high voltages on the distribution networks. |

**Level of maturity:** Mature in Victoria with ongoing trials in other jurisdictions

**Percentage of NSPs that identified power quality monitoring as priority**




### Qualitative cost-benefit analysis

**Costs**

Capital expenditures include:

- Installation of power quality monitors (e.g. distribution transformer monitors, LV circuit monitors, smart metering sensors)
- Installation or upgrade of data communication (e.g. on power quality monitors) and data storage infrastructure
- Development of LV network models (see LV network modelling).

Operating expenditures include:

- Procurement of smart meter data (outside Victoria)
- Procurement of solar data
- Operating expenditure related to power quality monitors (marginal).

**Benefits**

Network benefits include:

- More targeted investment to address identified issues, including the ability to predict and respond before power quality and safety issues arise
- Reduced quality of supply complaints thus reducing costs of service callouts
- Faster processing of connection applications
- Reduced manual collection of power quality data.

Customer benefits include:

- Improved quality of supply
- Improved performance, efficiency and longevity of equipment and appliances
- Increased installation rate of DER and increased PV generated on networks maintaining quality of supply and safety.

### Data requirements

**Data sources**

- Power quality monitors
- Smart meters
- Smart inverters

**Data systems & tools**

- GIS
- CIS and/or DER register
- Power flow model

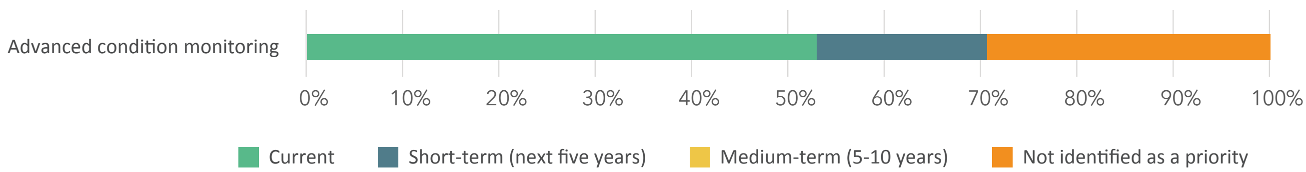
## Advanced condition monitoring

### Use case description and maturity

| | |
|---|---|
| ***Business unit*** | Network maintenance |
| **Definition** | Condition monitoring is the process of diagnosing the health of network assets based on conditions such as performance, age or location. Traditionally, condition monitoring was undertaken via inspections in the field. Advanced techniques (such as the ultrasonic testing for poles) and remote monitoring (such as using LiDAR or sensors) facilitate more accurate diagnosis of an asset's condition. Condition monitoring supports the optimisation of NSPs' asset management strategy. |

**Level of maturity:** Mature

**Percentage of NSPs that identified advanced conditioning monitoring as priority**




### Qualitative cost-benefit analysis

**Costs**

Capital expenditures include:

- Procurement of inspection equipment (e.g. ultrasonic testing for poles)
- Installation or upgrade of data communication (e.g. on power quality monitors) and data storage infrastructure
- Development of condition-based risk models (see Risk-based maintenance optimisation).

Operating expenditures include:

- Inspection and data acquisition (e.g. LiDAR) costs
- Software licences
- Cloud computing costs
- Operating expenditure related to inspection equipment (marginal).

**Benefits**

Network benefits include:

- Reduced inspection costs
- Reduced asset failure risks
- Minimised lifecycle cost of assets.

Customer benefits include:

- Increased network safety and reliability.

### Data requirements

**Data sources**

- LiDAR
- Aerial imagery
- Asset attributes and asset condition
- Weather monitoring devices

**Data systems & tools**

- GIS
- ERP
- LiDAR data visualisation tools

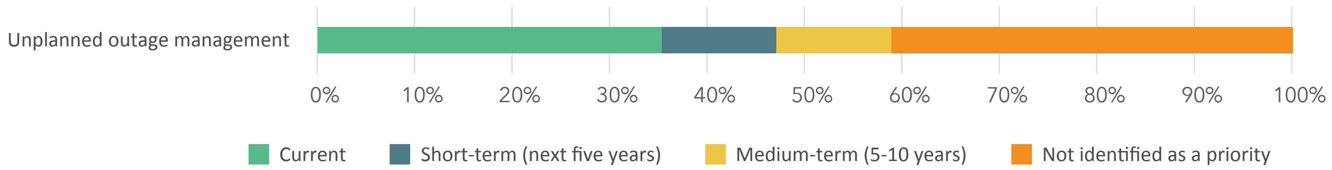
## Unplanned outage management

### Use case description and maturity

| | |
|---|---|
| ***Business unit*** | Network operation |
| **Definition** | Outage management is the process of using smart meters to identify unplanned outages and respond in a timely manner to reduce outage time. Smart meters or network sensors can notify DNSPs when a customer's power is out in real-time. This enables field crews to be allocated to jobs in a priority order so that customers' outage times are reduced. This can be further expanded to send alerts when a life-support customer is being impacted. |

**Level of maturity:** Relatively mature

**Percentage of NSPs that identified unplanned outage management as priority**




### Qualitative cost-benefit analysis

| Costs | Benefits |
|---|---|
| Operating expenditures include:<br>• Procurement of smart meter data, including live signals when meters deactivate (outside Victoria).<br>Capital expenditures include:<br>• Installation of network sensors. | Network benefits include:<br>• Reduced outage duration thanks to faster maintenance responses<br>• More efficient workforce effort.<br>Customer benefits include:<br>• Reduced outage duration<br>• Improved customer satisfaction (from proactive communications)<br>• Increased reliability. |

### Data requirements

| Data sources | Data systems & tools |
|---|---|
| • Network sensors<br>• Smart meters<br>• Customer attributes | • ADMS, DMS<br>• OMS<br>• SCADA<br>• GIS |

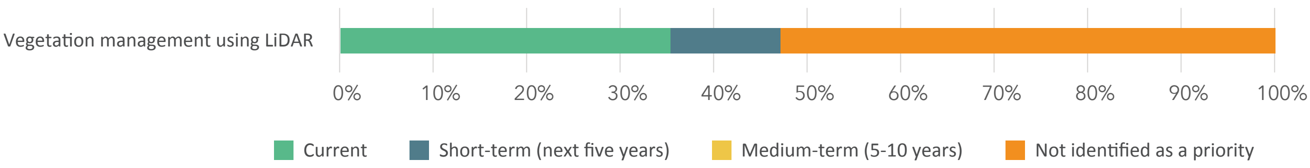
## Vegetation management using LiDAR

### Use case description and maturity

| | |
|---|---|
| ***Business unit*** | Network maintenance |
| **Definition** | Vegetation management is the process of managing vegetation near powerlines to reduce power outage risks and potential bushfires caused by vegetation. Traditionally, NSPs have undertaken vegetation management based on inspection cycles. NSPs are increasingly using LiDAR to remotely identify potential encroachment risks. This use case is undertaken by both TNSPs and DNSPs. |

**Level of maturity:** Relatively mature

**Percentage of NSPs that identified vegetation management using LiDAR as priority**




### Qualitative cost-benefit analysis

| **Costs** | **Benefits** |
|---|---|
| Capital expenditures include:<br>• Procurement of data acquisition equipment if done internally (e.g. drones and helicopters)<br>• Development of vegetation clearance and vegetation growth models (if done internally).<br>Operating expenditures include:<br>• Procurement of imagery and LiDAR data processing services (if done by an external provider)<br>• Software licences and cloud computing (if done internally). | Network benefits include:<br>• Reduced operating expenditures related to vegetation management<br>• Increased compliance<br>• Reduced bushfire risks.<br>Customer benefits include:<br>• Increased network safety and reliability. |

### Data requirements

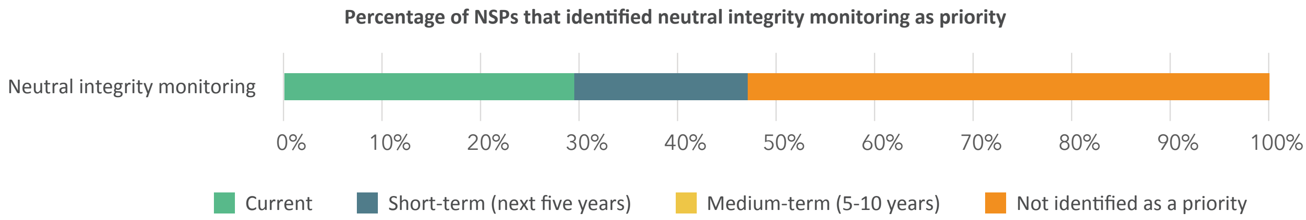
| **Data sources** | **Data systems & tools** |
|---|---|
| • LiDAR<br>• Asset attributes | • GIS<br>• ERP<br>• LiDAR data visualisation tools<br>• Machine learning techniques including classification models |

## Neutral integrity monitoring

### Use case description and maturity

| | |
|---|---|
| ***Business unit*** | Network maintenance |
| **Definition** | Neutral integrity monitoring is the process of identifying or predicting neutral integrity failures to reduce customer shock risks. Traditionally, neutral integrity risks are managed through inspection and replacement programs. However, smart meters or purpose-build sensors enable DNSPs to actively monitor network parameters to detect and respond to neutral integrity failures. This reduces the need for undertaking larger inspection and replacement programs. |

**Level of maturity:** Under development to relatively mature




### Qualitative cost-benefit analysis

| Costs | Benefits |
|---|---|
| Capital expenditures include:<br>• Installation of neutral integrity monitors or upgrade of smart meters<br>• Development of algorithm to detect neutral faults.<br>Operating expenditures include:<br>• Procurement of smart meter data (outside Victoria)<br>• Software licences<br>• Cloud computing costs. | Network benefits include:<br>• Reduced neutral integrity risks (e.g. fires and other safety issues)<br>• Faster and proactive maintenance responses<br>• Reduced customer complaints.<br>Customer benefits include:<br>• Reduced damage to appliances<br>• Increased network safety (reduced shock risk). |

### Data requirements

| Data sources | Data systems & tools |
|---|---|
| • Network sensors<br>• Smart meters<br>• Asset attributes | • ERP<br>• GIS<br>• Neutral fault identification software |

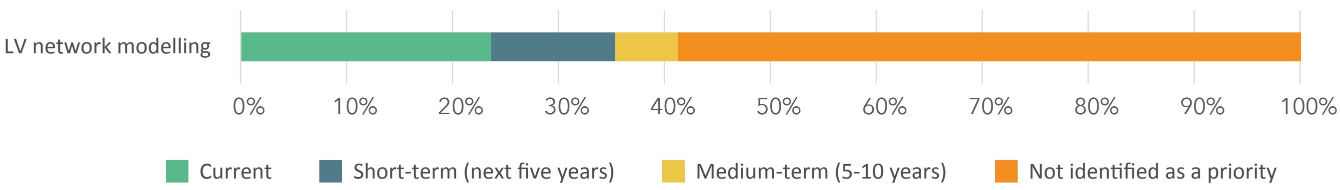
## LV network modelling

### Use case description and maturity

| | |
|---|---|
| ***Business unit*** | Network planning |
| **Definition** | LV network monitoring is the process of modelling LV network behaviour based on network characteristics and consumption and generation data. LV network modelling is the first step to a number of use cases including power quality monitoring. LV network modelling allows for improved load forecasting, better understanding of power quality and faster connection approvals. |

**Level of maturity:** Under development to mature

**Percentage of NSPs that identified LV network modelling as priority**




### Qualitative cost-benefit analysis

**Costs**

Capital expenditures include:

- Installation of network sensors
- Development of models.

Operating expenditures include:

- Software licence
- Cloud computing costs.

**Benefits**

Network benefits include:

- More targeted investment to address identified issues, including the ability to predict and respond before network issues arise
- Reduced quality of supply complaints thus reducing costs of service callouts
- Faster processing of connection applications
- Reduced manual collection of network data.

Enables other use cases:

- Power quality monitoring
- New connections
- Day ahead load forecasting.

Customer benefits include:

- Improved quality of supply
- Improved performance, efficiency and longevity of equipment and appliances
- Increased installation rate of DER and increased PV generated on networks.

### Data requirements

**Data sources**

- Network sensors (including smart meters)
- AMI (including smart meters and solar devices)
- Third party for PV generation, new technology uptake
- Connection agreements (DER installations)

**Data systems & tools**

- GIS
- Power flow models

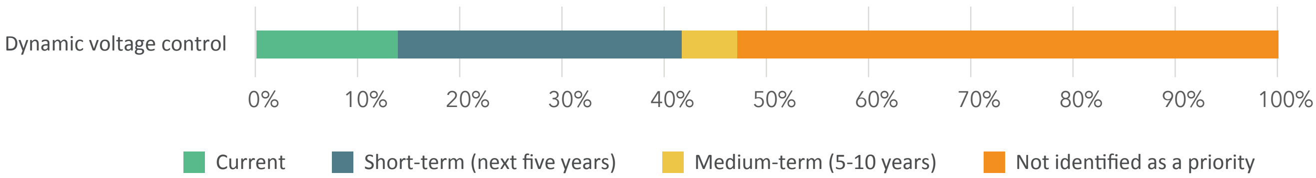
## Dynamic voltage control

### Use case description and maturity

| | |
|---|---|
| ***Business unit*** | Network operation |
| **Definition** | Dynamic voltage control is the process of managing voltage in real-time to maintain voltage within the nominal range. Power quality monitoring is a prerequisite to dynamic voltage control. Dynamic voltage control uses network voltage control devices such as on-load tap changers or low voltage regulators to respond in real-time to high or low voltages on the network. This use case is only relevant to DNSPs and has growing importance as DER penetration increases. |

**Level of maturity:** Under development

**Percentage of NSPs that identified dynamic voltage control as priority**




### Qualitative cost-benefit analysis

| Costs | Benefits |
|---|---|
| Capital expenditures include:<br>• Installation of network voltage control devices (e.g. OLTC, LVR).<br>Operating expenditures include:<br>• Software licences (e.g. ADMS software). | Network benefits include:<br>• Improved voltage regulation<br>• Deferral of network augmentation expenditure.<br>Customer benefits include:<br>• Increased quality of supply<br>• Increased installation rate of DER and increased PV generated on networks. |

### Data requirements

| Data sources | Data systems & tools |
|---|---|
| • Network sensors<br>• Smart meters | • ADMS, DMS<br>• SCADA |

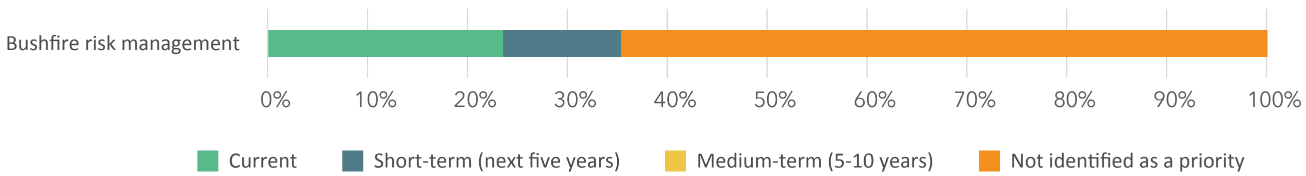
## Bushfire risk management

### Use case description and maturity

| | |
|---|---|
| ***Business unit*** | Network maintenance |
| **Definition** | Bushfire risk management is the process of assessing the network-related bushfire risk based on fault ignition likelihood and bushfire consequences such as property damages or agricultural losses. Bushfire risk management allows for targeted and optimised maintenance to reduce bushfire risks. This use case is relevant to both TNSPs and DNSPs, particularly those located in bushfire prone areas. |

**Level of maturity:** Under development to relatively mature

**Percentage of NSPs that identified bushfire risk management as priority**




### Qualitative cost-benefit analysis

#### Costs

Capital expenditures include:

- Development of bushfire risk models.

Operating expenditures include:

- Software licences
- Cloud computing costs.

#### Benefits

Network benefits include:

- Optimised maintenance
- Reduced bushfire risks and related consequences (e.g. F-factor penalty, insure claims).

Customer benefits include:

- Increased network safety
- Reduced bushfire consequences (e.g. property damage).

### Data requirements

#### Data sources

- Historical failure and ignition data
- Asset attributes
- Weather data
- Land-use data

#### Data systems & tools

- GIS
- ERP
- Risk quantification model

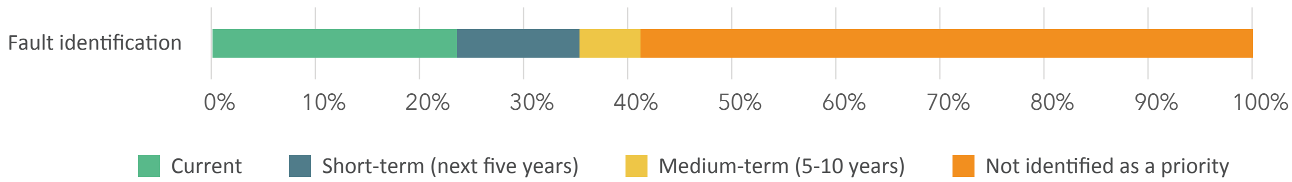
## Fault identification

### Use case description and maturity

| | |
|---|---|
| ***Business unit*** | Network operation |
| **Definition** | Fault identification is the process of using real-time data to detect or predict network failures. Fault identification includes network failures that lead to outages as well as other types of faults such as high impedance faults. Fault identification has consequences for outage management, neutral integrity monitoring as well as overall network reliability and safety. |

**Level of maturity:** Under development to mature

**Percentage of NSPs that identified fault identification as priority**




### Qualitative cost-benefit analysis

| Costs | Benefits |
|---|---|
| Capital expenditures include:<br>• Installation of network sensors.<br>Operating expenditures include:<br>• Procurement of smart meter data (outside Victoria). | Network benefits include:<br>• Proactive maintenance responses<br>• Faster resolution times<br>• Reduced operating expenditure.<br>Customer benefits include:<br>• Increased network safety and reliability. |

### Data requirements

| Data sources | Data systems & tools |
|---|---|
| • Network sensors<br>• Smart meters | • ADMS, DMS<br>• OMS<br>• SCADA<br>• Fault identification, location, isolation and service restoration (FLISR) |

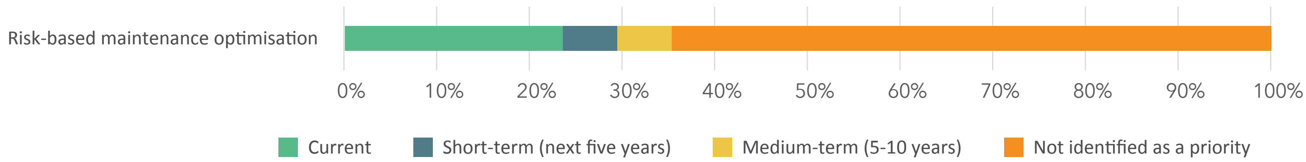
## Risk-based maintenance optimisation

### Use case description and maturity

| | |
|---|---|
| ***Business unit*** | Network maintenance |
| **Definition** | Maintenance optimisation is the process of improving asset maintenance and replacement strategies to optimise both network performance and inspection and replacement costs. Maintenance optimisation usually builds on other data use cases such as condition monitoring and bushfire risk management. For example, inputs from condition monitoring can be used to predict when an asset may need replacement. This can help optimise replacement strategies to ensure that assets are not replaced too soon or too late. |

**Level of maturity:** Under development to mature

**Percentage of NSPs that identified risk-based maintenance optimisation as priority**




### Qualitative cost-benefit analysis

**Costs**

Capital expenditures include:

- Procurement of inspection equipment (e.g. ultrasonic testing for poles)
- Installation or upgrade of data communication (e.g. on power quality monitors) and data storage infrastructure
- Development of condition monitoring models (e.g. risk-based models).

Operating expenditures include:

- Software licence
- Cloud computing costs.

**Benefits**

Network benefits include:

- Optimised maintenance, resulting in reduced operating expenditure
- Optimised replacement strategies, resulting in reduced capital expenditure
- Reduced asset failure risks
- Minimised lifecycle cost of assets.

Customer benefits include:

- Increased network safety and reliability.

### Data requirements

**Data sources**

- Inputs from condition monitoring

**Data systems & tools**

- GIS
- ERP
- Optimisation model or risk quantification model

# Appendix 4 — Regulatory information notices

The AER uses Regulatory Information Notices (RINs) to collect standardised information from NSPs both at the time it is making a regulatory determination and also annually throughout the regulatory period. The AER uses this information to:

- Assess regulatory expenditure proposals
- Monitor network business outcomes against determinations
- Develop performance reports
- Prepare for future determinations.

RINs are not directly related to data use cases, however several NSPs raised two main challenges of RINs for which recommendations have been made.

**Challenge 1:** RINs provide a repository of network data, given that non-confidential information is published on the AER website for transparency. The AER publishes a number of Excel spreadsheets for each NSP. However, it was identified by several NSPs that having this information in a centralised database would enable NSPs and other parties to use the information more easily for their own benchmarking and comparisons.

**Recommendation:** The AER may wish to consider displaying information collected through RINs in a more user-friendly database (compared to its current format). This will enable the energy industry to access and use the information more easily.

**Challenge 2:** In some cases, RINs require information that is not normally collected by NSPs during their normal course of business. The cost of compiling RIN information can be large where processes are not automated and, in some cases, the end-use of the information reported can be unclear.

**Recommendation:** The AER may wish to consider undertaking further consultation with NSPs on the requirements of RINs. This can be to clarify why the AER may be collecting such information and address other issues.

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