



Australian electricity networks

A STATEMENT ON NATIONAL RESEARCH
PRIORITIES FOR NATURAL HAZARDS EMERGENCY
MANAGEMENT AND RESILIENCE

ISSUES, PRIORITIES, DIRECTIONS



Australian Government
**Department of Industry,
Innovation and Science**

Business
Cooperative Research
Centres Programme



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MAY 2019

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The Sendai Framework for Disaster Risk Reduction 2015-2030 provides guidance and acts as a motivator for governments around the world to consider how best to make their infrastructure resilient and reliable. One of the seven global targets of the framework is to “substantially reduce disaster damage to critical infrastructure and disruption of basic services, among them health and educational facilities, including through developing their resilience by 2030”.

Effective disaster resilience thinking acknowledges the complexities and interconnections that exist at all levels across society, including that of a variety of different critical lifeline utility services that contribute to a complex web of risk ownership and management (see Figure 1 below). It is also best understood as a process with an outcome, that has at its core an understanding and willingness to negotiate with others to allow an effective balance of complexities that influence society.

Throughout 2016-2018, emergency service agencies and other key stakeholders that play a role in disaster resilience around Australia participated in workshops hosted by the Bushfire and Natural Hazards CRC to consider the major issues in natural hazards emergency management and resilience, and how different stakeholders can best contribute to building a more disaster resilient Australia. This publication summarises the outcomes of one of these workshops which was held with Australia’s electricity network service providers in August 2018 and poses questions as a guide for a national research agenda and outlines priorities for knowledge gaps to be filled. For more information on how the workshops were conducted, please see page 10.

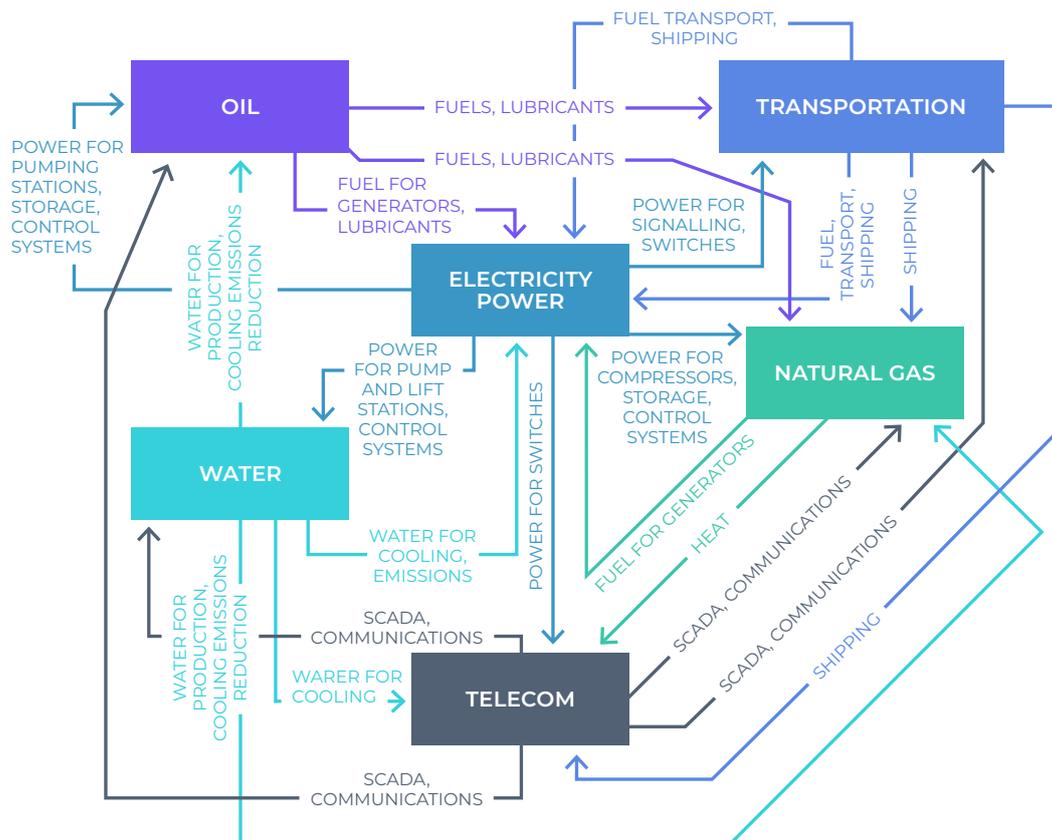


Figure 1: Examples of infrastructure interdependencies for selected critical infrastructure systems. Critical Infrastructure Resilience Strategy - Emergency Management Victoria (2015)

Electricity network context

Australia's electricity networks are one part of the electricity system, providing the infrastructure that connects generators to customers who purchase their electricity from a retailer. All these players operate in a highly regulated framework to ensure a reliable and cost-effective supply of electricity.

The nature of Australia's electricity system is transforming and moving away from large generators which operate over long distances to dispersed customers, to a system where customers are at the heart of the electricity system because they can now generate and store their own electricity and will provide services to support the electricity market. In this decentralised future, customers will still need to be connected to each other and to larger generators, via networks, to access the market.

By 2050 it is estimated that customers or their agents - not utilities - will determine how over \$200 billion in system expenditure is spent and millions of customer-owned generators will supply 30-45% of Australia's electricity needs¹.

In addition to the transformation in the way our electricity networks operate, the environment in which network infrastructure functions is also changing, with more extreme weather, such as cyclones, bushfires and heatwaves. Australia's networks need to respond to all of these significant changes and prepare their infrastructure, systems and supporting capabilities. This statement explores and identifies the priority areas that will allow networks to be resilient to natural hazards.

Increasingly, the complex linkages and dependencies between the electricity system and critical infrastructure and services have become better understood and acknowledged – with September 2016 in South Australia providing a good case study, with significant power outages following extreme weather².

Resilience and vulnerability in the context of electricity networks

Vulnerability is not the opposite of resilience, but understanding vulnerabilities is essential for the development of strategies and initiatives to build and sustain resilience. This includes:

- Understanding where there are vulnerabilities and the contributors to those vulnerabilities

- Where action can be taken effectively to reduce those vulnerabilities
- The ability for communities, governments and businesses to cope with adversity and disruptions to essential services and adapt accordingly.

Resilience is distinctly different from reliability – a term that holds specific connotations for the electricity sector and is a closely monitored metric. Reliability is linked to the everyday operation of electricity networks ensuring that electricity reaches those who need it, when they need it, whereas resilience is linked to the ability of the electricity system to supply electricity during and following an incident.

Resilience thinking acknowledges the existence of risk and prepares for the unexpected, recognising that at the same time, risks can never be completely known and quantified. Whilst electricity networks are only part of the broader electricity and energy sectors, they still have a critical role to play in mitigation and supporting communities to be more resilient to natural events now and in the future. Part of this approach relates to the ability of networks to make informed decisions about the physical design of the network, considering the lifecycle of pre-existing assets and also efficient and effective investments in new future assets (using concepts such as building back better) and maintenance strategies to maximise resilience, thereby supporting reliability.

Some complexity can be attributed to the fact that the electricity sector is currently incentivised for reliability (under the Australian Energy Regulator's Service Target Performance Incentive Scheme³) however, there are currently no specific incentive programs that reward network resilience. When investments are made in initiatives which support resilience, technical reliability requirements of networks and their assets are also addressed, however a balance must be made between increased costs for customers and an improvement in resilience and reliability.

As agreed by network service providers, the top four priorities for research related to natural hazard resilience for electricity networks are:

1. Understanding the fundamental vulnerabilities of Australia's electricity networks and strategies to minimise the risks posed by those vulnerabilities
2. New approaches to stakeholder engagement to support better planning and implementation of resilient networks and distributed generation capability
3. New concepts in operation and regulation of electricity networks (including frameworks)
4. Harnessing current and new data to enhance forecasting and modelling of electricity networks to better manage the risk and impacts associated with natural hazards.

What follows is a summary of each of the top four priorities identified, along with their corresponding challenges and opportunities.

Understanding the fundamental vulnerabilities of Australia's electricity networks and strategies to minimise the risks

Some of the specific challenges associated with minimising risks to electricity networks include achieving consistency across the sector for understanding vulnerability and defining risk. This encompasses:

- Understanding the fundamental vulnerabilities of the network overall, and in specific operating environments
- Clarifying who owns the risk for network failure
- Agreeing what is included in risk assessments
- Obtaining agreement on how to assess and value options to address those risks.

With clarity around these issues, networks will be able to focus on increasing the maturity of their approach to identifying and understanding:

- the vulnerabilities of their networks
- the risk management and minimisation strategies and practices across the sector to address those vulnerabilities.

With the greater capability that will come from this understanding, the vulnerabilities of businesses, communities and individuals who are reliant on the supply of electricity will also be included in the risk management and minimisation strategies.

More broadly, there are shared vulnerabilities and risks across the sector that go beyond the exposure of individual networks, and which need to be managed in parallel to ensure the reliability and resilience of the collective systems that are required to deliver electricity to consumers.

One of the biggest challenges is the lack of incentives in place to specifically improve resilience and a lack of clarity on acceptable decision points for future investment to reduce risk exposure. This includes risk mitigation and maintenance of assets such as powerlines. Compounding this, there is a need for greater recognition of the vulnerabilities of electricity networks to natural hazard risks by all stakeholders across government, private enterprise and the community, and agreement between them regarding the level of mitigation required to reduce risks to agreed levels.

Climate change is an important issue for the electricity sector. Better understanding of how the changing climate will influence the risks that networks face is critical. The decisions networks and regulators make today will deliver benefits into the future. Long term planning is important and will benefit from additional targeted research, particularly in the face of the uncertainties posed by the transformation of the electricity system and the impact of climate change on natural hazards. There are also opportunities to use the research to better inform 'day-to-day', critical, time sensitive decision making as natural hazards unfold around critical assets.

Risks, challenges and opportunities

RISKS

A national, common, shared understanding of risk, assessing risk and its management, is required for the electricity industry. This includes an understanding of the interaction and

interconnections between electricity networks and other critical infrastructure.

At local levels, we know that risk handovers between numerous stakeholders across the supply chain is not fully integrated, posing a substantial barrier to community resilience. It is acknowledged that risks can never be completely known and quantified, and robust approaches to resilience recognise the exposure of networks to residual risk and the need to prepare for the unexpected.

As expectations increase on networks to do more to mitigate against disruptions caused by natural hazards, and considering a future with more frequent and intense natural hazards over time, understanding how best to alleviate shocks and stresses on the networks will also become a significant issue.

CHALLENGES

Some of the specific challenges associated with risk management include how to achieve consistency across the sector for defining risk. This encompasses:

- clarifying who owns the risk
- what is included in risk assessments
- obtaining agreement on how to address those risks.

With clarity around these issues, networks will be able to focus on developing risk management practices so that a mature approach to the treatment of risk is common practice across the sector.

OPPORTUNITIES

As the electricity system transforms, identifying opportunities to re-imagine how networks operate and how new integrated approaches to energy resources, particularly at the distribution level, can build resilience and resistance to the impacts of natural hazards is important. For example, standalone power systems and larger microgrids have the potential to mitigate bushfire risks, minimise the impact of storms and improve reliability, while reducing the overall cost of operating the network. However, current regulations complicate the implementation of such approaches.

Workshop participants acknowledged that each network in Australia has different exposures to different hazard profiles (e.g. cyclone, bushfire, flooding etc), therefore creating vastly different

exposure and risk profiles, typically result in different methodologies for understanding, quantifying and addressing risk. Each network is best placed to determine the solutions that will work best in their location once they understand the local risk. Supporting networks to better understand that risk is an untapped opportunity.

While acknowledging the local differences, there are opportunities for networks to set agreed values and definitions for resilience nationally, which can contribute to developing a common framework for risk assessments. A standard approach to quantifying, assessing and mitigating risk that can be flexibly applied will result in a consistent approach and messaging to regulators, the community and other key stakeholders on the need for investment in risk mitigation and resilience.

New approaches to stakeholder engagement

Multiple stakeholders are responsible for ensuring resilience to the effects of natural hazards – individuals, communities, businesses and government. Effective disaster resilience is created when all stakeholders understand their role(s) and responsibility(s) in planning for and responding to an event, regardless of severity.

Risks, challenges and opportunities

RISKS

If network businesses undertake the development of approaches in isolation, without proper engagement with a broad range of stakeholders, creating resilience to natural hazards will not succeed.

Effective communication and expectation setting with the community about access to and reliability of supply is challenging. Networks, retailers, government and emergency services all have a need to communicate risk to communities and each entity has their own preferred method. In addition, how and what is communicated with communities matters, and when done poorly, can be a barrier to community resilience, especially for those most vulnerable in society. There is scope for enhancing the effectiveness of communication between these parties, when discussing potential threats and during natural hazard emergencies.

CHALLENGES

Across the emergency management and community safety spectrum, stakeholders (including electricity networks) are striving to maximise the two-way engagement with each other on vulnerabilities, risk and resilience, and to ensure that engagement is robust and informs effective decision making. Understanding how best to engage with communities across the full spectrum of key issues (including risk exposure, education, communication and ongoing engagement) remains essential.

Networks have identified the need for ongoing research to support a sustainable capability for productive dialogue and engagement with the planning sector. This maximises both shared and separate opportunities to mitigate natural hazard risks and build better resilience with current and future communities. Whilst there is tension between planning for reliability versus resilience, in general Australian networks are keen to focus resources on risk mitigation to minimise impacts.

Understanding risk in the context of what an individual stakeholder would find acceptable and balancing those competing risks is difficult. Coupled with this is reconciling what networks believe is high risk versus what customers believe is high risk. Communicating risk profiles and communicating outcomes if those risks aren't addressed is equally important.

Engagement with the community is inherently complex, especially regarding setting expectations on the regulatory perception of what consumers need, versus what consumers expect from their electricity providers across the supply chain (including networks). Despite the complexity, managing community expectations and awareness of power supply, reliability and impacts (the type and content of messaging being critical for shared risk ownership) is vital to ensure the community is not only aware, but also understands the shared actions that need to occur to make a more resilient society.

For example, some approaches (such as the suspension of reclosing) to mitigate bushfire risk may result in more numerous and/or prolonged outages or no power at all (a de-energised network). Ensuring that customers understand the risk versus the impact that a mitigating approach has is complex and delicate.

Customers are not the only stakeholders, and networks need to communicate and engage effectively with a broad range of organisations,

including emergency services, who typically encounter failed assets before network crews. In other countries such as the USA and the UK, there is a strong partnership between the electricity networks and the emergency services that effectively facilitates the management of assets during a natural hazard. In Australia, some networks are actively developing partnerships with emergency services, and the development of strong relationships between networks and other stakeholders would expand the ability of all to adequately respond to an event and therefore better prepare for a future with potentially more significant natural hazards.

OPPORTUNITIES

The opportunity for more effective engagement exists in Australia more so than many other countries due to a number of factors, including:

- Australia doesn't have land borders with other countries or electricity interconnection to other countries.
- The way which the networks are operating across the country provides an environment ripe for better collaborative and collegiate approaches to improve engagement between businesses, government and the community to build a more disaster resilient Australia.
- Networks indicate there is a real, untapped opportunity for them to take a more integrated (collaborative) approach, especially on data sharing, research, and effective customer engagement techniques, to ensure that no matter the region, networks, government, other businesses and communities have access to the same types of information and that it is delivered and communicated in a consistent way.
- Cross-agency engagement also provides an opportunity to facilitate efficiency and innovation, which can alleviate cost pressures that are barriers to resilience investment and network investment.

Understanding how best to improve social license when there is an outage offers an opportunity to deliver positive engagement with affected customers, to expand on their limited knowledge of electricity networks and how networks might be able to work in better partnership with communities to set and manage service delivery expectations⁴.

Better understanding the role that electricity networks occupy in natural hazard resilience and

the interaction with other utilities and service providers in this space will identify opportunities to build resilience through improvements to network reliability and implementing alternative energy solutions as permanent or temporary capabilities.

New concepts in operation and regulation of electricity networks

Electricity networks operate under significant regulatory structures that must be adhered to. Regulatory determination periods mean that networks have restricted flexibility in terms of their ability to put initiatives in place to strengthen the network and mitigate against natural hazards. All investments and spending need to be fully justified in submissions to the Australian Energy Regulator.

A tension exists between the perceived constraints of regulation and opportunities to deliver new approaches with some activities possible and some individual network businesses having a greater appetite for these approaches than others.

Risks, challenges and opportunities

RISKS

The current regulatory process is struggling to adapt to the transformation occurring in the electricity system and the current framework does not explicitly accommodate risk mitigation and resilience to natural hazards. Regulatory frameworks need to be supportive of approaches that will address high impact low probability events, since these events are likely to occur more frequently in the future and result in damage to network infrastructure, higher repair and maintenance costs, and may result in significant further impacts on communities.

Without incorporating mitigation of the risk posed by natural hazards and the uncertainties related to projecting the impact of climate change in the future (compounding the uncertain future resulting from industry transformation), it will be difficult to plan investment in the short term, for typically long lived assets.

CHALLENGES

Electricity networks operate in a political and regulatory environment that drives the need to operate with lower and falling costs. However,

significant expenditure is required before 2050 in order to facilitate the transformation of the electricity system currently underway, which may result in increasing costs if the transformation is unmanaged¹. Electricity networks are not ignoring resilience, but where the regulator requires efficiencies in spending, prioritisation must be undertaken. Ensuring that regulations support approaches to understanding and managing risk, as well as investing in approaches to deliver resilience to natural hazards is vital.

Electricity networks are incentivised to perform reliably, ensuring the number and length of outages that customers experience is minimised. With the expectation that natural hazards will become more frequent⁵, reliability may improve, but outages due to extreme weather may increase, resulting in more prolonged and difficult to resolve outages that have a significant impact on customers and their communities. Developing a new regulatory approach that supports resilience would facilitate progress by networks and other key stakeholders to further mitigate the impact of natural hazards.

Understanding the true cost and impact of a changing climate and increases in extreme weather (particularly storms) is needed to better inform both regulation and shared decision making on prioritising mitigation activities across all levels in the network businesses and government. Additionally, understanding the cost of not taking steps now (the counterfactual) to build resilient networks is difficult but critical for demonstrating the value of risk mitigation approaches.

OPPORTUNITIES

While each electricity network operates differently, there are approaches around succession planning and standardisation of qualifications nationally that would enhance resilient operation.

Following an event, the ability of electricity networks to share personnel and equipment easily would facilitate more a more rapid response and recovery. Consistent nationally applied standards and practices would allow the workforce to be utilised more efficiently in response to a major incident (as is seen in the emergency services in response to severe bushfires). Currently, the variety of different standards, safety rules, work practices and equipment standards for specific regions and businesses can limit the opportunity for network staff to move freely and work collaboratively to overcome natural hazards.

There is an opportunity for electricity networks to develop long term, consistent planning at a national level to ensure consistency in approach. In addition, there is recognition that peak bodies can leverage connections and activities to develop secure energy infrastructure. Electricity networks want to collaborate with the Australian Energy Regulator and the Australian Energy Market Operator to deliver long term planning (across asset lifetime) that would support resilience, as well as security and reliability.

Investing in disaster risk reduction prior to a natural hazard is more cost-effective than funding recovery and response following that event, and results in significant cost savings for customers. However, determining the costs saved of an event that was avoided is complex but necessary in order to demonstrate value and work is needed to develop these metrics.

Harnessing current and new data to enhance forecasting and modelling

Electricity networks recognise the value of data, both from their own operations and customer activities. They also recognise the need to maximise the use of that data for better decision making about future risks. Better forecasting and modelling tools are needed to support the day-to-day network operations, but also to understand the longer term potential impact of climate change and severe weather on networks assets and operations. Forecasting and modelling of imminent natural hazards will also facilitate an efficient and effective response as well as inform broader network resilience initiatives.

Risks, challenges and opportunities

RISKS

Electricity network assets are long lived and electricity networks need to understand the impacts of climate change and natural hazards on new and aging infrastructure. The environment, the operation of the electricity system and customers needs are changing rapidly and accommodating all these variables in a modelling approach is complex. Over-simplification may not give reliable results and a broad scale national analysis will not deliver the detail needed for each individual region or network business to adequately prepare for and develop resilient services.

CHALLENGES

One of the most significant challenges that electricity networks face is access to data. In order to model and forecast operations networks need to have real-time and historic data from customers and from network monitoring and performance.

Electricity networks need to ensure that there is reliable and accurate monitoring of the performance of network assets and in some cases the monitoring, recording, storage and analysis of data is not yet developed or available. While in other cases the data is not owned by the network businesses (e.g. customer data). An assessment of the data that will be needed versus what is currently available is essential for modelling and forecasting.

The systems and capabilities that provide additional monitoring and forecasting are not widely deployed and to extract the maximum benefits from data, significant investment in technology infrastructure will be required. Other industry stakeholders need to understand and recognise the critical importance of data and data access to deliver resilience to natural hazards and reliable day-to-day performance.

Data issues include:

- There is substantial customer data (on electricity use), and networks need to be able to access this data and to be able to manage and manipulate it in a way that best informs current operations and business planning for the future
- In order for there to be effective modelling, the networks need accurate data on how their system functions (monitoring), both historically and in real time
- Data may exist but the electricity networks will need to pay to access the data, and this cost may represent a barrier to using available data
- New forecasting and modelling techniques/methods will not only require data, but will also generate data which will need to be managed and harnessed appropriately.

Electricity networks may not have the capability to effectively utilise data in models, and while there are other national agencies that would have the capability, both to deliver a national perspective and the smaller-scale local impacts, significant collaboration would be required to provide input into the planning and response requirements for reliance. Collaboration externally with other stakeholders in the electricity industry and beyond will be necessary, but the issues of data ownership and sharing may limit progress.

OPPORTUNITIES

Identifying and leveraging data will inform decisions on planning for and responding to natural hazards. Data already exists, and where accessible provides an opportunity to begin modelling and forecasting work.

While electricity networks wish to understand how the global and national impacts of climate change will affect specific regions, there is a significant opportunity for networks to collaborate nationally to understand the impact of climate change on network businesses and on their ability to serve customers day-to-day and in response to natural hazards. Collaboration will deliver cost efficiencies, but investment will be needed to deliver the forecasting and modelling required at the local level.

Undoubtedly the use of data for modelling and forecasting long term future impacts and imminent threat will not only deliver planning to support resilience, but enhance the ability to respond to and manage natural hazards.

Summary

The world is increasingly interconnected, and the changing climate is increasing the frequency and intensity of natural hazards. It is in this context that the ability of electricity networks to better understand and address current and emerging risks is vital. Whilst electricity networks are a subset of a much broader electricity and energy sector, which is governed by regulation, there are still significant opportunities for network service providers to trial and lead innovative business practices and ways of thinking. Research can help networks consider risk differently (going beyond reliability), help improve two-way engagement with stakeholders and communities about risks, and maximise the capability of current data to significantly improve the resilience of communities and businesses against the expected natural events and those beyond our experience and imagination.



The development of these priorities

What are the most significant natural hazard emergency management issues Australia faces over the next 10 years?

This was the question posed to network service providers from around the country in a workshop hosted by the Bushfire and Natural Hazards CRC on 14 August 2018. This publication is an outcome of that workshop, and forms part of a broader national research agenda in natural hazards emergency management that was developed by the CRC.

The workshops provided an exploration of major issues that would benefit from the support of research at a national level. There was no attempt to solve any of the issues or problems raised, nor was there any discussion on the details of specific research projects. The participants discussed the issues they believed were relevant to the specific topic under discussion, the relative importance of the issues and the reasons underpinning their relative importance.

This publication summarises the outcomes of the workshop and provides a guide for future research activities by identifying national priorities across major themes and workshop outcomes have also influenced the evolving research agenda of the CRC. This statement has been developed with the assistance of the S&C Electric Company and Energy Networks Australia.

References

1. ENA-CSIRO, Electricity Network Transformation Roadmap, 2017
2. Severe thunderstorm and tornado outbreak South Australia 28 September 2016, Bureau of Meteorology, November 2016
3. Australian Energy Regulator Service Target Performance Incentive Scheme v 2.0, 2018
4. The Energy Charter, www.theenergycharter.com.au, 2019
5. Climate Council, Weather Gone Wild: Climate Change Fuelled Extreme Weather in 2018

bnhrc.com.au/nationalpriorities

