Energy Networks Australia

Network Innovation

Discussion Paper

July 2017

1. Overview

In today's rapidly evolving energy market, network businesses must become more innovative to provide the services their customers will value into the future.

Australia's gas and electricity systems face more dynamic changes than at any other point in their history. It is frequently said that the current technology, consumer and digitisation trends in the electricity sector are driving its greatest transformation since the *War of the Currents* between Edison and Tesla in the 1890s.

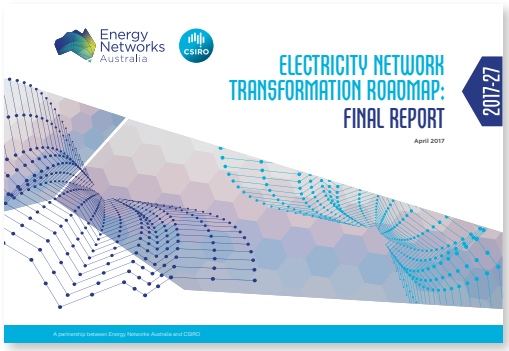
A culture of agility and innovation is likely to be vital across the supply chain to maintain the security, reliability and affordability valued by customers today, in a transformed energy system.

Gas and electricity networks can play a key role in developing and implementing innovation to: improve the efficiency and effectiveness of their own services to customers; animate adjacent markets; and, provide platforms for smart energy systems.

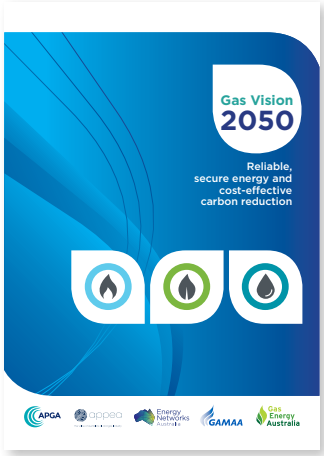
Given the scale of existing electricity and gas infrastructure and its significance for customer outcomes, it will be vital to leverage advances in technology to meet the evolving needs and expectations of customers.

Gas and electricity networks are natural monopolies. In Australia, these businesses are regulated by the Australian Energy Regulator (AER). The AER sets the prices network businesses can charge their customers. To maximise beneficial innovation for customers, the regulatory framework needs to evolve to ensure that it appropriately allows and incentivises innovation.

Numerous Australian and international studies, including those by the Australian Energy Market Commission, COAG Energy Council, Australian Energy Market Operator and others, have identified the likelihood of relatively rapid transformation in energy systems, driven by customer requirements and technological opportunities.



In the electricity network sector, CSIRO and Energy Networks Australia developed an Electricity Network Transformation Roadmap (the Roadmap), a blueprint for transitioning Australia's electricity system to enable better customer outcomes. The Roadmap identified a number of areas that will require continuous attention and innovation over the long-term including in system operation and management, incentives and regulatory frameworks, and carbon abatement.



Gas Vision 2050 was developed by Australia's peak gas industry bodies and demonstrates how gas can continue to provide Australians with reliable and affordable energy in a low carbon energy future. Innovation will be the key to achieving this. The Gas Vision 2050 identifies three transformational technologies – biogas, hydrogen and carbon capture and storage – as areas for innovation efforts.

Australia's electricity systems are likely to require up to $888-988 billion in capital and operating expenditure between now and 2050.[1] These costs include customer owned resources, off-grid technology, centralised generation, and transmission and distribution services.

With over a quarter of that expenditure required in electricity network services, it is crucial that network firms are well-positioned to innovate. While the Roadmap highlights economic benefits to customers of animating new and competitive markets, it also relies on innovation within monopoly network services to achieve efficient customer outcomes. Customer benefits will rely on regulated networks having the capacity to explore, trial and deploy new technologies, systems and business processes in a timely manner.

Similarly, innovation will play a key role in realising opportunities for further decarbonising Australia's gas sector. There is a strong potential to use three transformational technologies - biogas, hydrogen and carbon capture and storage – to create clean, dispatchable energy resulting in zero emissions that can use existing gas networks' infrastructure.

Despite the potential benefits, Australia is currently one of the lowest funders of network innovation compared to other countries according to the International Energy Agency (IEA). The historical data shows that the UK spends three times more on network innovation on per capita basis when compared to Australia.

In addition, Australia's public investment in research, development and demonstration (RD&D) in energy networks does not reflect the significance of the sector to customer cost and service outcomes today or in the future. As discussed in Section 6, electricity network RD&D is currently less than 1 per cent of public RD&D investment in energy, despite networks representing 40-55 per cent of the current average residential electricity bill and about 25 per cent of future electricity system expenditure.

International experience shows that the operation of network innovation schemes can deliver concrete benefits to energy customers. For example, the UK regulator Ofgem has estimated that the net-benefits of its Low Carbon Networks Fund, which operated between 2010 and 2015, could be up to six times the cost of funding the scheme.[2]

Informed by this international experience, a Network Innovation Scheme could be introduced to foster timely innovation in gas and electricity networks for the benefit of customers. Such a scheme should be designed with robust public policy processes by an independent institution with wide consultation. It would be expected to adopt a broad view of innovation under clear criteria, avoid picking technology 'winners' and support multi-year innovation projects. Eligibility to apply for funding should be extended to non-network parties wishing to partner with networks recognising the importance of collaboration. Innovation projects supported by the scheme should be obliged to transparently share insights and learnings benefiting other participants and energy customers.

The purpose of this Discussion Paper

The purpose of this Discussion Paper is to:

- Explore policy frameworks that can stimulate energy network innovation in Australia and internationally that then informs recommendations to policy-makers about how to enhance the existing innovation measures.
- Provide a basis for engagement with stakeholders, including:
  - To provide stakeholders with the relevant context; and,
  - invite stakeholders to discuss the questions identified throughout the paper and any other matters they consider relevant.

The structure of this Discussion Paper

This paper is structured as follows:

- Section Two sets the scene for a detailed discussion in the remainder of the Paper.
- Section Three identifies a number of priority areas for network innovation and discusses a range of barriers in the existing regulatory framework which hinder greater innovation by networks.
- Section Four summarises Australia's existing innovation policies and programs that are relevant to the electricity sector.
- Section Five discusses how the UK regulator Ofgem has emphasised innovation in recent years.
- Section Six outlines previous examples of direct funding of energy innovation by industry and governments.
- Section Seven contemplates a possible regulatory scheme that would serve as a stimulus for fostering network innovation.

Have your say

Consultation questions are identified throughout the Discussion Paper. Stakeholders are encouraged to respond to these questions or provide feedback on any issue they consider relevant.

Outcomes from this consultation will be summarised and made available to all respondents.

With this collaboration and feedback, Energy Networks Australia and its members would seek to develop formal proposals for changes to innovation frameworks, including potential rule changes where required.

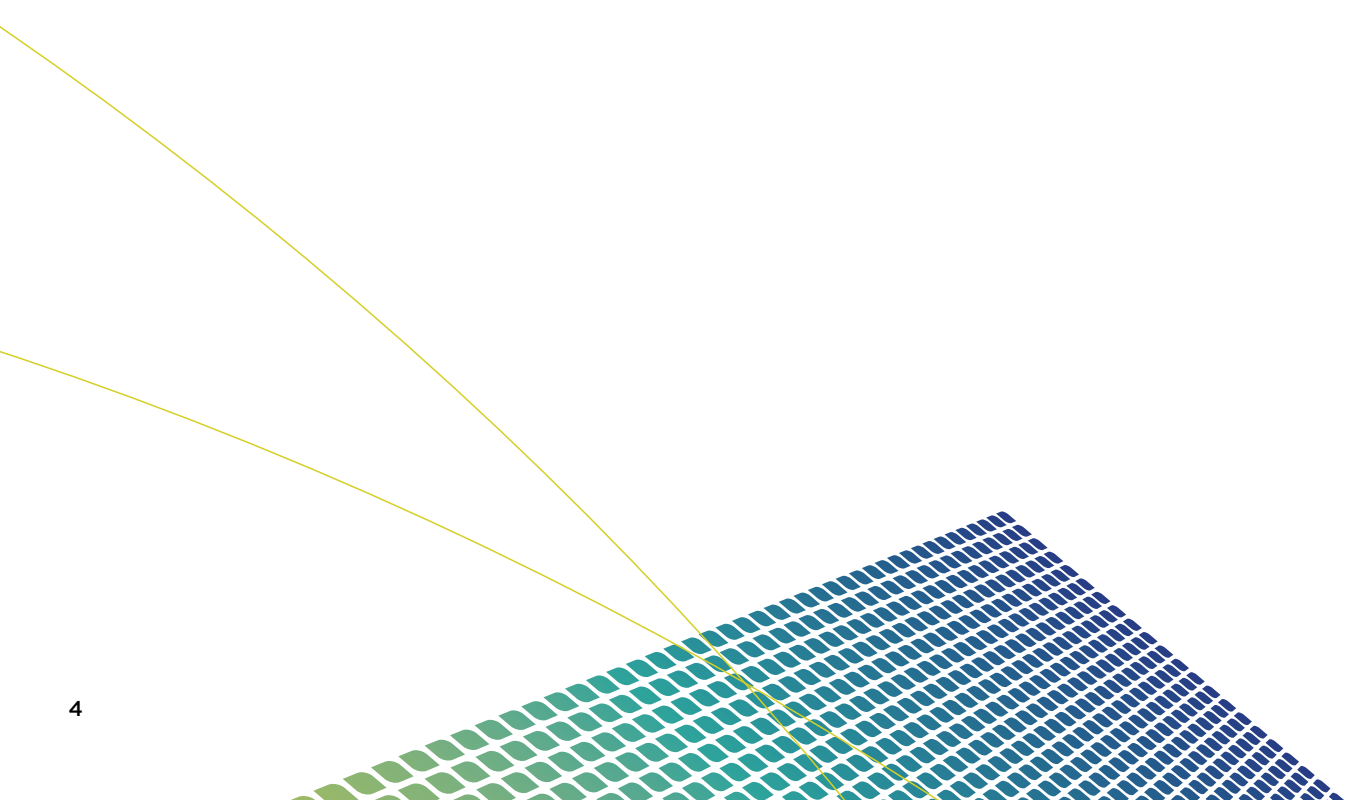
Providing Feedback:

Please provide your responses by 26 September 2017 to Irina Umback, Principal Economic Advisor, at **iumback@energynetworks.com.au.**

Summary of consultation questions

Consultation questions

1. Does the current regulatory regime encourage the innovation required in network services to meet the long-term interest of customers? What is the evidence?
2. What changes could be made to introduce efficient and effective incentives for innovation in network regulation?
3. Given the rapid rate of technological change, do you agree that the Demand Management Innovation Allowance funding scale is too small to enable electricity networks to deliver innovation that drives optimal outcomes for customers?
4. Do Ofgem innovation measures look appropriate for Australia?
5. Are there other options we should consider?
6. Do you agree that a Network Innovation Scheme is required in addition to the existing arrangements?
7. What are the features of an effective innovation scheme that can deliver the goal of accelerating network innovation?
8. What other public policy responses can be adopted in response to concerns about incentives for network innovation?



2 Innovation and RD&D

Recent trends in the energy sector involving rapidly evolving technologies and business models, show that innovation in the delivery of network services may have substantial social benefit. Conversely, the absence of innovation will come at a cost. The innovation required goes beyond productive and allocative efficiency improvements. These types of improvements are the traditional focus of, and are incentivised under, Australia's existing electricity and gas network revenue and pricing regimes.

The recent ***Independent Review into the Future Security of the National Electricity Market*** chaired by Australia's Chief Scientist Dr Alan Finkel, highlighted the urgent need to ensure that rules, market frameworks and processes are aligned to support emerging technologies and the ability to test them:

> ***"By end-2018, the Australian Energy Market Commission should review and update the regulatory framework to facilitate proof-of-concept testing of innovative approaches and technologies."***[3]
>
> Finkel Review of NEM Security

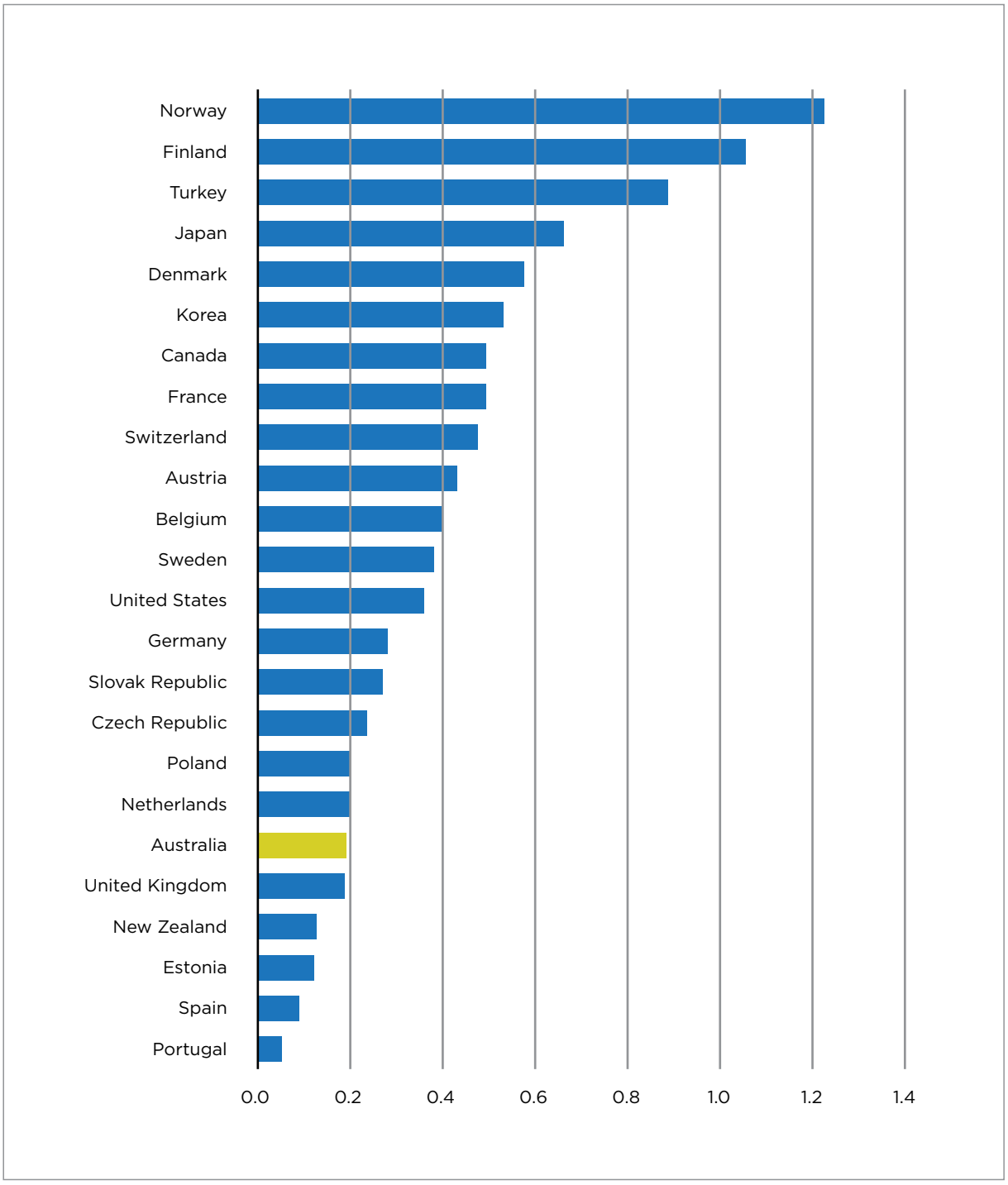
The customer driven energy revolution will require energy networks as agile as the technologies they connect. Australia has the opportunity to follow the example set by its global counterparts to improve customer outcomes by supporting network innovation and RD&D more broadly through effective government schemes.

RD&D expenditure

In 2014, Australia was one of the lowest funders of RD&D in terms of investment intensity, according to the IEA. *Figure 1* indicates that Australia's public RD&D investment in energy, including generation, networks and other supply chain expenditure, was ranked 19 out of 24 developed nations.

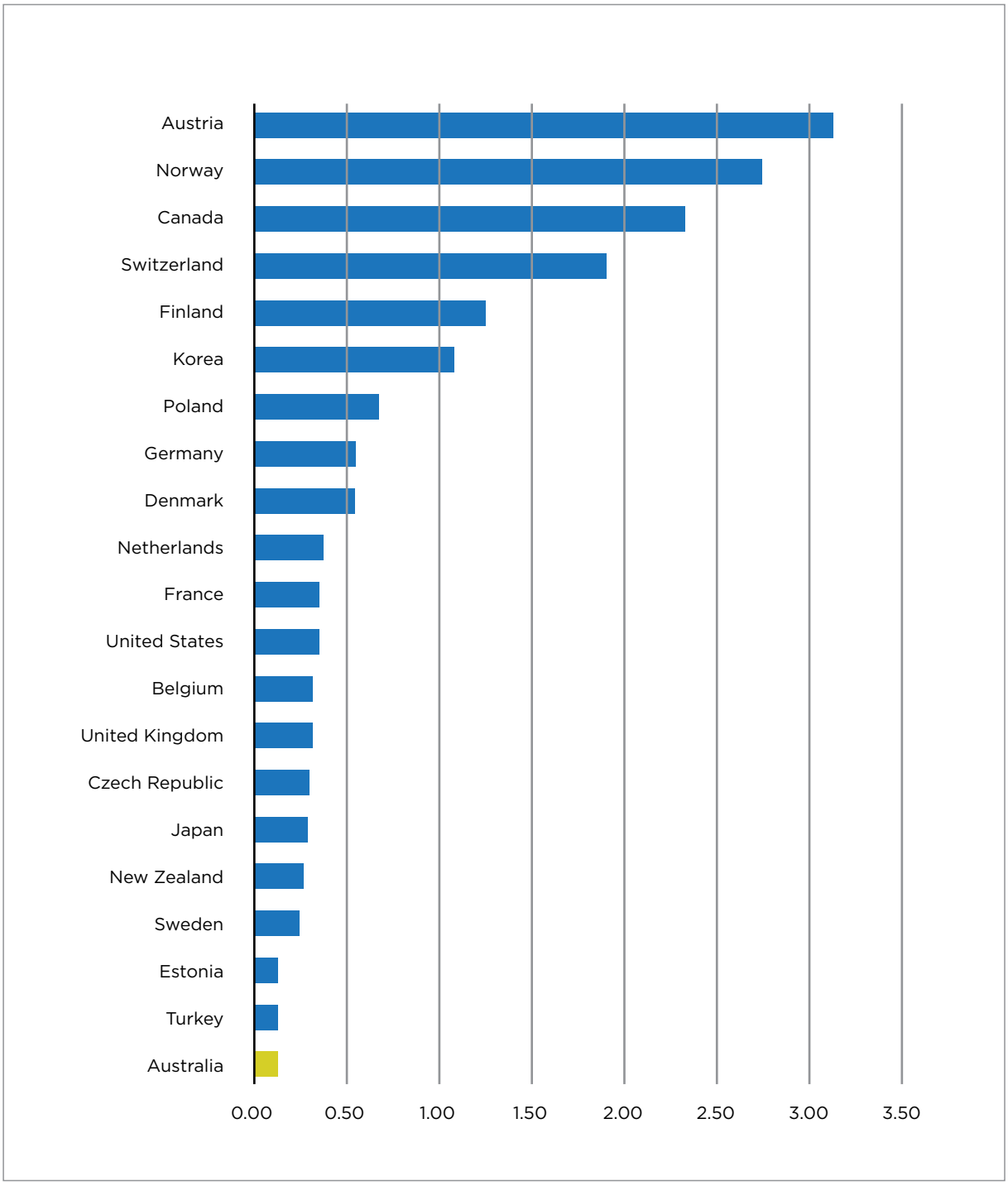
As shown in *Figure 2*, when electricity network (transmission and distribution) expenditure is considered on its own, Australia ranked very low. Australia's spending on network innovation relative to population was the lowest when compared to 21 international counterparts based on this historic data.

Figure 1: Energy RD&D per thousand units of GDP in 2014



Source: IEA database, Total public energy RD&D expenditure in nominal national currencies divided by GDP in nominal national currencies at market prices and volumes, expressed in thousand units of GDP.

Figure 2: Network RD&D funding per capita in 2014, USD (2015 prices and PPP)



Source: IEA and United Nations database, Electricity transmission and distribution RD&D funding per capita, USD (2015 prices and PPP), 2014

Australia has a series of energy innovation programs in place that provide public funding for innovation projects relevant to the energy industry. In contrast to other countries, the current RD&D mechanisms in Australia provide fragmented and relatively limited support for network innovation. The existing programs do have the potential to assist with the delivery of innovation required to integrate low carbon energy sources into the energy system.

While Australia is at an earlier stage of the journey than other countries, some regulatory incentives currently apply. One of the main mechanisms to encourage innovation by electricity distribution networks has been the Demand Management Innovation Allowance (DMIA). A small innovation allowance (i.e. between $0.1–1.0 million per company per annum) currently applies to all electricity distribution businesses across eastern Australia[4]. Currently, there is no specific innovation scheme for gas distribution businesses.

Broader capital and operating efficiency incentives included in the regulatory framework encourage innovation to some extent, however, their scope is limited. Incentives typically focus on containing costs and deriving operational efficiencies within a short-term timeframe. As discussed below, the regulatory framework is unlikely to provide sufficient flexibility and incentives when the energy sector is changing swiftly.

Seizing the opportunity

During a time of rapid technological change, Australia's regulatory policy framework is yet to fully realise the benefits of innovation activities that are undertaken by network businesses and third parties that customers value. This means that Australian energy customers may miss out on the opportunities for integrating new technologies into the grid that could improve the quality and reliability of network services and allow better responsiveness to customer choice in technology and service.

International experience shows that the operation of network innovation schemes includes a valid process of learning, adjustment, and refining. There is evidence that innovation schemes can deliver concrete benefits to energy customers. This should give the Australian community confidence to trial and experiment with its own approaches.

A potential solution

Australia needs well-designed policies and approaches to support network innovation efforts, encourage progress of adventurous ideas and provide an environment where the risks of innovation can be managed. While funding provided to companies will ultimately be paid for by customers through their bills, customers stand to benefit from network innovation in the long run through decreased energy costs and improvements to valued services. The environmental benefits will also be realised by society at large.

There is an opportunity to learn from mechanisms used in the United Kingdom to achieve similar objectives. For instance, a Network Innovation Scheme could be introduced as a stimulus for addressing a range of concerns about the incentives for innovation and a lack of sufficient network innovation funding and programs. This Discussion Paper seeks stakeholder feedback on this idea.

3 The case for a greater level of network innovation

Key areas for network innovation

Gas and electricity networks are strategically positioned to drive innovation efforts to facilitate the transformation of the energy sector. Given the scale of existing electricity and gas infrastructure and its significance for customer outcomes, it will be vital to leverage advancements in technology to meet the evolving needs and expectations of customers.

While this Discussion Paper draws on numerous sources of information to kick-start the innovation conversation, it attempts to build on the priority areas for innovation that were identified by two specific documents – the Roadmap and Gas Vision 2050.

Electricity Network Transformation Roadmap

CSIRO and Energy Networks Australia developed the Electricity Network Transformation Roadmap, a blueprint for transitioning Australia's electricity system to enable better customer outcomes. The Roadmap identified a number of areas that will require continuous attention and innovation over the long-term: system operation and management; incentives and regulatory frameworks; and, carbon abatement.

In the past, the mandate of electricity networks was to deliver a safe and reliable supply of electricity to their customers in the most cost-effective way possible, using a relatively stable set of known technologies. However, society's expectations of networks and the entire energy system are changing. Modern electricity networks are expected to be able to support the delivery of new products and services enabled by new technologies.

The Roadmap's findings that relate to innovation can be summarised into four key areas. In these areas, network innovation can drive optimal outcomes for electricity customers and society as a whole:

1. **Customer empowerment.** Electricity customers are becoming increasingly active and directly engaged with their electricity network service providers. It is clear that electricity networks need to continue to innovate to meet evolving customer needs.[5]
2. **Clean energy future and distributed energy resources.** Electricity networks are expected to innovate in ways that encourage environmental sustainability and facilitate lower emissions from the electricity sector. Very significant innovation efforts will be required to transform the efficiency of energy delivery with the orchestration of distributed energy resources (DER).[6]
3. **Safe, reliable and resilient network.** Customers will continue to value a secure and reliable electricity supply, given Australia's increasingly automated and digitised economy and lifestyle.[7]
4. **Continuous improvement.** Networks are expected to continue putting downward pressure on network charges by containing their costs.

CSIRO modelling for the Roadmap has projected that Australia's electricity systems are likely to require up to $888-988 billion in capital and operating expenditure between now and 2050, in customer owned resources, off-grid technology, centralised generation, plus transmission and distribution services.[8] With over a quarter of that expenditure required in network services, it is crucial that network firms are well positioned to achieve optimal outcomes by exploring, trialling and deploying the right technology at the right time.

Gas Vision 2050

The Gas Vision 2050 was developed by Australia's peak gas industry bodies and demonstrates how gas can continue to provide Australians with reliable and affordable energy in a low carbon energy future. Innovation will be the key to achieving this.

The Gas Vision 2050 focuses on three transformational technologies - biogas, hydrogen and carbon capture and storage. These technologies could provide new zero-emission and low emission fuels that can deliver power to Australian homes, businesses and vehicles using the existing gas distribution network.

Gas has an essential role to play in reducing emissions. Fuel switching from coal to gas offers the most immediate and risk-free option to cut emissions from the electricity generation sector. Innovation in this area will create the potential for clean, dispatchable energy resulting in zero emissions while using existing infrastructure.

Barriers to network innovation

Significant investment and innovation will be required by network businesses in coming years to facilitate the sector's transformation. In such a dynamic environment, a business-as-usual approach to network services is itself a risky strategy to adopt on behalf of energy customers.

However, innovation and sector transformation involve different risks and uncertainty, which can be challenging in a highly codified, risk-averse framework, focussed principally on cost reduction. Individual investment failures in nascent technologies are not uncommon in dynamic markets, but that does not imply that the experimentation which might result in such investments is inefficient or not in the long-term interests of consumers. However, other commentators have recognised that Australia's current regulatory framework and culture would likely take a dim view of such investments.[9]

The following aspects of Australia's energy networks' regulation have the potential to limit efficient network investment in innovation:

- **Regulatory approval process.** Due to the inherent uncertainty of outcomes associated with innovative initiatives, it is often hard to demonstrate *a priori* that the proposed activities will satisfy regulators' traditional expenditure tests. Therefore, expenditure on cutting edge, innovative, projects is unlikely to be approved by the regulator.
- **Risk-Reward Ratio.** The existing regulatory regime discourages equity holders from investing their own funds in innovative projects. Having invested in a successful innovative project, equity holders in the regulated firm are effectively limited to receiving the regulated rate of return on the underlying assets.[10] However, innovative projects are riskier than business as usual. The mismatch between the higher risk profile of innovative projects and the regulated return deters the pursuit of innovation investments for commercial reasons.

- **Weak incentive for dynamic efficiency.** The Australian energy network regulatory framework provides for incentive mechanisms that encourage some innovation, but their scope is limited. These mechanisms typically focus on containing costs and deriving operational efficiencies. They are not sufficiently dynamic to suit a time such as now when the energy sector is changing swiftly.
- **Short-term focus.** The existing incentives are limited to the duration of the regulatory period (typically 5 years), which leads to a focus on short-term cost reduction and does not recognise that innovative projects may incur costs, and deliver benefits, across multiple periods. As discussed below, the United Kingdom has both a longer regulatory period (i.e. 8 years compared to 5 years) and a stronger incentive framework.[11]

Energy networks have been innovative in incentivised areas under the existing regulatory framework. However, into the future, additional means of promoting innovation are likely to be necessary. This will require recognition that 'success' for networks in the new world requires greater levels of innovation in delivering mandated service standards. Innovation needs to be a key part of what businesses do, and part of the basis on which they are remunerated.[12]

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Consultation question

1. Does the current regulatory regime encourage the innovation required in network services to meet the long-term interest of customers? What is the evidence?

4 The Australian regulatory framework

Current incentive framework design

Australia's current innovation-related regulatory tools were designed before the full scope of transformational change underway in the energy sector became apparent. The existing tools seek to solve a narrower economic goal of driving productive and allocative efficiency.

The electricity and gas networks' regulatory framework requires that a form of price control is applied to services with monopoly characteristics. In addition to this price control, a range of additional complementary incentive mechanisms are also applied. Under these arrangements, network firms can achieve profits when they spend lower than the approved forecasts. This encourages innovation to some extent.

However, the existing regulatory arrangements are not sufficiently dynamic because they do not promote efficiency and innovation in the optimum manner over the longer-term. This was recently recognised in the context of the Demand Management Incentive Scheme rule change and the guideline development process. An analysis by the Institute for Sustainable Futures concluded that the existing framework may lead to underinvestment in demand management projects and subsequent potential losses in customer value.[13] This outcome would reflect an unintended weakness of existing regulatory frameworks and produce outcomes similar to a market failure. That being, the most efficient and effective solutions may not be adopted.

The current regime does not recognise the relatively higher risks associated with the development pathway for innovative solutions. The focus tends to be on short-term cost reductions, which in turn can reduce the ability to take a longer-term, strategic view on innovation.

The Roadmap identified that "a regulatory regime that is outpaced by technology and market developments cannot protect consumers or deliver a balanced scorecard of societal outcomes."[14]

Cambridge Economic Policy Associates, in expert advice included in the Roadmap, have suggested that there is strong potential over the medium-term to move away from the existing schemes to TOTEX (Total Expenditure – both capital and operational) based approaches, which provide clearer and stronger incentives aligned to customer outcomes. This was adopted as a Roadmap recommendation to be trialled by 2018 and implemented by 2027.

The adoption of the TOTEX approach will contribute to achieving the goal of dynamic efficiency. However, this is not the only policy response required to address concerns about incentives for network innovation. Electricity and gas networks need to have an environment where the risks of innovation, including the failures of attempts to innovate, can be managed.

> "A regulatory regime that is outpaced by technology and market developments cannot protect consumers or deliver a balanced scorecard".
>
> *Electricity Network Transformation Roadmap*

Information box 1 – Current regulatory approaches to incentive design

For electricity network businesses, the AER adopts 5-year revenue caps based on the expected costs of running each network during this period. It also applies some additional incentive frameworks. These incentive frameworks have been developed sequentially, and are directed at particular problems. The existing regulatory regime allows the following incentive mechanisms:

- The **Efficiency Benefit Sharing Scheme** (EBSS) is a mandatory scheme, which incentivises businesses to pursue efficiency improvements in operating expenditure over the regulatory period and to share the benefits of efficiencies gained with customers.[15]
- The **Service Target Performance Incentive Scheme** (STPIS) is a mandatory scheme, which incentivises businesses to maintain or improve service standards and to limit the risk of cost reduction incentives that compromise appropriate service quality over time.[16]
- The **Capital Expenditure Efficiency Sharing Scheme** (CESS) is a scheme designed to incentivise businesses to pursue efficiency improvements in capital expenditure over the regulatory period and to share the benefits of efficiencies with customers.[17] This scheme is not mandatory.

The mechanisms listed above complement and reinforce each other by ensuring that incentives for operating and capital expenditure efficiencies are:

- constant throughout the duration of a regulatory period;
- balanced so that any reduction in costs does not compromise appropriate service quality; and,
- neutral in terms of which type of expenditure (capital or operating expenditure) to incur during a regulatory period.

For gas distribution businesses, the *National Gas Rules* provide the AER with discretion in relation to the implementation of incentive schemes. The AER currently applies the EBSS to all gas distributors across Australia. In its July 2017 draft decision for Victorian gas distributors, the AER approved the introduction of the CESS for AGN and AusNet Services.

Trials and experimentation play a critical role in energy systems, not least because networks have a legal obligation to keep the system in a steady operating state. Service providers must maintain safety, security and reliability during a time of unprecedented transformation affecting the energy industry. There is no single transition point between two modes of operating the energy system. This reality highlights the need for a staged evolution enabled by trials and demonstration projects. For instance:

- there is a need for regulatory flexibility to trial delivery models, which may not be economic initially, but where integration and operational experience is required;
- it may be important to experiment now to anticipate and enable step changes in the use of the energy network (e.g. the advent of widespread electric vehicles, rapid battery storage uptake or inverter-based energy systems subject to aggregated switching); and,
- In some respects, the system may require a planned evolution from one operating state to another (e.g. Gas Vision 2050 identified the potential for hydrogen or biogas to be progressively introduced into gas networks).

Consultation question

2. What changes could be made to introduce efficient and effective incentives for innovation in network regulation?

Specific mechanisms for network innovation

The Australian electricity network regulatory framework contains some measures which specifically target innovation. These are:

- The **Small Scale Incentive Scheme.** The *National Electricity Rules* provide for a small-scale incentive scheme which can be introduced at the discretion of the AER. The rewards or penalties under such schemes are capped at 0.5 per cent of the allowed revenues, but can be up to 1 per cent of the annual revenue if the network business consents. To date, however, the AER has not developed any small-scale incentive schemes.
- The **Demand Management Incentive Scheme** (DMIS) for electricity distribution businesses. The AER's current DMIS has two components—a capped DMIA, plus a foregone revenue component. This measure has been the subject of a recent rule change, with the AER due to deliver a revised scheme by November 2017.

The DMIA is the main mechanism used to encourage innovation by electricity distribution networks. It does not apply to electricity transmission businesses. This source of funding is specifically targeted to demand management activities and does not include all types of innovation. A small innovation allowance (i.e. between $0.1–1.0 million per company per annum) currently applies to all electricity distribution businesses across eastern Australia.[18]

Consultation question

3. Given the rapid rate of technological change, do you agree that the DMIA funding scale is too small to enable electricity networks to deliver innovation that drives optimal outcomes for customers?

5 A UK comparison

A number of international case studies are discussed in Appendix A. The UK's energy industry structure of regulated energy networks and a national economic regulator is often compared to that in Australia. However, the innovation frameworks for energy networks in these two countries are distinct in their differences.

In the UK, funding for network innovation has been in place since 2010. Having already provided £250 million ($425 million) for innovative projects, the UK regulator - the UK Office of Gas and Electricity Markets or Ofgem - has indicated that funding will remain in place until at least 2023.[19] Ofgem is also on the lookout for opportunities to further increase the value for money for consumers from its network innovation schemes based on what they have learned in the time the schemes have been in place.

This experience shows that the operation of network innovation schemes includes a valid process of learning, adjustment and refining. It also demonstrates evidence that innovation schemes can deliver concrete benefits to energy customers.

Low Carbon Networks Fund

Ofgem recently completed a review of its first network innovation scheme. The Low Carbon Networks Fund allowed the industry to spend up to £500m ($850 million) on innovation. It has provided approximately £250 million ($425 million) of funding to projects sponsored by the six electricity distributors of Great Britain over the period 2010-2015.[20]

The cost of the scheme is significant - valued at approximately £1.7 ($2.9) per customer annually.[21] However, an independent evaluation of the scheme concluded that the Low Carbon Networks Fund has delivered value for money. It is estimated that the roll out of successful projects across Great Britain could see net-benefits, which are up to six times the cost of funding the scheme.[22] Ofgem identified the total potential benefit of between £800 million ($1.3 billion) and £1.2 billion ($2 billion).[23]

Innovations under the Low Carbon Networks Fund were considered to be relatively successful. Overall, nearly 40% of the initiatives have been successfully rolled into business as usual (BAU). Another 40% of initiatives are suitable for roll out once the business case can be established. The remaining initiatives require further development before being suitable for business as usual.[24]

Another success of the Low Carbon Networks Fund is the embedding of change and innovation within the operations of networks. The independent evaluation includes the following findings:

- The scheme has provided approximately £250 million ($425 million) of funding to innovative projects, when prior to its introduction the total expenditure on RD&D by distributors was estimated to be less than £10 million ($17 million) per annum.[25] Spending on innovation in Great Britain is now greater than the EU average.[26]

Figure 3: Estimated number of innovation initiatives per category[27]

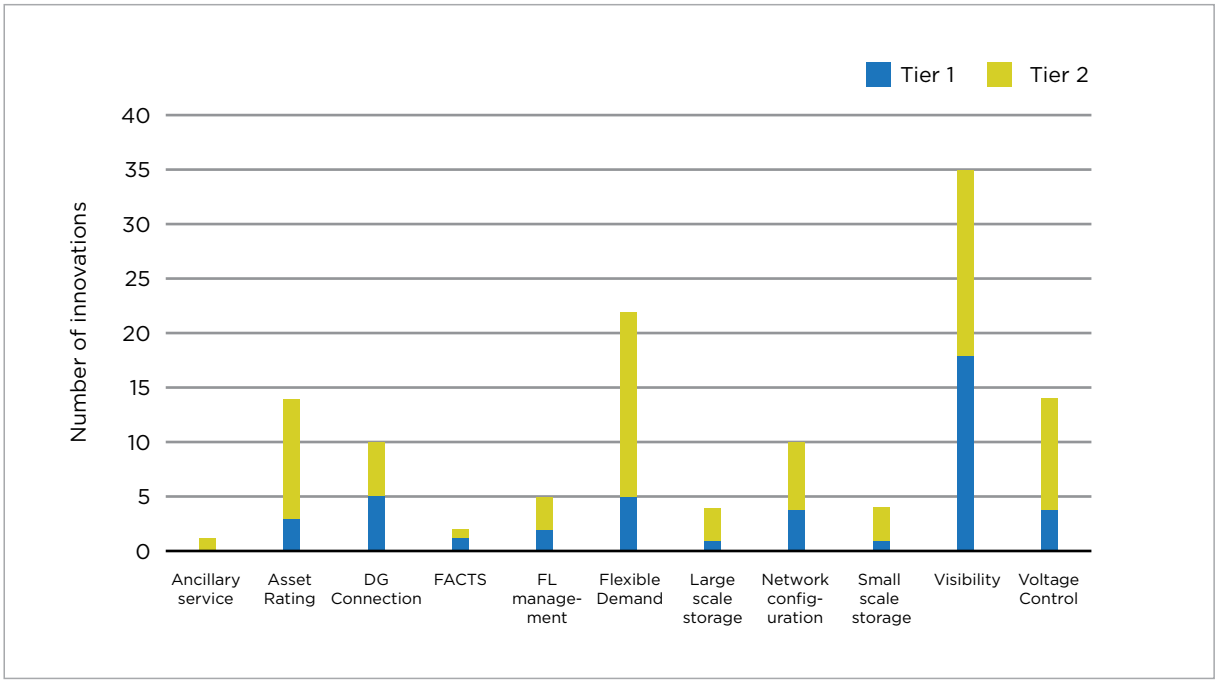


Figure 4: Innovation initiatives by category and timing of business as usual (BAU) potential[28]

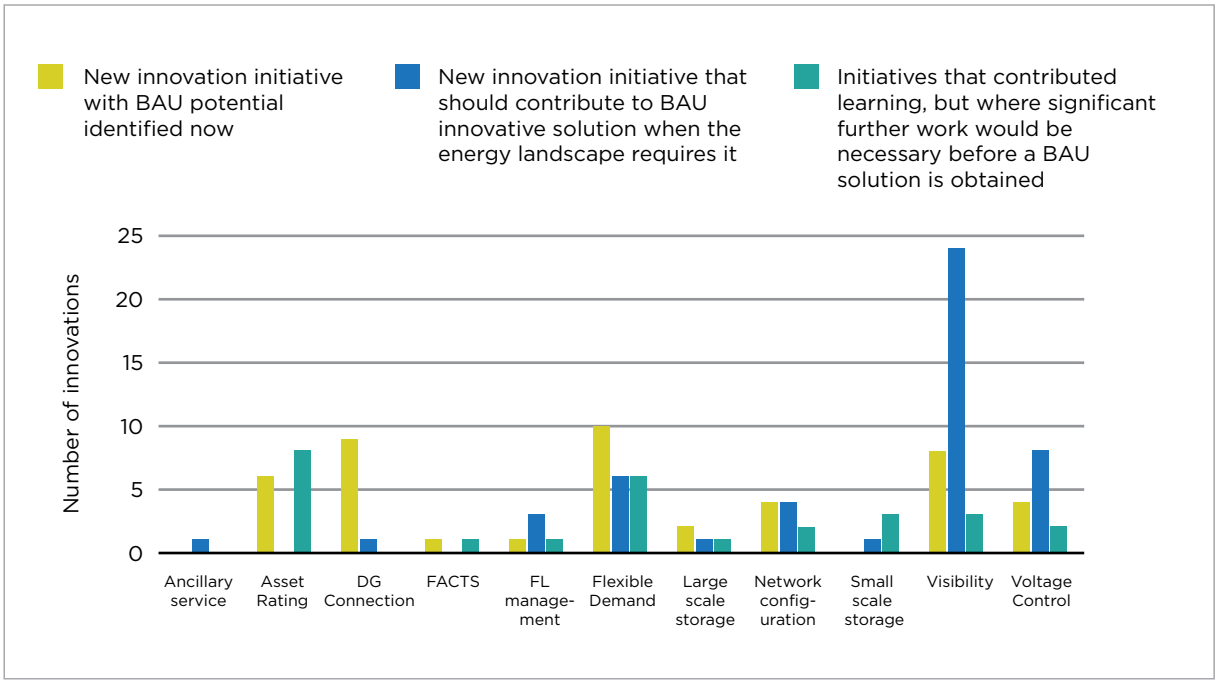


Figure 5: Nominal spend on R&D[29]

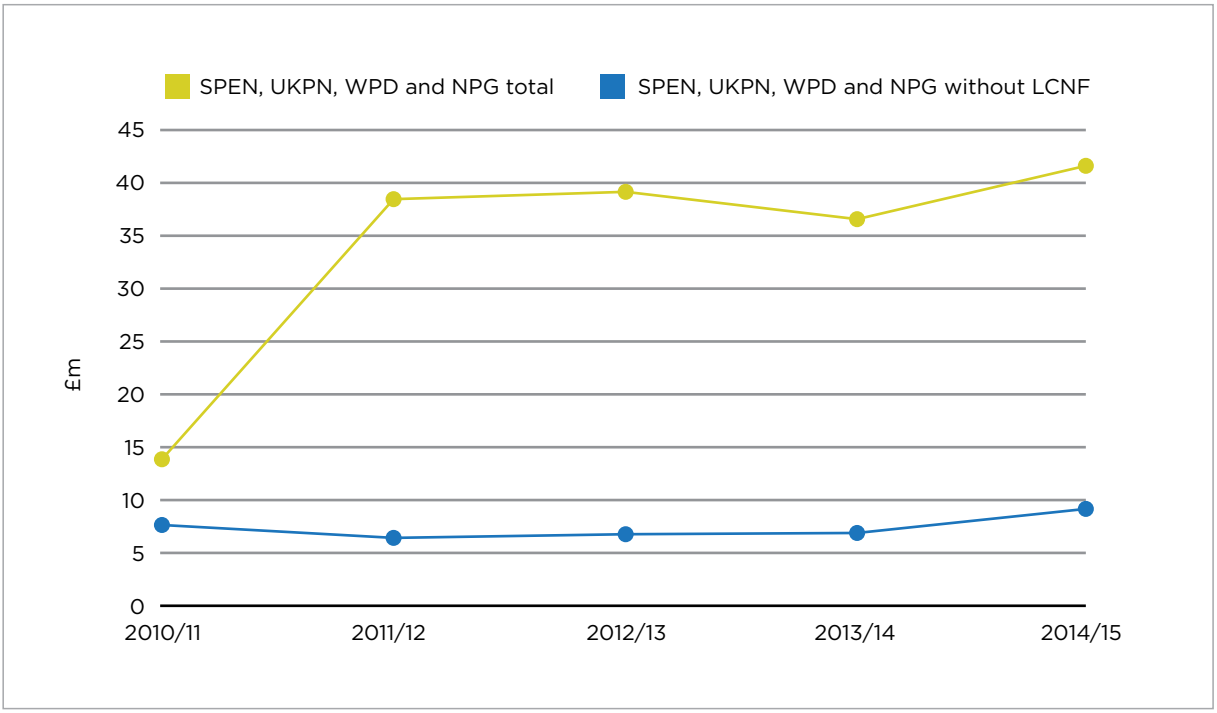
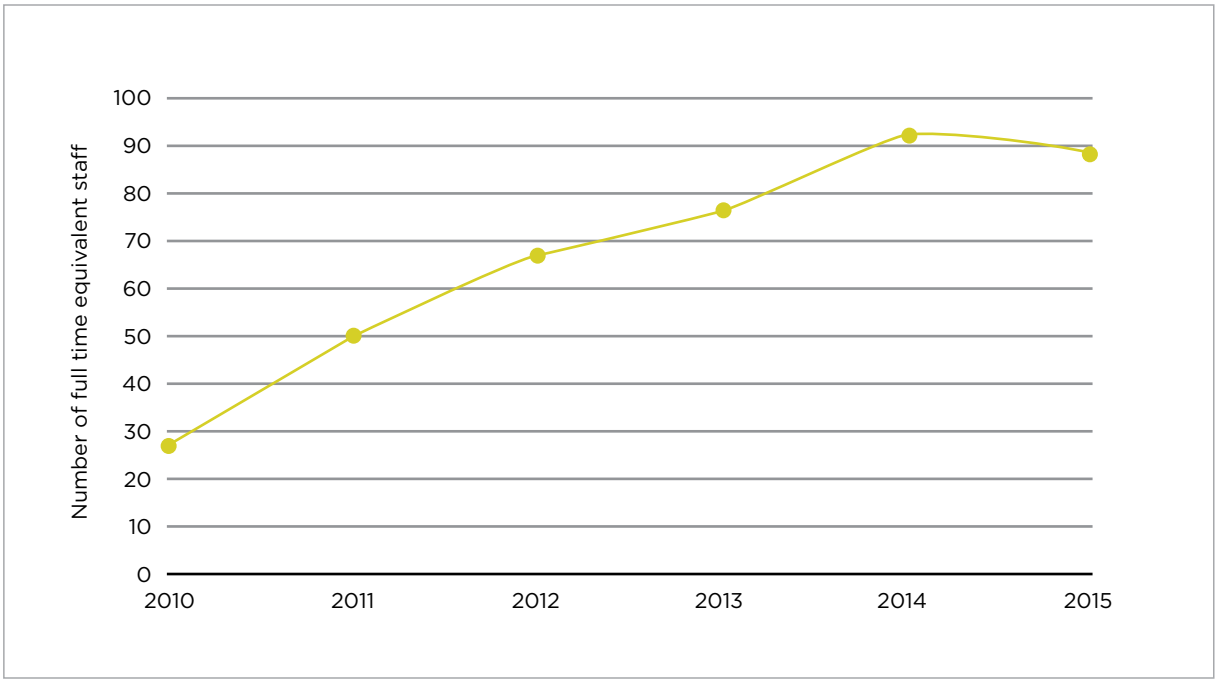


Figure 6: Growth in Future Networks technical staff[30]



- Dedicated innovation teams have emerged within networks, suggesting that innovation is becoming a core part of their business. Over the period 2010-2015, the total number of technical staff in the Future Networks teams, for six distributors, increased from 27 to 90.[31]
- Over the five-year funding period, 23 large-scale projects and 42 small-scale projects have received funding under the scheme. 12 more projects were unsuccessful on their applications and were not funded.[32]

The independent evaluation recognised that even "failures" of innovation attempts can provide useful information.[33] Scope and success of innovation projects has also benefited from the involvement of others outside of the industry.[34]

Ofgem's current innovation schemes

Ofgem's most recent revised framework for the regulation of network businesses (termed the Revenue = Incentives + Innovation + Outputs, or RIIO) builds on the Low Carbon Networks Fund. This framework was introduced for gas distribution companies and electricity and transmission companies in 2013, and for electricity distribution companies in 2015.

Innovation stimulus consists of two innovation funding programs:

- The **Network Innovation Allowance** (NIA) provides partial funding for small innovation projects and covers all types of innovation. The NIA is available to each network business as part of their price control. The funding is set at £61 million ($103 million), and allocated based on the quality on the company's own innovation strategy.[35]
- The **Network Innovation Competition** (NIC) is an annual competition to fund selected large-scale innovation projects which have the potential to contribute to meeting low carbon economy objectives. The annual funding available to a NIC winning project is capped at £90 million ($153 million) for electricity networks and £20 million ($34 million) for gas networks.[36]

Based on the independent evaluation of the Low Carbon Network Fund, Ofgem has decided to introduce some changes to the NIA and NIC.

The changes are designed to make these schemes even more effective and increase the benefits for consumers. In particular, Ofgem will reduce the level of funding for the electricity NIC from £90 million ($153 million) to £70 million ($120 million), place new obligations on the network companies to issue an annual call for ideas from third parties, and, to develop joint innovation strategies for the gas and electricity sectors.[37]

Consultation questions

4. Do Ofgem innovation measures look appropriate for Australia?
5. Are there other options we should consider?

6 Direct funding of energy innovation in Australia

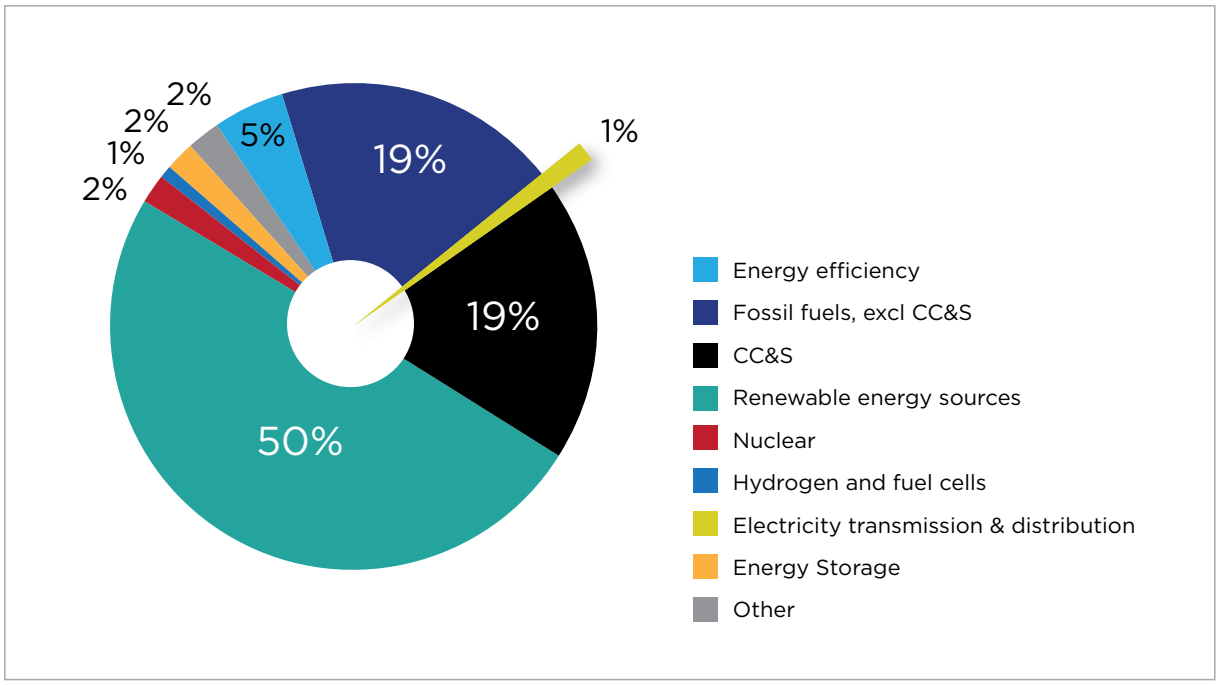
Examples of government support for energy sector innovation

Australia has a number of energy innovation programs in place that provide public funding for innovation projects relevant to the energy industry. The review of a variety of existing programs suggests that the current RD&D mechanisms provide fragmented and limited support for network innovation. The existing programs do have the potential to assist with the delivery of innovation required to integrate low carbon energy sources into the energy system.

Figure 7 indicates that clean energy technologies play the key role in Australia's total energy RD&D. This includes renewable technologies, carbon capture and cleaner fossil energy, as well as energy efficiency (in industry, buildings and transportation). It is estimated that only around 0.6 per cent of total energy RD&D directly related to the electricity transmission and distribution in 2015.

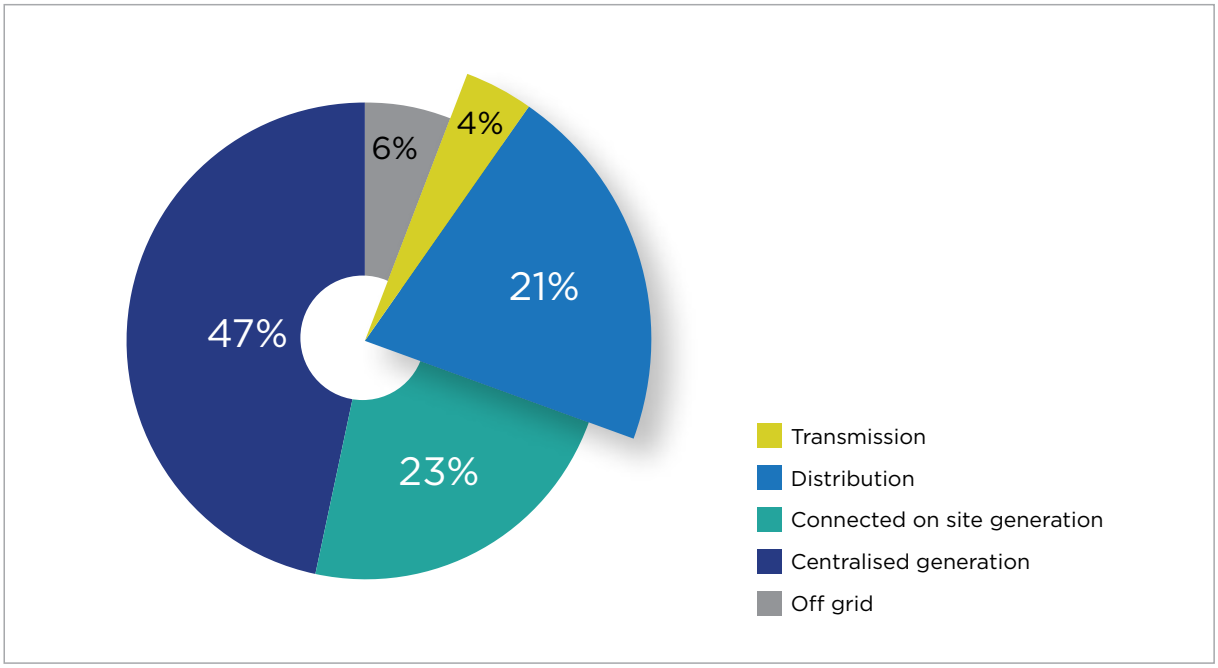
Networks' RD&D is currently the focus of about 0.6% of the public RD&D investment in energy, despite representing 40 per cent to 55 per cent[36] of a current average residential electricity bill, depending on the location. In terms of future expenditure, the Roadmap forecasts that distribution and transmission spending would represent about 25 per cent of future system expenditure.

Figure 7: Australia's energy RD&D Budget by category in 2015



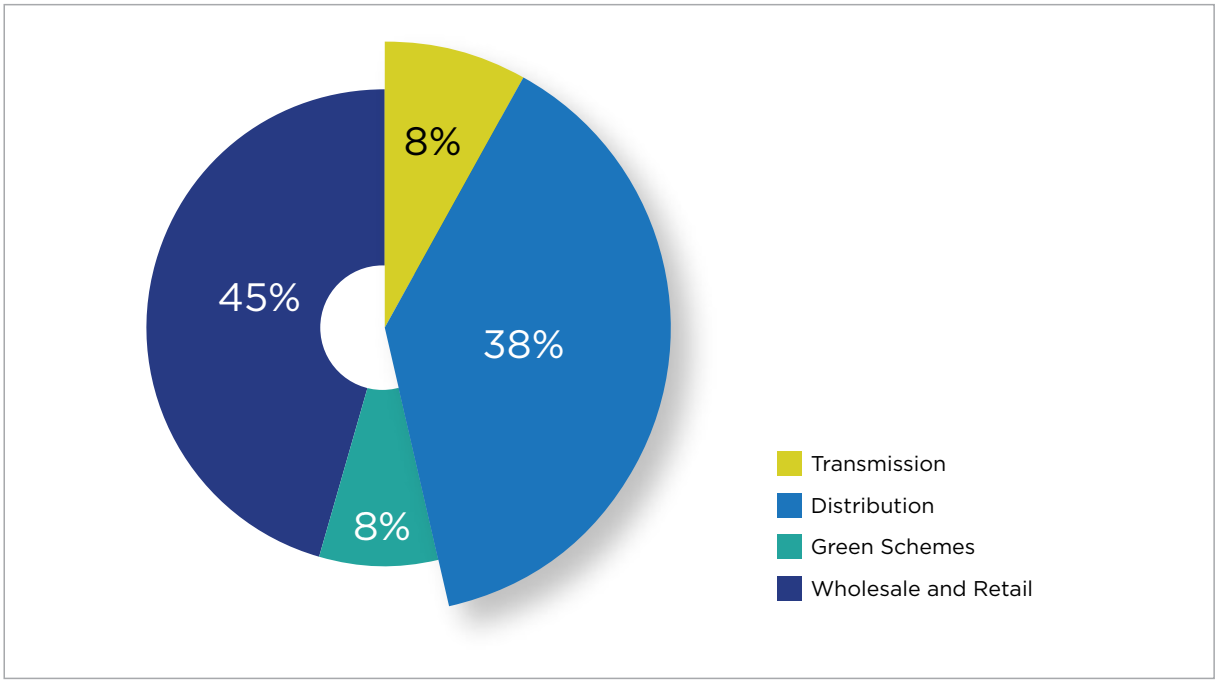
Source: IEA database, Detailed Country RD&D Budgets, Funding institutions included in Australia's dataset:
- Department of Industry, Innovation and Science
- Australian Renewable Energy Agency (ARENA)
- Commonwealth Science and Industrial Research Organisation (CSIRO)
- Australian Research Council (ARC)
- Australian Nuclear Science and Technology Organisation (ANSTO)
- Australian National Low Emissions Coal Initiative (NLECI)

Figure 8: Expenditure to 2050 (The Roadmap Scenario)



Source: CSIRO and the Energy Networks Australia, Electricity Network Transformation Roadmap, Final Report, p.9. Expressed in percentage terms.

Figure 9: Composition of Electricity Bill (National Average)



Source: Australian Energy Regulator (May 2017) State of the Energy Market Report, p.129.

There are two key institutions which support innovation in the renewable energy industry:

- Australian Renewable Energy Agency (ARENA) is providing grant funding to advance renewable energy technologies from early research to deployment in the early commercialisation stage.
- The Clean Energy Finance Corporation (CEFC) provides low interest loans to increase the flow of funds into renewable energy technologies, which are commercially proven but require support to become competitive. The CEFC may invest in earlier stage projects, which have significant support and an acceptable (but not excessive) level of risk.

Given its charter, the desktop review of ARENA-funded projects indicates that ARENA has supported few projects directly relating to network innovation since its establishment in 2012. Despite ARENA adopting a broad view of the issues related to advancing renewable energy, the ability to attract ARENA funding for network-related initiatives is limited to projects that:

- address barriers to the long-term uptake of renewables; or
- integrate renewable energy with existing electricity supply to power industrial processes and communities in remote off-grid areas; or
- demonstrate how distributed renewable energy systems can reduce the need for network augmentation or provide other benefits, particularly at the fringes of grids or where there are network constraints.

There are a number of other innovation initiatives relating to the energy sector. However, these initiatives are often either not directly relevant to the network sector, or the available funding is too small. Examples include:

- The Industry Growth Centres initiative provides a total of $250 million in Australian Government funding over the four years from 2016-17 to 2019-20. Growth Centres are established to deliver innovation, productivity and competitiveness in six industry sectors, including energy resources sector.[39]
- Australian Research Council linkage grants provide funding of $50,000 to $300,000 per year for two to five years to projects, which include collaboration between universities and other parts of the national innovation system.[40] Energy Networks Australia currently participates in two linkage projects.
- Federal and State governments pursue network innovation efforts on an ad-hoc basis. Examples include:
  - Ausgrid's CBD Embedded Generation Project received funding of $460,000 from the New South Wales Government.
  - The Smart Grid, Smart City project (2009) received Australian Government funding of $100 million. Government funding was complemented by private industry contributions.

Examples of industry network innovation efforts

Australia's electricity and gas networks regularly make investments in innovation. However, the scale of this investment is unlikely to be sufficient to achieve the step change in network innovation that is required to support the transformation of the energy sector in Australia. Examples of industry-led initiatives include:

- RD&D funded directly from a special research fund administered by Energy Networks Australia and Australian Power Institute through the *Framework for Energy Innovation* initiative.
- Direct funding on specific research by individual members. For example, the *Integrating Renewables into the Grid* Stocktake indicates that 18 of 54 network–led renewable energy grid integration projects were commercially funded by networks. The Roadmap and the Vision 2050 are also examples of industry-led innovation.
- Energy Networks Australia's Gas Committee innovation fund was established in 2016 for targeted R&D and technical activities in industry-identified priority areas.

7 Towards a solution

In a transforming energy system, the agility with which energy networks can enable customer choices and provide a platform for new markets and value creation will be pivotal to customer outcomes.

Even in a highly 'disrupted industry' with major changes in business models, self-supply prosumers and contestable markets consumers will still have a direct interest in a strong innovation culture established within energy network services. As noted earlier, electricity network services alone will require about one quarter of future system expenditure between 2017 and 2050; but are currently the focus of less than 1 per cent of public RD&D investment.

It is recognised that where innovation investments are funded by taxpayers or energy customers, the ultimate benefits of innovation must outweigh the costs. In other jurisdictions, like the United Kingdom, there is recognition that customers stand to benefit from network innovation through decreased energy costs and improvements to valued services. The environmental benefits will also be realised by society at large.

There is an opportunity to learn from mechanisms used in the United Kingdom to achieve similar objectives. For instance, a Network Innovation Scheme could be introduced to address concerns about the incentives for innovation and a lack of sufficient network innovation funding and programs. Such a scheme could apply to both gas and electricity network businesses.

It is likely that the design of any scheme would be best undertaken through a robust public policy process led by an independent institution with wide consultation. The scheme design would need to address the following features:

- **Objectives and focus of the scheme.** The key overarching objective under the *National Electricity Law* and the *National Gas Law* is to promote the long-term interests of customers. A Network Innovation Scheme can support this objective by focusing on the key areas where network innovation can drive optimal outcomes for gas and electricity customers and society. To achieve optimal outcomes the scheme needs to adopt a broad view of innovation and not attempt to pick technology winners.
- **An appropriate funding model**. The level of funding must be sustainable, long-term and predictable so that networks can plan and execute multi-year innovation projects. It is therefore recommended that the scheme provides for *ex-ante* rather than *ex-post* funding approvals.
- **Eligibility criteria.** The policy rationale for the Network Innovation Scheme is to address a combination of industry and regulatory constraints that hinder greater innovation by networks and hence limit services that networks' customers value into the future. To this end, networks' experience is crucial to achieving successful innovation and applying it in business as usual processes. This suggests that electricity and gas network companies should lead innovation projects under the scheme. However, eligibility to apply for funding should be extended to non-network parties wishing to partner with networks. This is to recognise the importance of collaboration and to leverage the knowledge and experience of other parties, where possible.

- **Governance.** A rigorous framework would need to address clear assessment criteria, governance and oversight. A variety of governance options are available, including establishing an Independent Expert Panel or empowering the AER to administer the scheme.
- **Sharing of learnings.** Learning dissemination is a critical element to maximise the benefits of successful innovations. Where supported by the scheme, the benefits of successful innovation should flow to other participants and energy customers. The energy network sector could lead this process through activities such as: holding industry conferences, making relevant information available online; and/or through industry guidelines.

Notwithstanding examples of success from countries like the United Kingdom, the design of any scheme would rely on more than just replicating these policies in Australia. There is also an opportunity to learn from other jurisdictions across the world. For example, another leading jurisdiction in the area of network innovation is Italy. Italy has undertaken competitive processes to facilitate pilots, where innovative projects were selected with appropriate rigour and funded through regulated revenue. In that case, the innovative projects were further incentivised with the ability to earn a premium return.[41]

The detailed design of a Network Innovation Scheme is recommended for further study.

Consultation questions

6. Do you agree that a Network Innovation Scheme is required in addition to the existing arrangements?
7. What are the features of an effective innovation scheme that can deliver the goal of accelerating network innovation?
8. What other public policy responses can be adopted in response to concerns about incentives for network innovation?

The detailed design of a Network Innovation Scheme is recommended for further study.

Appendix A

Additional international case studies

Some international regulators are taking proactive actions to ensure that energy regulatory frameworks encourage appropriate levels of network innovation. This focus on innovation is one of the sharpest contrasts emerging between Australia's energy network regulatory environment and that of the UK and United States. This section provides examples of innovation initiatives from the review of international experience.

California Public Utilities Commission

California's energy network legislation explicitly requires the regulator to consider policies to promote network innovation and provides the regulator with discretion to allow network firms to recover the associated costs from their customers. California's energy regulator, the California Public Utilities Commission (CPUC) has recognised the need to address a range of issues facing the energy sector in its decisions over the last few years.

In 2012, the CPUC authorised three utility companies to spend up to $150 million over a five-year period to participate in a program known as "21st Century Energy Systems" (CES-21). The program was expected to deliver $552 million in savings by 2020 from: improved resource planning related to the integration of renewables into the grid; potential substantial savings from improvements in natural gas operations; improved safety and reliability from enhanced capabilities to model electricity and gas flows; and, improvements in cybersecurity.[42]

Utilities did not propose any specific projects that they would undertake over the five-year period. Rather, the businesses provided "illustrative examples" of project activities that may be undertaken. The CPUC found that the use of "illustrative cases" is appropriate in light of the rapidly changing technologies and energy priorities that characterise California's energy industry. Notwithstanding its support for this initiative, the CPUC modified the proposed governance arrangements to ensure that there is appropriate oversight of the spending of ratepayer funds.

Subsequently, a 2013 Senate Bill 96 required that the CPUC-approved funding be reduced to the total of $35 million over a five-year period. This Bill also limited areas of research to cybersecurity and grid integration. It is understood that the revision to the project arrangements was due to concerns with the CPUC's oversight of the project.[43] The companies involved in the project were allowed to recover previously incurred costs in the areas of cybersecurity and grid integration against the $35 million cap.[44] However, the recovery of program management and administrative expenses, were disallowed ($75,723).

New York State Energy Research and Development Authority

The Technology and Market Development Program was established by the New York State Public Service Commission in 1998. The program is ratepayer-supported and administered by the New York State Energy Research and Development Authority (NYSERDA). The program runs in 5-year terms and is re-authorised each term.

In the 2006-2011 authorisation period, funding of $154 million per year was made available. Approximately half of this focused on energy efficiency activities and the other half on technology and market development activities.[45]

For the 2012-2016 period, an average annual funding rate of $93.8 million was authorised. Initiatives during this period focused on power supply and delivery, advanced clean power and combined heat and power.

Under this model, utilities collect the funds from ratepayers for the NYSERDA, which then directs the funds at its discretion. Utilities, however, can apply for funding for innovation projects.[46]

During 2012-2016 period, technologies eligible for NYSERDA funding included: innovative renewable-electric and other advanced clean power technologies for grid-connected applications, storage technologies for sub-utility-scale stationary applications, or technologies that improve grid power quality and reliability.[47]

Table 1 Survey of the CES-21 innovation arrangements

Features	Comments
Funding model	Network customer funded to promote network customer-directed benefits.
Approved budget	$150 million, subsequently reduced to $35 million over 5 years
Proponent	Regulated utilities propose and administer innovative programs, subject to regulatory oversight
Role of the regulator	• Assesses research proposals and approves funding • Undertakes regulatory oversight

Table 2 Survey of the Technology and Market Development Program

Features	Comments
Funding model	Network customer funded to promote public interest benefits.
Approved budget	$93.8 million per year
Proponent	Regulated utilities and other parties can apply for funding, but NYSERDA can initiate its own projects as well.
Role of the regulator	• Agency that administers how funds are spent is set up outside of the regulator. • Regulator establishes categories of research that can be funded.

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