ATTACHMENT 17.1
NETWORK INNOVATION SCHEME FOR ATCO

ATCO 2020-24 PLAN

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Gas Network Innovation Scheme for ATCO

A report prepared for ATCO's AA5 submission

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Executive Summary

The purpose of this report is to identify the key arguments in support of a network innovation scheme (NIS) being implemented as part of ATCO's AA5 for the 2020-25 regulatory period and that will likely be in the long-term interests of WA gas consumers consistent with the National Gas Objective (NGO) in the National Gas Law (NGL).

Key messages

The key messages from our report are that:

- A rapidly evolving energy landscape has important implications for future gas network service provision, including potentially the transporting of new blended gas fuels consistent with Australia's energy policy objective of a less carbon-intensive fuel supply.
- The existing national gas regulatory framework is not designed to provide strong incentives for network innovation, particularly leading-edge technologies associated with potentially major changes in future gas network services provision, because it assumes a stable and predictable energy market and no fundamental change in network service provision.
- Evidence from other countries' economic regulators, including in the UK and US, indicates that the existing Australian national gas regulatory frameworks will need to evolve to encourage greater network innovation consistent with serving the long-term interests of gas consumers.
- The proposed small-scale NIS set out in our report has been designed as a first step in addressing the weak innovation incentives available under the existing national gas regulatory framework;
  - however, future changes in the NGR/NGL may also be necessary, including to clarify the type of energy that is being transported and/or stored in gas networks for the purpose of applying price regulation to network services.

Key design features of NIS

The NIS that we are proposing has been designed to satisfy sections 98(1) and (3) of Part 9 of the National Gas Rules, including being consistent with the Revenue and Pricing Principles and NGO in the NGL

The key design features of the NIS are set out in Table 1 below.

Table 1 NIS key design features and reasons

Design feature	Key details	Reason
Incentive scheme objective	• The NIS objective is to provide ATCO with funding for trials and projects using innovative and new technologies with the potential to deliver medium to long term improvements in network services that are in the long-term interests of WA gas consumers.	• Objective makes explicit that projects must demonstrate the potential for medium to long-term benefits – that is, over timeframes beyond a single regulatory period. • Establishing an overarching objective for specific incentive schemes and/or key regulatory instruments is a good regulatory design feature of Australia's national energy regulatory framework.
Project eligibility criteria	A potential trial/project will be assessed against and must satisfy the following criteria to receive funding under the NIS • it is a project or program for researching, developing, or implementing a piece of new equipment, a new arrangement or application of existing network infrastructure, a new practice directly relating to: - the operation or safety of the network or - an improvement in customer service, or - a new commercial arrangement, or - a reduction to the carbon intensity of the gas distributed by the network; or - makes an incremental contribution to achieving any of the above changes; and • it is innovative, in that the project or program: - is based on new, novel or original concepts; - involves technology or techniques that differ from those previously implemented or used in the Western Australian Energy Market; or - facilitates the adoption of new technologies that can expand the existing range of uses for gas and/or the gas network; or - has the potential, if proved viable, to reduce long term network costs and prices and/or improve the quality of network services; and • the potential benefit to gas network customers is material, considering the scale of innovation funding proposed and the level of uncertainty associated with the project or program; and • the project or program relates to the services provided by means of the regulated network assets.	• To provide confidence that the only projects/trials etc that should receive funding under the NIS are those that satisfy the NIS objective and hence are in the long-term interests of gas network consumers.
Administrative details	Key administrative features of the NIS are as follows: • an annual cap of $1 million (indexed each year of the regulatory period using the ERA-approved CPI forecast) will be available to ATCO for innovative projects that satisfy the project eligibility criteria (refer row above); • ATCO will each year seek ex-post recovery of actual costs incurred that year under the scheme up to the funding cap, to be recovered through the annual tariff variation mechanism (this implies a one year lag in the recovery of actual costs ATCO incurs);each year of the regulatory period, ATCO can apply to the ERA for an up front, indicative approval for planned expenditure under this NIS;	• The NIS would be administered by ERA on an annual basis in the AA5 regulatory period and beyond, including checks and balances to ensure existing gas consumers only pay for approved trials/projects. • Incorporating the NIS funding into ATCO's revenue allowance will simplify the operation of the scheme. ATCO will not be allowed to keep any under-spend of the allowance, which must be returned to its customers at the end of each regulatory period. • The administrative features are consistent with the NIS objective

Design feature	Key details	Reason
	• there is no requirement for ATCO to identify at the start of each regulatory period the suite of trials/projects that it intends to undertake over the full regulatory period, to maintain ATCO's flexibility to respond to changing market circumstances; • eligible projects can be funded across regulatory years and periods provided the total NIS allowance is not exceeded in any AA regulatory period; • the NIS allowance should only provide funding for projects that have not been funded previously from another source (eg ARENA grants, ERA's AA determination); and • the size of the NIS allowance should be reviewed by ERA as part of each AA determination.	and will provide certainty to ATCO and the ERA about how the scheme will operate. • This should also facilitate the effectiveness of the NIS and ensure its consistency with achievement of the NGO and Revenue and Pricing Principles in the NGL.
Compliance reporting	The key compliance reporting requirements are: • ATCO must submit to ERA annual reports on its activities, actual expenditures relative to the approved NIS allowance, and projects undertaken under the scheme demonstrating satisfaction of the project eligibility criteria; • ERA will conduct ex-post reviews of ATCO's trials/projects to determine their compliance with the project eligibility criteria, which will determine ATCO's eligibility to receive funding for the specific trial/project under the scheme; • at the end of each AA regulatory period, ERA will determine whether ATCO has underspent relative to the NIS allowance for the purpose of calculating customer refunds; • ATCO's annual compliance report is to be supported by a statutory declaration; and • ATCO will periodically advise ERA on whether innovative projects/trials it has undertaken remain likely to be in the long-term interests of WA gas consumers.	• Annual compliance reporting will ensure that ERA can determine that ATCO is complying with the scheme's administrative details and, more broadly, the scheme's objective. • This will occur through ERA having the power to conduct ex-post reviews of completed trials/projects to ensure compliance and eligibility for their funding, which should provide confidence to ERA and WA gas consumers about the efficacy of the scheme.

Contents

Figures and Tables

1 Introduction

ATCO Gas Australia (ATCO) is preparing its Fifth Access Arrangement submission (AA5), due to be lodged with the Economic Regulation Authority (ERA) in September 2018.

The rapidly evolving Australian energy market is driving the need for greater innovation in both gas and electricity network services provision, including in response to new generation sources and consumers' changing energy consumption expectations/requirements.

Given these energy market changes, the purpose of this paper is to propose a Network Innovation Scheme (NIS) that satisfies the National Gas Law (NGL) and National Gas Rules (NGR). The scheme is intended to assist overcome the disincentive for gas networks, such as ATCO, to invest in novel innovative projects under conventional economic regulatory frameworks, such as the NGL/NGR. The NGR already allows for an access arrangement to include one or more incentive mechanisms to encourage efficiency in the provision of network services.[1] However, unlike Chapter 6 of the National Electricity Rules (NER), the NGR provides little guidance on the design, structure and operation of incentive mechanisms, such as a NIS.

In this context, the purpose of our report is to provide supporting evidence that implementation of a small-scale NIS in ATCO's AA5 regulatory period would be in the long-term interests of WA gas consumers.

The remainder of our report is structured as follows:

- Chapter 2 summarises key elements of the economics of innovation.
- Chapter 3 provides more details on the rapid evolution of energy markets in Australia and internationally, specifically focussing on how this will likely affect future gas network service provision;
- Chapter 4 explains the challenges associated with creating strong incentives for innovation under economic regulatory frameworks, such as the NGL/NGR; and
- Chapter 5 identifies several innovative projects that ATCO is currently considering with potential long-term benefits to WA gas consumers but that would be unlikely to satisfy prudency and efficiency tests under the current national gas regulatory framework because of the uncertainty associated with the size and timing of these future benefits;

[1] National Gas Rules, Part 9, Division 9, Clause 98

- uncertainty is a fundamental characteristic of innovation, including the future size of cost, price and service outcomes arising from innovative activities.

- Chapter 6 explains the key design elements of the NIS that we propose should be implemented in ATCO's AA5 regulatory period and applies the NIS eligibility criteria to a sample of ATCO's current innovative projects.

2 Economics of innovation

The purpose of this chapter is to provide a summary of the economic literature on the nature of innovation, including as a driver of economic growth over time. Understanding the drivers of innovation is particularly important in the context of the design of economic regulatory frameworks and whether such frameworks are likely to encourage innovative activities by regulated network businesses.

2.1 Defining innovation

Innovation, which primarily involves both the creation and diffusion of new products, processes and methods, is recognised to comprise a wide range of activities, including research and development (R&D), organisational training, testing, marketing and design.

Although innovation has been described in a number of ways, we consider the OECD definition to capture its essense:[2]

> '…the implementation/commercialisation of a product with improved performance characteristics, such as to deliver objectively new or improved services to the consumer… the implementation/adoption of new or significantly improved production or delivery methods… involv[ing] changes in equipment, human resources, working methods or a combination of these'

Innovation can be further characterised as being either 'new to the world' or 'new to the firm', which provides a means of better understanding its drivers and methods of diffusion across the broader economy.[3]

Innovations are new-to-the-world when their impact is felt across all markets and industries. These can include general purpose technologies such as electricity, the internet and transistors, which have wide applciability, and open up new opportunities rather than offering complete, final solutions. However, it may also include innovations that are minor or incremental, such as improvements to the specifications of existing products and services.

New-to-the-firm innovation can also have wide or narrow effects. It includes technology transfer, imitation, or copying, reflecting the individual firm's adaptation of innovation in its specific market context. New-to-the-firm innovation is especially important for the adoption of new-to-the-world innovations, enhancing the productivity effect of the

[2] Oslo Manual 2005

[3] Palangkaraya A., Spurling T., Webster E, (2016), What drives firm innovation? A review of the economics literature", April

latter. The substitution of 'new' for ' old' technology is not necessrily a discrete step change, with firms continuing with old technologies long after the introduction of a radical new invention, either because of sustained improvements to the old technologies or because the new technology is insufficiently settled and reliable.[4]

2.2 Innovation and the facilitation of economic efficiency

Economists generally consider economic efficiency across the following three dimensions:

- Productive efficiency – which requires that goods and services be produced at the lowest possible cost.
- Allocative efficiency – which requires that available resources be used to produce the goods and services that consumers value most.
- Dynamic efficiency – which requires the optimal allocation of resources over time as technology, the availability of inputs and consumer preferences change.

Productive and allocative efficiencies are examples of static efficiency, which describes the level of efficiency at a point in time. In contrast, dynamic efficiency relates to businesses innovating and investing to improve productive capacity and efficiently identify and deliver products and services in response to consumer preferences over the long term. Hence, any long-term assessment of consumer benefits, including that embodied in the National Gas Objective under the NGL, must capture the dynamic element of efficiency and its contribution to increasing economic efficiency in the long term.

Ideally, efficiency will be maximised to the long-term benefit of consumers through both the achievement of short-run static efficiencies, such as cost reduction, and the longer-term efficiency gains, such as lower prices or improved services, that arise from innovation and investment. However, innovation typically entails a high degree of uncertainty, long time horizons, and interdependencies across projects. These characteristics of innovation makes it problematic in an economic regulatory context because of the judgements required in determining the efficacy of incentives aimed at delivering efficiency gains, against the desire to rapidly transmit the benefits of those gains to consumers.

[4] Palangkaraya A., Spurling T., Webster E, (2016), pp 3-4

2.3 Innovation's contribution to economic growth

Innovation is well-accepted in the economic literature as an important driver of economic growth. This is especially the case in the long run in advanced and emerging economies. However, the links between innovation and economic growth are dynamic and complex.

Several economic models have been developed to explain the role of innovation (technological progress etc) in driving economic growth.

2.3.1 Neoclassical growth model

A commonly used neoclassical framework for explaining growth is set up through a production function consisting of a firm's inputs and outputs. In simple terms, a firm can increase the number of inputs that go into its production process, or find new ways in which it can derive more output from the same number of inputs ie achieve multifactor productivity, the part of output growth that cannot be explained by increased factor inputs.

Evidence has shown that the measured growth of inputs (i.e., in capital and labour quantities) does not fully explain actual growth in the output of the economy over the long term. In other words, innovation forms part of the unexplained or residual of the growth model. This unexplained proportion of growth can be attributed to productivity, including that driven by innovation.[5] In 2007, the Productivity Commission indicated that from 1964 to 2005 around 65 per cent of economic growth per capita in Australia could be ascribed to MFP growth.[6]

2.3.2 Endogenous growth models[7]

In contrast to the neoclassical growth model, endogenous growth models incorporate productivity growth as an endogenous factor in their formulation, which accounts for long-term technological progress and productivity growth.

The product variety model of Romer is an important example of these endogenous growth models, in which innovation causes productivity growth by creating new, but not necessarily improved, varieties of products. This model emphasises the role of technology spillovers.

[5] Rosenberg N., (2004), Innovation and Economic Growth, Abstract, p 1

[6] Productivity Commission (2007), Public Support for Science and Innovation, p 110

[7] Aghion P., Akcigit U., (2015), Innovation and Growth: The Schumpeterian Perspective, pp 2-5

Another branch of innovation-based endogenous growth models is the Schumpeterian paradigm. This paradigm places firms and entrepreneurs at the heart of the economic growth process and is underpinned by three main ideas:

- First – long-run growth relies on innovations, whether they be process innovations to increase the productivity of labour and/or capital; or product innovations (introducing new products); or organizational innovations (to combine production factors more efficiently).
- Second – innovations result from investments like research and development (R&D), firms' investments in skills, search for new markets that are motivated by the prospect of monopoly rents for successful innovators;
  - importantly, this model recognises that innovations generate positive knowledge spillovers (on future research and innovation activity), which they cannot fully internalize.
- Third – creative destruction entails new innovations that tend to make old innovations, technologies and skills obsolete. Hence, growth involves a conflict between the old and the new: the innovators of yesterday resist new innovations that render their activities obsolete. This idea also explains why innovation-led growth in advanced economies is associated with a higher rate of firm and labour turnover.

Perhaps the most powerful implication of the Schumpeterian paradigm in the context of Australia's rapidly evolving energy market and associated wave of technological change is that regulated gas (and electricity) networks cannot afford to be left behind in terms of seeking ways to ensure that their network services remain relevant to current and likely future requirements of their customers.

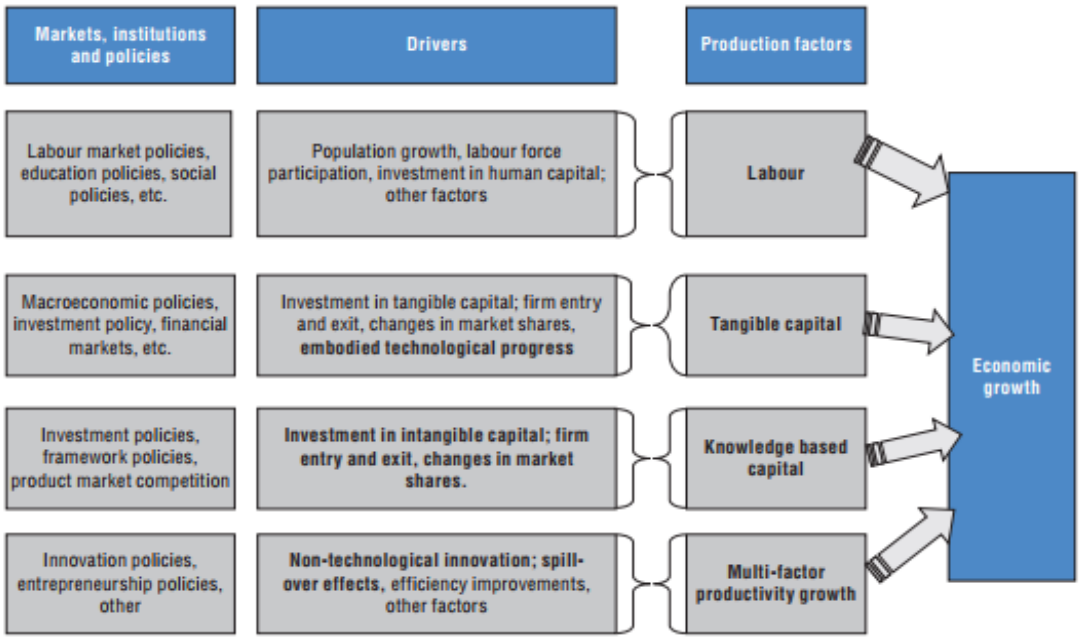
In this regard, it is also clearly the case that new entrants to the energy market represent a mix of technologies some of which will allow enhancement and/or evolution of the traditional network service. However, there are also new technologies and market participants that are supplying services that are directly competing with traditional gas (and electricity) network services. In other words, they are potentially involved in Schumpeter's creative destruction of old technologies and traditional ways of doing things, including the provision of gas network services.

This raises important regulatory design issues because of the risks posed for ATCO and other network businesses if the NGL/NGR unduly constrains their ability to respond to these energy market changes. This issue is discussed further in section 2.5 of this chapter.

2.3.3 OECD's analytical framework for economic growth

Figure 1 shows how the OECD has applied economist's economic growth models, identifying labour, tangible and knowledge-based capital inputs, as well as multi-factor productivity growth, to explain the drivers of economic growth.

Figure 1 A simplified framework to analyse economic growth



Data source: OECD "A New Economy? The Changing Role of Innovation and Information Technology in Growth" 2000

Under the OECD's analytical framework, innovation effects three aspects of the production function:

- tangible capital, such as new machinery or computers incorporating technological advancements;
- knowledge-based capital (KBC), such as R&D, software, design and firm-specific skills or organisational capital; and
- multifactor productivity growth, resulting in increased efficiency in the use of labour and capital.

In a recent report, the OECD argue that in an environment of slower forecast economic growth than by average historical standards, multifactor productivity growth and innovation will become the most important driver of future economic growth, accounting for around three-quarters of growth:[8]

[8] Braconier, Nicoletti and Westmore (2014, "Policy challenges for the next 50 years", pp 6 & 23

Against this backdrop, future gains in GDP per capita will become more dependent on accumulation of skills and, especially, gains in multifactor productivity driven by innovation and knowledge based capital.

2.4 Drivers of innovation

Technological innovation shares common features of a public good, where costs making it available to many users are low compared to the cost of its development. This characteristic leads to spill over effects of innovation (positive externalities).

As firms are unable to capture all the benefits generated through its innovative activities, this results in higher benefits from innovation compared to the private returns from firms. Thus, where innovation has public good characteristics, there is a market failure, which lessens the incentive to invest in innovative activities and hence the amount of innovation undertaken. Furthermore, technological knowledge is understood to display other positive characteristics, such as accumulation (increasing returns) and its dynamic nature to economic growth, which is likely to push the equilibrium further away.

Although market failure exists, firms continue to innovate, which can be partly explained by Schumpeter's studies, that firms are rent seekers. Innovation either through technological devices or productivity-enhancing processes gives the firm a cost advantage over its competitors which allows the firm to gain market share and seek further rents. Other studies have also shown the significance of innovation to provide firms with a competitive advantage.

Summarised below are drivers of innovation that have been identified through empirical studies in academic literature reflecting both new-to-the-world and new-to-the-firm innovations over the last 15 years.

Drivers of new-to-the-world innovation

Table 1 identifies and summarise new-to-the-world innovations recognised in the economic literature.

Table 2 Summary of new-to-the-world innovation drivers in literature

Drivers	Summary of findings
Firm Size	Generally, studies find a positive, but not universal, association between size and measures of new-to-the-world innovation as it is commonly believed that larger firms can amortise fixed costs over a broader base and will, therefore, be more innovative than smaller firms. It is important to note, however, that the association depends heavily on the actual measure of innovation used.
Firm Age	Empirical results are mixed with a leaning towards a negative association between firm age and innovation ie the older the firm the less innovative is will be and vice versa.
Persistence	Product innovation tends to be path dependent or persistent (related to what the firm did last period). However, actual persistence in innovation is not widespread where studies have found only a minority of firms, most particularly large firms and those in high-tech industries, are persistent innovators.
Internationalisation	There is clear and consistent evidence that new-to-the-world innovation causes export. However, the evidence is less clear on whether the innovations are product or process related, and whether there is an association between foreign ownership and innovation activity.
Government Programs	Many studies have shown that, for most of the second half of the 20th century, the size and structure of government defence spending, as well as public procurement programs in agriculture, space and health in various countries, in countries such as US, UK Sweden, Israel and France, had a major impact on innovative activities.
Intellectual Property	There is considerable evidence that patents increase innovation on a partial equilibrium basis (i.e. from the perspective of the patentee) where the effect is largest for pharmaceuticals, chemicals and instruments. However, from a general perspective, there is also evidence patents stifle innovation because the benefits to the patentee are outweighed by restriction to follow-on idea development and financial costs.
External Networks	There is a clear endogenous association between firms' decision to innovate and external networks such as social capital, membership of a cluster and localised groups supporting the industry. This may be because firms wanting to make a step-change in their innovation activities will choose to locate in a cluster that offers appropriate and effective support. However, it is important to note that firms with low technological competence may benefit more from being located in a cluster, while firms with high technological competence may face the risk of outward knowledge spillovers.
Frontier Science	While there is evidence that regions hosting leading-edge research departments produce significantly more inventions and more innovations, other studies also suggest that the mere presence of university researchers had no significant impact on the innovativeness of nearby firms.
Entrepreneurs and Managers	Studies have found that a CEO who sets challenging goals for employees, who is ambitious, and who embodies transformational leadership will create a more innovative firm. In addition, studies have found that internal firm governance rules tend to depress R&D.
Managerial Practices	Where subordinates are allowed greater autonomy and decision latitude by their supervisor, there is more individual innovative behaviour. Furthermore, top managerial support is positively related to product innovation but has no effect on process innovation, which is influenced by organisational learning capability and organisation collaboration.

Source: A. Palankaraya, T. Spurling, E. Webster "What drives firm innovation? A review of the economics literature" April 2016

Drivers of new-to-the-firm innovation

Table 2 identifies and summarise new-to-the-world innovations recognised in the economic literature.

Table 3 Summary of new-to-the-firm innovation drivers in literature

Drivers	Summary of findings
Conduit Technologies - ICT	There is evidence that ICT adoption is usually accompanied by new organisational practices and is more common in larger firms and those with higher levels of human capital.
Conduit Technologies - Machines	Using data on Australian firms, there has been a clear positive association between new-to-the-firm innovation and investment in new physical capital. In addition, for low and medium technology industries, new-to-the-firm innovation was dependent on the external provision of machines, equipment and software.
Age, ownership and market characteristics	Studies show that the probability a firm has carried out product innovation reduces with the firm's age that new-to-the-firm innovation was mainly concentrated in high-tech industries and any export (and import) activities have a positive association with new-to-the-firm innovation.
Persistence	There was evidence of strong persistence especially for large firms and those in dynamic markets. However, more than half of innovating Australian firms in services industry are 'one-time' innovators, whereas about half of innovators in the resources industry can be considered as 'sporadic' innovators.
Managerial Practices	Studies have shown innovative activity is positively affected by regular and formal contact with clients, that organisational goals and managerial strategies and dimensions are key to stimulating innovation, and more flexible styles of management and more aggressive managerial approaches were significantly associated with more innovative modes of production.
Government programs	Although there are only a few evaluations of government programs to encourage new-to-the-firm innovation, a study reveals that these programs had a clear and positive effect on firm performance. However, how long the benefits last are questionable as benefits are only measured for the first few years post-program.
Managers' character and education	Evidence suggests more highly educated managers, those with tertiary education or an MBA, tend to adopt good management practices and/or be innovative.
Workers' education and skill	It is demonstrated that more training leads to more product and process innovation with a study estimating 42% of employees innovated with new products who undertook on-the-job training, compared to 24% in workplaces that did not. In addition, there exists a positive relationship between diversity in education and gender on the likelihood of introducing an innovation and employee education and training were positively associated with innovation in small firms.
Organisational flexibility	There was evidence that organisational rigidities limited innovative activities, while good work culture and employee participation are strongly positively associated with product and process innovations.
Financial constraints	Financial constraints, as reflected in low gross profit margin ratio or large banking debt, significantly reduce the likelihood that firms engage in innovative activities.

Source: A. Palankaraya, T. Spurling, E. Webster "What drives firm innovation? A review of the economics literature" April 2016

2.5 Chapter key points

It is clear innovation, whether it be new-to-the-world or new-to-the-firm innovation, is a key driver of economic efficiency and in so doing, economic growth.

This is important in the context of the regulatory framework embodied in the NGL/NGR, which is underpinned by an economic efficiency objective (the National Gas Objective).

Dynamic efficiency, relating to businesses innovating and investing to improve productive capacity and efficiently deliver products and services in response to consumer preferences over the long term, is particularly important in the context of an

Australian energy market being fundamentally transformed by major technological change and the associated emergence of new market participants and services.

The economics of innovation, particularly the Schumpeterian paradigm and its creative destruction idea, suggests that gas (and electricity) network businesses will need to innovate to maintain the relevance of their network services in the face of major technological change sweeping across the Australian energy market. This raises important issues regarding the design of the NGL/NGR and specifically the innovation incentives that it is creating for gas network businesses such as ATCO. This issue is discussed further in Chapter 4 of our report.

3 Rapidly evolving energy landscape

The purpose of this chapter is to summarise how industry and government agencies are responding to current and prospective major changes in Australian and international energy markets in the face of generational technological changes.

3.1 Background

Over the past decade, Australia's supply of and demand for energy has fundamentally changed and the way gas and electricity networks operate has been required to change with it. This includes due to rapidly increasing renewable generation, changing consumer energy demand patterns and increasing distributed generation.

In addition, new fuels, such as biogas and hydrogen, have the potential to become mainstream and complementary energy solutions that will use existing gas network infrastructure.

There is widespread recognition that these broader energy market changes mean that gas networks, such as ATCO's Mid-West and South-West distribution system, will need to innovate and evolve, including to:

- handle different blends of gas (including hydrogen and biogas, as opposed to just natural gas) as part of the decarbonisation of energy supply and
- provide enhanced services, such as energy storage, to meet the evolving needs and expectations of its current and prospective customers.

The scale of existing gas network infrastructure in WA and its significance for customer energy consumption emphasises the importance of leveraging contemporary and prospective advances in energy technology in network service provision.

However, it is important to note the dilemma facing existing network owners in that changes in the broader energy market, including new sources of energy, could potentially have large future effects on the operation of their networks, but the regulatory framework hinders their ability to prepare for any such changes because it is predicted on a stable technological change assumption with substantially unchanged energy supply and demand patterns. This tension emerging in the design and administration of energy regulatory frameworks is discussed further in Chapter 5 of our report.

3.2 International experience and case studies

A substantial body of work has been presented in recent years, from industry and government, on how Australian and international energy markets are changing, primarily driven by major technological advances underpinning innovation in energy

generation and transport. In the context of our paper, gas network innovation is of specific interest.

This section of our paper summarises several of the most significant pieces of work in this field.

3.2.1 Future Security of the National Electricity Market (the Finkel Review)

While primarily focussed on the future security of Australia's National Electricity Market (NEM), including the essential role played by gas in providing secure and reliable electricity, the Finkel Review also made several important points about innovation occurring in the energy market including that:[9]

> Australia has a once-in-a-generation opportunity to reshape our electricity system for the future. A wave of technological change is sweeping across us. The key driver – innovation – cannot be reversed. Taking advantage of these technological changes requires a culture of proactively developing new approaches, and ways of thinking to facilitate the next wave of development rather than hold it back.

To this end, to support network innovation efforts and, ultimately, put initiatives/technologies to work, the Finkel Review recommended that:

> "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" (p. 66).[10]

As will be discussed further in the sections below, the Finkel Review's emphasis on the critical role that new technologies and innovation will play in future electricity service provision applies equally to future gas supply.

3.2.2 ENA Gas Vision 2050

Gas Vision 2050 (prepared by an ENA-led consortium of peak gas industry bodies) revealed that innovation efforts, particularly in the areas of biogas, hydrogen, and carbon capture and storage, will be critical to the provision of reliable and affordable energy in a low carbon energy future.[11]

The ENA Gas Vision 2050 predicts that the total population of Australia to be near 40 million people. Of this, gas powered homes will climb to around 10.2 million. This

[9] Finkel, A. (2017), Independent Review into the Future Security of the National Electricity Market: Blueprint for future. Published by the Department of Environment and Energy, June 2017, p 29

[10] Finkel, A. (2017), p 66.

[11] Energy Networks Australia (2017). Gas Vision 2050: Reliable, secure energy and cost-effective carbon reduction.

dictates the need for clean methods of natural gas production and usage. As there will be an increased reliance on gas, replacements need to exhibit high order reliability. The changes that may be seen are the mixing of natural gas and hydrogen until a point of which the natural gas is completely removed and replaced with hydrogen.

Furthermore, the hydrogen can be stored underground to streamline the supply and demand of energy.[12]

Such changes in the composition of gas will require significant changes in gas networks to ensure continuation of safe and reliable gas supply.

3.2.3 UK ENA Gas Network Innovation Strategy

The UK ENA's Gas Network Innovation Strategy identifies that gas pipelines and distribution networks will need to be upgraded to make way for new solutions in reducing carbon emissions from gas consumption and production. A key objective is to ensure alignment between the supply of gas and the demand from consumers.

As the UK gas networks are aging, the implementation of new materials is also being researched in accordance to criteria such as useful life, resistance to corrosion and what gasses can pass. It has been identified that as the blend of gases used will change, so does the materials the pipes will be made from. This is to ensure no unexpected or lengthened outages due to failure of the system.[13]

3.2.4 ENA/CSIRO Energy Transformation Roadmap

The ENA/CSIRO Energy Transformation Roadmap, one of the key outputs of a partnership between the two entities, proposes a pathway for the transformation of the Australian electricity network sector over the next decade, supporting better customer outcomes as the sector accommodates rapid adoption of new technologies.

It is focussed on the need for electricity networks to be responsive to the changing demands for traditional services, while enabling new opportunities for energy resource sharing and balancing. However, it also expressed the following view about potential future fundamental change in gas supply consistent with the Australian and UK work referred to above:[14]

> Gas may be increasingly valued as a way to reduce reliance on grid electricity. As greenhouse gas emissions constraints begin to strengthen, natural gas suppliers may

[12] Gasvision 2050 (2017). Reliable, secure energy cost-effective carbon reduction. Energy Networks Australia.

[13] Gas Network Innovation Strategy (2018). Energy Networks Association

[14] ENA/CSIRO (2017), Electricity Network Transformation Roadmap, Final Report, p 33

> look to technologies such as bio-methane, fuel cells and solar gas to strengthen their environmental position.

The Roadmap also identified 'power to hydrogen storage' as a potential energy balancing solution in a low or zero net emissions system.[15]

3.2.5 COAG Energy Council – Optimising Network Incentives Report (April 2018) (energy market not regulatory framework discussion).

The Optimisation Network Incentives Report commissioned by the COAG Energy Council and prepared by KPMG, is focussed on the regulation of Australian electricity networks in the NEM. However, it raises the following important point regarding the incentives for innovation associated with the current regulatory framework applied to electricity networks:[16]

> The current framework for regulating revenue may not be effective in driving the scale of innovation that is required for this innovation to occur. While innovation is occurring, it is not occurring on the scale or with the speed required to keep pace with technology changes and consumer preferences or on par with international jurisdictions.

Given the broad ranging nature of rapid technological change in the energy sector and the similarities between Australia's national electricity and gas regulatory frameworks, we consider KPMG's findings to be equally pertinent to innovation incentives existing under the current gas regulatory framework.

3.2.6 ENA's Network Innovation Discussion Paper (July 2017)

The purpose of ENA's Discussion Paper was 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.

Using 2014 data from the International Energy Agency, ENA presents data on investment intensity that shows Australia is one of the lowest funders of research, development and determination (RD&D), i.e. ranked 19 compared to 24 international counterparts for RD&D investment in energy, and the lowest out of 21 international counterparts when only electricity network expenditure is considered. [17] ENA attributes

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15 ENA/CSIRO (2017), p 55

16 KPMG (2018), Optimising Network Incentives (2018). A report for the Energy Market Transformation Project Team, January, p 1 of Executive Summary

17 Energy Networks Australia (2017). Network Innovation: Discussion Paper. July, pp 5-8.

this finding to Australia's regulatory regime for network companies, which has been designed to promote efficiencies in costs (rather than innovation) in the business-as-usual activities of companies. This issue is discussed further in Chapter 4 of our report.

The Discussion Paper also notes that Australia has a series of energy innovation programs in place that provide public funding for innovation projects relevant to the energy industry. However, compared to other countries, the current RD &D mechanisms in Australia provide fragmented and relatively limited support for network innovation.

3.3 UK examples of gas network innovation

Reflecting the greater focus on gas network innovation in the UK, facilitated by Ofgem's RIIO (Revenue = Incentives + Innovation + Outputs) regulatory framework (discussed in more detail in Chapter 4 of our paper), this section of our paper identifies several examples of innovation applied by UK gas networks.

Section 3.3.1 references examples of multiple small-scale innovative projects/trials being run by gas utilities. In addition, Section 3.3.2 references large-scale trials/projects associated with a separate major gas innovation competition initiated by Ofgem.

3.3.1 Small-scale innovation trials/projects

In recent years, several UK gas utilities, have been undertaking many innovative trials/projects annually, including collaborations with other gas networks.

It should be recognised that the potential benefits of these trials/projects are uncertain/not demonstrated when they begin, including the timing of any future benefits. It is also the case that these trials/projects may not deliver a future benefit and it is only through trying that the utilities identify projects that ultimately are more likely in future to satisfy standard regulatory prudency and efficiency tests.

Significantly in the light of rapid energy market change, Ofgem's small-scale innovation scheme is intended to encourage an innovation culture within the gas utilities, such that the performance of innovative trials/projects will increasingly take on the nature of business-as-usual activity.[18]

Northern Gas Networks (NGN) and Wales and West Wales Utilities (WWU) provide a good illustration of these innovative trials/projects.

[18] Ofgem (2016), The network innovation review: our consultation proposals, December, p 9 & p17

NGN

NGN, in its 2016 Innovation Report, indicated that it had completed 37 projects since 2013/14 made possible by Ofgem's small-scale gas innovation scheme, with a further 32 live projects in the pipeline.[19]

NGN indicated that its NIA spending is focussed on the following four areas, which shows the potentially broad scope of innovation across its business:

- Asset and network management
- Safety and environment
- Customer services
- Future role of gas

Trial/projects it has completed include:[20]

- Refining the 'capping-off' of decommissioned small diameter gas pipes close to buildings using foam bags that could abut to the large main leaving no gap or stub;
  - the development process included lab test and field trials and is now being used extensively across the network, saving costs, improving safety and reducing public inconvenience.
- Faster tracking of water ingress into the distribution network by using a remote camera, which is sent down pipes to spot water and simultaneously pump it out;
  - the technology was used first in field trials and has now been used in serval live water ingress incidents, saving costs and enabling much quicker restoration of customer's gas supply.
- Use of dogs to locate gas leaks more quickly, helping to speed up repair jobs and reduce the need for engineers to dig exploratory holes in roads;
  - controlled trials have been successfully undertaken with second phase trials to commence.

These trial/project summaries indicate how the benefits of innovation, while often long-term in nature, can also deliver short to medium term benefits to the benefit of existing gas consumers. It is also clear from these examples that these trials/projects would fail to satisfy conventional regulatory prudency and efficiency tests as apply under the UK's and Australia's gas network regulatory frameworks.

[19] Northern Gas Networks, Clever Stuff, Our Innovation Report, p 4

[20] Northern Gas Networks, Clever Stuff, Our Innovation Report, pp 16-21

Wales and West Utilities

Along similar lines to NGN, WUU in its 2016/17 Innovation Report identifies a wide range of innovative trials/projects it has been pursuing directed to promoting more efficient gas network services in the medium and longer term.[21]

Trial/projects it has completed include:[22]

- Rapid steel pipe cutter trial, intended to develop a hand-held tool that will safely cut through steel pipes without damaging newly inserted PE pipe to reduce the size and duration of street works activities, minimising disruption and reducing costs.
- Optomole Phase 4 trial, which is testing the use of innovative laser and fibre optic technology to assess its ability to locate gas leaks in underground utility ducts quickly and accurately, reducing excavation and repair costs.
- GPS-enabled video in-route walk survey trial, which is testing emerging software technology that improves the quality and availability of field survey records (through video mapping), reducing site visits and providing a robust audit trail.
- Flexible bio-methane production using carboxylic acids, working with universities to investigate a cost effective, and flexible method of storing biomethane as a future low carbon way of managing gas demand.

As for NGN, it can be seen that these innovative trials/project have both shorter term and long-term potential benefits to gas consumers but would fail to satisfy conventional regulatory prudency and efficiency tests.

3.3.2 Large-scale innovative trials/projects

The following trials/projects were funded under Ofgem's national gas innovation competition where entities were required to pitch their proposal to an independent judging panel. This contrasts with the small-scale innovative trials/projects being funded under Ofgem's gas determination price controls.

[21] Wales and West Utilities, Innovation for today's and tomorrow's customers, Wales and West Utilities Innovation Report 2016/17

[22] Wales and West Utilities, pp 8-10

'H21' project

The H21 Leeds Citygas project is a study with the aim of determining the feasibility, from both a technical and economic viewpoint, of converting the existing natural gas network in Leeds, one of the largest UK cities, to 100% hydrogen.[23]

Funding of £18.7 million was provided for the trial in 2017 for Phase 1A, which would confirm potential changes in the background leakage levels and Phase 1B, which would confirm any changes to the safety risk arising from a move to a 100% hydrogen network.[24]

The judging panel found that it is sensible to start testing the viability of using 100% hydrogen in the GB gas distribution networks to inform thinking on the long-term future of heating and the use of the gas networks and that sufficient benefits will accrue to gas customers through learning about the network assets from Phases 1A and 1B to contribute funding to this part of the project.

HyDeploy gas blending project

This project was funded by over £6.8 million to begin major testing on the prototype, which would blend up to 20% hydrogen, into the natural gas mix used for residential and commercial purposes to reduce overall carbon emissions. The panel believed that this project was suitable to award funding as it addressed all relevant criteria for success, such as costs for implementation and environmental effectiveness.[25]

Future billing methodology

This project aims to separate and alter the pricing schedule of gas based on its overall quality and usefulness. This project is aimed at allowing consumers with poor gas quality to not pay the same amount as another with excellent quality.

The panel deemed this project effective in reducing carbon emissions as it will open the gas network and allow new low carbon emitting gas production methods to begin. This ultimately resulted in funding for the project of £4.8 million.[26]

3.4 Chapter key points

This chapter indicates that rapid technological change in the energy sector is driving the need for greater innovation in electricity and gas network service provision. However,

[23] H21 (2017) Leeds City Gate

[24] Ofgem (2017), Network Innovation Competition 2017 Funding Decisions, November, pp 12-15

[25] Gas Network Innovation Competition: 2016 Funding decision (2016). Ofgem

[26] Gas Network Innovation Competition: 2016 Funding decision (2016). Ofgem

there are increasing concerns in Australia and internationally that economic regulatory frameworks applied to such networks are not creating strong enough financial incentives for innovative activities to be pursued. This is likely to be to the long-term detriment of energy consumers.

The next chapter of our report discusses the facilitation of innovation under regulatory frameworks in more detail.

4 Facilitating innovation under economic regulatory frameworks

The purpose of this chapter is to set out the challenge posed by expenditure incurred on innovative projects and activities under economic regulatory frameworks, with specific reference to the NGL/NGR under which ATCO's prices and services are currently being regulated.

As discussed in Chapter 3 of this paper, the innovation challenge stems from the high degree of uncertainty associated with many forms of innovation, including the sharing of the risks and ultimate beneficiaries of any such expenditure.

We consider the current design of the NGL/NGR is unlikely to create strong incentives for genuinely innovative projects and activities because the high degree of uncertainty associated with them is contrary to the underlying regulatory assumption of stability and predictability in gas network service provision.

4.1 Barriers to energy network innovation

Until recent times, gas and electricity network service provision has been characterised by relatively slow technological change, such that their essential service characteristics have been assumed to remain broadly stable over time.

The design of Australia's national energy regulatory framework fundamentally reflects this characterisation of the core network service, which continues to be regulated as a natural monopoly service, in contrast to the contestable sectors of the energy supply chain.

However, energy regulation is now being applied in an increasingly dynamic energy market setting, which is becoming more akin to the telecommunications network sector and is raising challenges in the application of economic regulation that has traditionally applied in the latter sector.

Box 1: Innovation and economic regulation in telecommunications

Economic regulation in the telecommunications sector

The international telecommunication sector has been subject to significant and transformative technological change for decades. Given aspects of telecommunications services have periodically had an essential service and/or natural monopoly characteristic (eg traditional fixed line telephony prior to the emergence of mobile phones), the existence of persistent technological change has proven challenging in regulatory design and application.

Technological change in telecommunications can often mean cost conditions shift considerably over time and can transform a market that requires regulation into one that does not or that requires a different form of regulation. A standard regulatory response to this market dynamism in telecommunications service markets then has been to gradually reduce the scope of economic regulation applied to former monopoly assets as competition from new

technologies and services encroaches on and ultimately provides head-to-head competition with the former monopoly service.

Regulating in an environment of new and competing services

The challenge of applying economic regulation to existing telecommunications services in an environment of constantly emerging complementary or competing new services has been neatly summarised as follows:[27]

> Telecommunications services are based on an increasingly sophisticated and complex network able to produce a rich variety of services that differ in distance travelled, quality, amount and nature of data or voice transmitted per unit of time, requirement of immediate (real-time) delivery, and so on. Making effective use of elements of market organization in many telecommunications contexts often requires considerable and detailed regulation. Many times, these regulations, even if they work well for existing markets, have pretty poor results when applied to markets for new products. This lack of flexibility of regulation is particularly important in modern telecommunications because new telecommunications services are continually produced, helped by the availability of complementary goods and services.

Importance of nimbleness and certainty in applying economic regulation

It has been recognised widely that regulation of the telecommunications sector should support the growth of competition where possible, while remaining in place where significant market power concerns persist,

In the UK, this has been characterised as fostering the use of competition and markets for general welfare and competition efficiency benefits, while retaining regulation where there is clear consumer detriment from the operation of unregulated retail markets.[28]

The NZ Ministry of Business, Innovation & Employment has similarly explained this regulatory challenge as follows:[29]

> It is important to provide the regulatory system with the maximum flexibility to respond to change, while allowing and incentivising deregulation if technological changes or new business models create new opportunities for competition that we have not anticipated. In a rapidly changing market, regulation also needs to be technology neutral, more timely, less complex and able to resend to market changes.
>
> There have been major challenges in the implementation of wholesale regulated pricing for copper services and in providing clarity about how the framework deals with investment and innovation.
>
> This uncertainty has a negative effect on incentives for investment and innovation, with flow-on effects for consumers.

It can be expected that these regulatory challenges will become more pressing under Australia's energy regulatory framework as significant technological change increasingly affects the supply and consumption of energy.

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[27] Nelson R., The Limits of Market Organisation, Economides N., Chapter 3 Telecommunications regulation: An Introduction, pp 48-49

[28] Stern J., (2016), Competition and Economic Regulation in Infrastructure Industries: Lessons from Economic History and Current UK Debates, CCRP Working Paper Series, CCRP Working Paper 29, November, p 39

[29] Ministry of Business, Innovation & Employment (2015), Regulating communications for the future, Review of the Telecommunications Act 2001, pp 14-15

Notwithstanding ongoing work and refinements to the framework initiated by the COAG Energy Council and Australian Energy Market Commission, there is an increasing risk that the slowness of the framework to respond to energy market change and/or how regulators' continue to administer the framework, will hinder networks' ability to respond to the broader market changes to their financial detriment and that of energy consumers.

A recent ENA Discussion Paper, neatly summarised the following areas of Australia's national energy regulatory framework that may impede networks' innovative behaviours, investments and/or practices:[30]

- the regulatory approval process – regulators are unlikely to approve expenditure on cutting edge technology given the inherently uncertain nature of innovation initiatives;
  - standard efficiency and prudency tests have been designed to favour projects and programs with clearly identified needs and solutions that provide a high degree of certainty in terms of future network service delivery, rather than new and innovative initiatives;
- risk-reward ratio – the framework provides inadequate incentive for equity holders to invest in innovation because of the mismatch between the higher risk profile of innovative projects and the regulated rate of return;
- weak incentives for dynamic efficiency – the framework is primarily focussed on operational efficiencies and cost containment (ie static efficiency), which is not sufficiently dynamic to suit the rapidly changing energy market; and
- short-term focus – the length of the current regulatory period is too short to fully realise the benefits of innovation activities, which require sustained effort across regulatory periods, including to respond to broader energy market developments.

Reflecting these concerns, the 2017 Finkel Review recommended closer alignment of regulatory and market frameworks in order to support network innovation efforts and, ultimately, put innovative technologies to work: [31]

> "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."

[30] Energy Networks Australia (2017). Network Innovation: Discussion Paper, July, pp 10-11.

[31] Finkel, A (2017). Independent Review into the Future Security of the National Electricity Market: Blueprint for future. Published by the Department of Environment and Energy, June 2017, p 66.

4.2 Facilitating innovation under economic regulatory frameworks

The NGL/NGR regulatory framework is designed such that it aims to ensure the long-term interests of gas consumers are served. This is embodied in the NGO, which is:[32]

> to promote efficient investment in, and efficient operation and use of, natural gas services for the long term interests of consumers of natural gas with respect to price, quality, safety, reliability and security of supply of natural gas."

Further to the NGO, the Revenue and Pricing Principles provide that:[33]

> A service provider should be provided with effective incentives in order to promote economic efficiency with respect to reference services the service provider provides.
>
> The economic efficiency that should be promoted includes—
>
> (a) efficient investment in, or in connection with, a pipeline with which the service provider provides reference services; and
>
> (b) the efficient provision of pipeline services; and
>
> (c) the efficient use of the pipeline

In our view, dynamic efficiency — specifically, improvements in service over time that come particularly from investment and innovation in service delivery and the range and nature of the services themselves — should be a fundamental goal of the administration of the national gas regulatory framework, given the economic efficiency basis of the NGO and the supplementary Revenue and Pricing Principles.

This goes to the heart of the regulatory challenge regarding the facilitation of innovation. In this respect, two factors affect a regulated firm's costs:

- exogenous factors — these relate to the technologies that the firm might use, cost of capital for the firm and the difficulty in undertaking certain tasks; and
- endogenous factors — these relate to the discretionary actions of the firm, including innovation, that affect costs and service quality, generically termed effort.

A regulator could take one of two extreme positions:

- the regulator can put in place a pricing scheme which ensures that the firm bears the cost consequences of its actions. The extreme example would be permanently

[32] National Gas Law, Part 3, Division 1, section 23

[33] National Gas Law, Part 3, Division 2 section 24

fixed prices, in which case the firm that reduced costs by $1 would realise $1 of additional profit; or

- the regulator can set prices based on the actual costs incurred, such that if the firm reduces costs by $1, then the firm realizes no additional profit.

The former, a high-powered incentive schemes addresses the moral hazard problem that regulators face, namely that by fully insuring profits the regulator presents no incentive for the service provider to innovate and improve. The latter low-powered incentive schemes will help to ensure that the regulated firm does not earn monopoly profits, but encourages cost inefficiency and presents no incentives to innovate.

While no regulatory framework sits entirely at either of these extremes, given the bow wave of technological change currently and prospectively impacting on the Australian energy market, in our view, the design and administration of the regulatory framework should err in favour of incentives to innovate where reasonably and prudently possible. A balanced tilting of the incentives provided for innovation under the national gas regulatory framework, in particular, is more likely to facilitate delivery of the dynamic efficiency benefits that are important to the long-term interests of consumers than is currently the case.

The next section of this chapter assesses the nature of incentives currently existing under the NGL/NGR regulatory framework.

4.3 Existing incentives under Australia's gas network economic regulatory framework

The Revenue and Pricing Principles in the NGL make it clear that the national gas regulatory framework is incentive-based.[34] As a result, not all financial incentives created under the framework for service providers need to be in the form of explicit incentive mechanisms.

Amongst other things, incentives can be created in how the building blocks are determined in setting revenue allowances and how the reference tariff variation mechanism is structured. However, incentive schemes can play an important role in complementing and reinforcing other elements of the regulatory framework in order to promote both the Revenue and Pricing Principles and the NGO.

Consequently, it is important to note the generally lower level of financial incentives available to gas service providers under the NGR compared to the NER. In this regard, we note that no incentive schemes are currently applying to ATCO in the AA4 regulatory period.

[34] National Gas Law, Part 3, Division 2, section 24

4.3.1 Existing incentive schemes available under NER

The following mandated and optional incentive schemes are currently being applied to electricity network businesses under the NER:

- efficiency benefits sharing scheme (EBSS) which encourages efficiencies through improvements in operating expenditure;
- capex efficiency sharing scheme (CESS) which encourages efficiencies through improvements in capital expenditure;
  - service target performance incentive scheme (STPIS) which encourages efficiencies through improvements in service providers' service performance compared to past performance.
- demand management incentive scheme (DMIS), including the demand management innovation allowance component (DMIA);
  - the DMIA provides an allowance for expenditure by electricity distribution networks (it does not apply to electricity transmission networks).
    - it should be noted, however, that the source of funding is small (in the range of $0.1-1.0 million per network on an annual basis) and the allowance is narrowly focussed on demand management;
- small-scale incentive scheme which encourages businesses to promote the National Electricity Objective (NEO) (this scheme has yet to be applied).

The mandated EBSS and optional CESS are primarily focussed on providing financial rewards to networks for achieving cost containment derived from operational and capital efficiencies within a single regulatory period, rather than incentivising innovative projects that could potentially deliver benefits over multiple regulatory periods.

The STPIS is a mandated scheme designed to offset potentially adverse incentives created by the EBSS and CESS to achieve cost savings at the expense of reduced service quality.

The DMIS is an incentive scheme narrowly focussed on encouraging networks' consideration of demand management solutions to demand-driven network constraints, potentially offsetting any bias to capex solutions to such constraints. The DMIA component of the scheme is intended to create a small-scale financial incentive for networks to undertake R&D, trials and more innovative activities to manage network peal demand. The DMIA has specific relevance for this report given its focus on encouraging innovative projects unlikely to satisfy standard regulatory prudency and efficiency tests. It is discussed further in Chapter 6 of our report.

It is reasonable to conclude that these schemes are primarily focussed on providing financial rewards for cost containment and efficiencies achieved in relation to the provision of core network services. Except for the DMIA, genuinely innovative projects that could potentially deliver long-term benefits to energy consumers will not be incentivised under these schemes.

Further, we consider it is reasonable to conclude that ERA has, up to this point, exercised its discretion under the NGR to approve low powered incentive-based access arrangements for ATCO, including no specific incentive scheme approved for the AA4 regulatory period.

4.3.2 AER's rejection of AGN's innovation scheme proposal

Although gas distribution businesses have been subject to the EBSS and the CESS, they lack specific incentives for network innovation under the NGL/NGR regulatory framework.

As previously noted, several recent reports have highlighted this issue and have suggested, amongst other things, the introduction of a Network Innovation Scheme (NIS) to foster timely innovation in the energy sector for the long-term benefit of consumers.[35]

In this regard, Australian Gas Networks (AGN) proposed a NIS for funding of its small scale operational expenditure targeted at managing peak demand on its Victoria and Albury network, instead of investing in network infrastructure, as part of its access arrangement for the 2018 to 2022 regulatory period.

While acknowledging the reduced incentive for network businesses to innovate when compared to competitive businesses, the AER rejected AGN's proposal. It did so because it did not consider the NIS would encourage efficiency in the provision of services in the long-term interests of gas consumers for the following reasons:[36]

- consumers bear the cost of investment and therefore take 100 per cent of the risk that the innovation project will fail;
- it is not clear how the benefits of the innovation projects will be shared between AGN and its customers;
- the proposed NIS is not targeted at a specific social problem (such as emissions reduction).

[35] Farrier Swier Consulting (2016). Victorian Gas Distribution Businesses' consultation on Incentive Mechanisms. Prepared for Multinet Gas, Australian Gas Networks and AusNet Services, 23 September.

[36] AER (2017), Australian Gas Networks Victoria and Albury gas access arrangement 2018 to 2022, Attachment 14 – Other incentive schemes, Draft Decision, November, pp 13-16

The AER concluded that the current framework provides sufficient opportunity to invest in innovation while allowing businesses to retain any efficiency benefits, particularly with the addition of a CESS to AGN's access arrangement.

Our primary concern with the AER's decision is that it does not address the fundamental challenge with truly innovative projects, which is that they have a high degree of uncertainty, but also potentially offer significant future benefits to energy consumers. Hence, the future sharing of benefits from innovation cannot be precisely identified today.

However, it would be unreasonable to consider that there will be no future benefit to consumers given evidence from innovation activity that occurs economy-wide across unregulated product and services markets. Unfortunately, reliance on the CESS and EBSS will not address the innovative project challenge, which does not appear a reasonable outcome in light of the significant technological changes currently and prospectively impacting on Australia's energy services market.

4.4 International regulatory approaches to innovation

It is instructive to contrast the current Australian situation with how network regulatory frameworks internationally have been changing in response to rapidly evolving energy markets.

Network innovation schemes introduced in the UK in recent years are now quite mature, particularly the gas network innovation scheme introduced by OFGEM and comparable schemes introduced by other UK energy regulators (eg in Northern Ireland and Scotland).

There are other network innovation schemes established under regulatory frameworks in Europe and the US, which have attempted to create stronger incentives for innovation including by:

- Italian Regulatory Authority for Electricity Gas and Water
- California Public Utilities Commission
- New York State Energy Research and Development Authority.

In comparing regulatory innovation initiatives in other countries, it is important to distinguish between the source and size of funding made available. Hence, some initiatives are large government/taxpayer funded schemes with specified broad energy policy or environmental goals, while others are smaller ongoing schemes funded through regulated revenues and with generally a narrower focus on network service innovation. The NIS proposed in this report is more in keeping with the small-scale innovation schemes observed overseas.

This section of our report summarises the key aspects of these international innovation initiatives in the regulatory sphere.

4.4.1 United Kingdom – RIIO framework for electricity and gas networks

In 2013, the UK's energy regulator, the Office of Gas and Electricity Markets (Ofgem), introduced a new performance-based regulatory framework for the regulation of electricity and gas network businesses, often referred to as RIIO (Revenue = Incentives + Innovation + Outputs).

This regulatory framework is designed to encourage network businesses to be innovative by means of two specifically targeted innovation mechanisms:[37]

1. Incentive as part of the price control mechanism
   - This mechanism promotes innovation through a long-term ex-ante output-oriented regulatory model where businesses benefit from successful innovation in conventional electricity network service provision.
2. The Innovation Stimulus Package (ISP), which comprises the following three different streams:
   - the Network Innovation Allowance (NIA);
   - the Network Innovation Competition (NIC); and
   - the Innovation Roll-Out Mechanism (IRM).

Under the ISP, network licensee, and non-network licensee parties (who must partner with a network) are eligible to apply for funding to progress projects at any stage of innovation – including research and development (R&D) trials and pilot schemes.

Table 4 highlights key features of the innovation stimulus package by each scheme.

[37] Poudineh, R., Peng, D. and Mirnezami, R.S. (2017). Electricity Networks: Technology, Future Role and Economic Incentives for Innovation. The Oxford Institute for Energy Studies, OIES Paper: EL 27.

Table 4 Key features of the Innovation Stimulus Package by incentive scheme

	NIA	NIC	IRM
Description	A fixed annual allowance for small innovative projects, covering all types of innovation. Funding available under the scheme is for two purposes: • To fund smaller technical, commercial, or operational projects directly related to the licensees network that have the potential to deliver financial benefits to the licensee and its customers; and/or • To fund the preparation of submissions to the Network Innovation Competition (NIC), which meet the criteria set out in the NIC Governance Document	An annual competition that funds selected large-scale innovative projects, including development and demonstration of new technologies, operating and commercial arrangements, that have potential to meet the low carbon economy objectives. Funding is provided for the best innovation projects which help all network operators understand what they need to do to provide environmental benefits, reduce costs, and maintain security of supply as Great Britain moves to a low carbon economy.	This scheme funds the roll-out of proven innovations/technologies, but only when it cannot be funded under other mechanisms and costs savings and/or environmental benefits are adequately demonstrated through a business case to Ofgem.
Funding arrangements	Between 0.5% and 0.7% of network companies' allowed revenue in RIIO-1 (capped at 1%)	£90 million for electricity networks (2015 to 2016)[38] £20 million for gas networks. The amount of funding each winner receives is dictated by the judging panel and does not need to be an equal division of total funds.	Two application windows throughout the eight year price control period, though it depends on the number and quality of applications received.

Notes: The NIA and NIC are successors to the Low Carbon Networks Fund (LCNF). Estimates relating to funding levels are expressed in nominal currency terms.

Source: Cambridge Economic Policy Associates, 2018; Ofgem, 2017[39]

A 2016 independent evaluation of the Low Carbon Network Fund (LCNF)[40], a predecessor to the RIIO innovation schemes, revealed net financial benefits between £4.8bn and £8.1bn by 2030, in addition to £600m-£1.2bn of carbon abatement benefits.[41]

Further identified benefits included:

- companies becoming more innovative;

[38] Because the NIC was underutilised, Ofgem decided to adjust the funding for electricity networks downwards so that a total of £70m per annum is available until at least 2021.

[39] Cambridge Economic Policy Associates (2018). Review of the RIIO framework and RIIO-1 performance. Prepared for Ofgem, Final Report, March.

Ofgem (2017). The network innovation review: our policy decision. Final Decision, 31 March.

Ofgem (2018), Gas Network Innovation Competition.

[40] The LCNF provided around £250 million of funding to projects sponsored by electricity distributers over the period 2010 to 2015.

[41] Ofgem (2017). RIIO-2 Stakeholder Workshop – Long Term value for Money. 1 November.

- licensees engaging with customers and third parties at unprecedented levels; and
- initiatives/innovations, to a good extent, being successfully rolled into business-as-usual expenditure programs.

Overall, the LCNF evaluation found nearly 40% of the initiatives have been successfully rolled into business-as-usual activities and 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.[42]

4.4.2 Italian Regulatory Authority for Electricity Gas and Water

In 2010, the Italian Regulatory Authority for Electricity, Gas and Water (AEEGSI) implemented a scheme (input based) which incentivised the investment of 'smart' grid projects which actively attempted to reduce the overall environmental degradation resulting from utilities generation and distribution. This incentive was a two percent increase to the firms Weighted Average Cost of Capital (WACC) for a 12-year duration on all smart investments.

As time has progressed, AEEGSI has altered and reformed the incentive scheme to also include customer demand management.[43] In 2015, there was a shift to include incentives for output-based functions and customer awareness of the importance of smart grid projects. This allowed the network companies the ability to evaluate and quantify the benefits of projects when targets are achieved.

4.4.3 California Public Utilities Commission[44]

In 2012, the Californian Public Utilities Commission (CPUC) delegated authority to three utility network firms to spend US$150 million over a five-year period for the promotion of '21st century energy systems', which were expected to carry benefits of US$552 million in potential savings by the year 2020.

These technological upgrades were to be completed by advancing the resource planning (renewable energy use), improvements to the natural gas distribution network, heightened cybersecurity, improved reliability from enhanced capabilities to model electricity and gas flows and improved workplace safety of the industry.

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42 Pöyry, An Independent Evaluation of the LCNF, a report for Ofgem, October 2016, p.55-56

43 Poudineh, R., Peng, D. and Mirnezami, R.S. (2017) (2017). Electricity Networks: Technology, Future Role and Economic Incentives for Innovation. The Oxford Institute for Energy Studies, OIES Paper: EL 27.

44 Energy Networks Australia (2017), Network Innovation: Discussion Paper. July, p 25.

However, in 2013, the funding to these three firms was reduced from US$150 million over five years to US$35 million over 5 years, with areas of research limited to cybersecurity and grid integration, due to concerns about oversight of the program.

4.4.4 New York State Energy Research and Development Authority[45]

Implemented in 1998, the New York State Public Services Commission (NYSPSC) created a program of technological advancements and market development were to be promoted. The program is ratepayer-supported and administered by the New York State Energy Research and Development Authority (NYSERDA).

Under this innovation program, NTSERDA administers how funds, with the regulator (NYSPSC) responsible for establishing categories of research that can be funded.

The scheme involved a budget of US$154 million in 2006, of which firms could apply (in 5-year terms) for funding of new projects which met the criteria. Half of the allocated budget was for technological advancements and energy efficiency whereas the remainder was for market development activities.

The 2012-16 term, had a reduced budget of US$93.8 million. 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.

4.5 Potential benefits of regulatory innovation schemes

There are existing general energy innovation support programs in Australia, such as Australian Energy Renewable Agency (ARENA) grants and the SA Government's Renewable Technology Fund, both targeted at encouraging innovators in new renewable energy technologies, including facilitating the commercialisation of such technologies.

It is reasonable to say that these mechanisms are essentially targeting innovation that is anticipated to be in the long-term interests of Australian energy consumers. However, we consider there are gaps in these funding mechanisms for a gas network business that is planning and investing for the long-term, including due to:

- the one-off nature of individual project funding under these grant schemes;

[45] Energy Networks Australia (2017), pp 25-26

- the continuity required in funding over time, reflecting that the focus of innovative activities (trials etc) may evolve and change over time in response to previous trial results and an evolving energy landscape; and
- the need for the network to 'own' the innovation because it needs to be tailored to its own business circumstances, including network characteristics and customer requirements.

These factors reflect the critical new-to-the-firm aspect of innovation where firms learn-by-doing including adapting to new-to-the-world innovations, as discussed in Chapter 2 of our report.

However, we envisage a regulatory innovation incentive scheme may complement general innovation support programs. This includes, in some cases, funding may be available fully from ARENA, such as the AGN electrolyser pilot plant trial to inject a small amount of hydrogen into the South Australian gas grid. However, in other cases, funding for a specific innovative project/trial perhaps of a larger scale could receive funding from both the regulatory innovation incentive scheme and a general innovation support scheme.

The potential for 'double dipping' in funding for a specific project can easily be prevented through design of the regulatory innovation incentive scheme.

4.6 Chapter key points

The current Australian national gas regulatory framework has been designed for a more stable energy market and currently provides weak incentives for innovation outside of long-established network service provision.

Given the current framework design, novel or unique innovative gas network projects cannot reasonably be expected to emerge, even if there are potentially large future benefits to gas consumers.

Given the speed and intensity of the evolving energy market, in our view, continuation of a regulatory framework with low powered incentives for innovation is not likely to be in the long-term interests of WA gas consumers.

Our brief overview of international regulatory experience, particularly in the UK, shows that specific mechanisms for network innovation can potentially deliver a net benefit to energy consumers. These findings from international case studies also generally provide an indication that the operation of a well-designed NIS for ATCO is likely to support its development and deployment of innovative ideas, learnings and technologies, in turn, ensuring that ATCO maintains a reliable and affordable gas network that provides services over time that meet its customer's energy requirements.

5 ATCO's innovation challenge

ATCO's innovation problem in the context of the national gas regulatory framework is committing expenditure to projects that are necessary innovations to enable ATCO to anticipate and respond to the rapidly evolving energy market, but that will not satisfy the prudency and efficiency tests in the NGR (primarily Clauses 79 and 91 of Part 9) and the NGL.

Further, ATCO's customer engagement outcomes reveal that its customers expect gas distribution networks to research and develop innovative energy solutions.

5.1 Facilitating innovation under conventional regulatory frameworks

Further to our discussion on the economics of innovation in Chapter 2 and our summary of international regulatory innovation schemes in Chapter 4, it is evident that a network business undertaking innovative activities, will incur up-front costs in the short to medium term, with the potential for a long-term benefit to accrue in terms of lower costs and/or new and improved services required by customers. However, the incentive to do so is constrained by the regulatory framework

The Australian Energy Regulator (AER) argues that this is because, all else being equal, distributors will be required to pass a material portion of any future gains onto consumers. In contrast, distributors still face 'down-side risk', including because the costs of innovation occur significantly earlier than the benefits, with the distributor facing the risk of being financially penalised from making these decisions under the regulatory regime.[46]

The AER made these points when introducing a Demand Management Innovation Allowance for electricity distributors under the National Electricity Rules, which is intended to facilitate research and development (R&D) in demand management projects that have the potential to reduce long-term network costs. The AER further commented that:[47]

> It is worthwhile acknowledging that regulated monopolies, like [electricity] distributors, naturally have less of an incentive to conduct R&D than competitive businesses.

[46] AER (2017), Demand management innovation allowance mechanism, Explanatory Statement, Electricity distribution network service providers, December, p 9

[47] AER (2017), p 9

While small in scale, the DMIA is intended to offset this weaker incentive for regulated electricity distributors to undertake innovation (in the form of R&D) than a competitive business. The AER noted that its DMIA will increase distributors 'capacity to explore, trial and deploy new technologies, systems and business processes in a timely manner' as proposed by the Energy Networks Australia.[48] The AER's DMIA is discussed further in Chapter 6 of our report.

In this context, it is useful to consider possible goals innovative projects might target and that are in the long-term interests of ATCO's gas consumers, such that alternative funding mechanisms under the NGR/NGL should be considered. Individual innovative projects may address one or more of these goals.

5.2 Long-term efficiency improvements

General goal: To exploit opportunities to improve the efficiency of network services in the long-term.

5.2.1 Challenges and uncertainties

It is difficult to create a compelling internal business case for long-term business transformation in response to highly uncertain long-term market trends, particularly when economic regulatory frameworks are based on shorter term approved expenditure cycles. This problem means that the economy foregoes the benefit of efficiency gains that might otherwise have been realised. Of perhaps greater concern is that, in an era of rapid change and high uncertainty, regulated businesses face incentives that discourage the most socially beneficial response to industry disruption – namely investing in fundamental changes to business models, practices and technologies.

As a modest step to address this issue, section 3.3 of our report identified Ofgem's small-scale innovation scheme, which is intended to encourage an innovation culture within gas utilities, such that the performance of innovative trials/projects will increasingly take on the nature of business-as-usual activity. The project examples cited in Section 3.3 illustrate the potential of research and development projects to deliver a tangible efficiency gain (such as a reduction in maintenance costs), albeit that these gains are difficult to predict with confidence. This recognises the potential economic gains from innovation discussed in Chapter 2 of our report, which were also revealed by the outcomes from Ofgem's small-scale scheme.

[48] ENA (2017), Network Innovation Discussion Paper, July, p 2

5.2.2 Relevance to gas customers

In general, gas consumers will be better off in the long term if regulated service providers have the incentive to consider all commercial opportunities to improve the efficiency of network services, regardless of whether the payback horizon is near or far.

This is what occurs in competitive market situations and is driven by innovation by new market participants seeking to supply consumers with enhanced or new services. The national gas regulatory framework generally does not facilitate such an outcome because it is based on the assumption of a regulated monopoly network service provider not subject to competitive threat, which is supplying a service with fundamentally stable characteristics conducive to predictable long-term investment using well-established technologies.

5.2.3 Potential issues with investment

Expenditure directed to understanding and preparing for reasonably expected but significant change in future gas network service provision is, by definition, of higher risk than expenditure on current gas network service provision. Consequently, such expenditure will fail standard regulatory prudency and efficiency tests because of the relatively high degree of uncertainty about the future benefits arising from the expenditure.

5.3 Zero Emission Gas Readiness

General goal: To ensure that the gas distribution system is ready to receive, transport, deliver monitor and meter hydrogen for the long-term benefit of gas customers.

Hydrogen is anticipated to be important in Australia's future energy mix both as a replacement for natural gas and as a means of storing the energy captured by intermittent wind and solar generators.

ATCO believes that if the opportunity is well managed, there is significant scope to invest in its network to supply new and existing gas customers with a gas conveyance and capacity service that supplies hydrogen rather than natural gas. Taking early steps to ready the network to be able to achieve this change is in the long-term interests of gas customers, since the cost of deriving energy from carbon intensive sources is likely to rise rapidly in the future. Meeting customers future energy needs at lowest cost may, therefore, require ATCO to able to offer conveyance services for a zero emission energy source like hydrogen.

5.3.1 Challenges and uncertainties

Hydrogen presents specific chemical, engineering and social challenges if it is to be successfully introduced into the gas distribution system.

For example, in many applications, it requires polyethylene (PE) pipes to be safely and efficiently conveyed. Hydrogen would initially need to be mixed with natural gas and this blending would change the composition of the product delivered to customers, with composition differing depending on the location within the network. Further, hydrogen has different chemical characteristics that give rise to differences in odour management (an issue for network operation) and flame visibility and speed (an issue for customer appliances).

These technical challenges are currently being studied and overcome in academic settings, but more work is required to produce protocols, systems and equipment ready for deployment.

The timing, scope and scale of the hydrogen opportunity is necessarily uncertain. It will be informed by technology advances and relative energy cost differentials (see above), as well as energy policy settings like the cost of carbon (whether priced explicitly or in shadow form).

However, if ATCO does nothing to prepare for the possible introduction of hydrogen into the distribution network, it creates a material risk of asset stranding that is inconsistent with actions of a prudent network service provider. Further, it would appear to be inconsistent with the overarching Revenue and Pricing Principles of the NGL, which provide that regard should be had to the economic costs and risks of the potential for under and over utilisation of a pipeline that provides regulated pipeline services.[49]

5.3.2 Relevance to gas customers

Assuming the cost of carbon will rise over time, gas customers could reasonably be expected to increasingly demand a low carbon gas option (hydrogen or biogas). Hydrogen-readiness of the gas distribution network will directly address a broader energy market-driven customer requirement.

As the importance of gas as a balancing fuel and a source of bulk energy storage in electricity increases, if ATCO can supply hydrogen using its network, this will facilitate greater network utilisation and indirectly assist customers by placing downward pressure on unit costs and consequently network service prices.

[49] National Gas Law, Part 3, Division 2, Clause 24(7)

5.3.3 Potential issues with investment

Investment in distribution network hydrogen-readiness obviously relates to the transport of hydrogen not natural gas. Since the NGR/NGL does not explicitly contemplate the regulation of a gas distribution network transporting hydrogen, it is not clear that expenditure directed to facilitating its conveyance on such a network would satisfy the NGR/NGL prudency and efficiency tests. This includes because it is not strictly necessary to maintain the existing gas network service.

However, a small to moderate level of such expenditure on small-scale trials could represent the actions of a prudent network service provider anticipating how future gas network services may need to change to meet a changing energy market circumstances and gas consumer demand.

5.4 Making gas a stronger complement to electricity network services

General goal: To position the gas distribution system to be a compelling complement to electricity services (cost effective, reliable, future-ready).

A gas network can offer electricity customers reliability and security benefits that complement current and future electricity network services.

For example, the interruption of electricity and gas services often have different drivers, with gas capable of providing back-up supply when electricity networks fail. Similarly, gas networks offer energy reserves to assist in meeting peak demand when electricity network capacity is inadequate. Further, gas distribution networks could provide storage and conveyance services that complement the ability of decentralised renewable generation plant to convert surplus electricity into hydrogen.

These opportunities should be better understood and potentially developed to facilitate better utilisation of the gas network in future.

5.4.1 Challenges and uncertainties

There are technical and marketing challenges facing the realisation of this goal and material uncertainties as to how energy markets will develop. Specific examples of these issues include the following.

- New knowledge and products are required to optimise the production of hydrogen within hybrid small-scale renewable energy generation and storage units. The time scales over which these capabilities will move from proof-of-concept into mass deployment are unclear.

- Energy customers may not appreciate the immediate reliability benefits nor the potential option value of a gas connection. Accordingly, developers may lack incentives to include gas connections.
- It is not clear to what extent electricity networks will appropriately price their scare capacity. Pricing reform of this kind could strongly drive customer interest in alternative ways of managing peak demand.
- Advances in, and the relative costs of, different technologies over time are uncertain. Therefore, the scale and timing any market for gas networks to provide these benefits is also uncertain. Relevant technologies include batteries, small scale electrolysis systems and hydrogen fuel cells.

What can confidently be predicted is that if ATCO does nothing to position the gas distribution network as a stronger complement to electricity services, excess investment in electricity solutions will be more likely and future utilisation of the gas network will be less.

5.4.2 Relevance to gas customers

Facilitating greater gas network utilisation in the long term will place downward pressure on unit costs to the benefit of gas consumers.

5.4.3 Potential issues with investment

Positioning the gas distribution system as both a supplier of important capacity and reliability complement to electricity network services has a relatively high degree of uncertainty regarding the future benefits to gas consumers (including lower gas network prices).

5.5 Track and understand transformative ICT opportunities

General goal: To identify, track and understand transformative information and communications technologies (ICT) opportunities to enable the business to maximise efficiency through timely and well-informed adoption.

5.5.1 Challenges and uncertainties

Significant opportunities are likely to exist to improve business efficiency through increased automation and integration, better analytical tools and better supervision and control of the network using new ICT applications. The ICT sector is rapidly developing new classes of capabilities in artificial intelligence, process automation and data analysis that have very broad potential applications.

ATCO makes extensive use of ICT throughout its business and continuously invests in incremental improvements to its ICT systems. However, the application of new ICT applications presents particular challenges for complex utilities with low tolerance for safety and reliability risks. In the absence of urgent drivers – such as systems becoming unsupported or incompatible with business requirements – some ICT opportunities may be passed over, even where potential exists to significantly increase efficiency in the long-term.

ICT is one of many potential sources for technological innovations that can drive efficiencies in gas network service provision. Features that set ICT apart from other categories of technologies include:

- the rapid rate at which new ICT applications emerge and improve;
- the complexity that accompanies ICT applications in terms of understanding both new and existing systems and the interactions between them;
- risks and uncertainties associated with delivery of expected benefits from applications, particularly where specific ICT applications are new to the market; and
- the fact that realising the transformative potential of new ICT applications requires businesses to reflect deeply on how technologies developed for general application can create value in a specific business context (the new-to-the-firm innovation discussed in Chapter 2 of our report).

5.5.2 Relevance to gas customers

Gas customers will benefit if ATCO adopts new ICT applications in its regulated network business and thereby realises cost savings, service improvements or new opportunities to grow throughput, all of which would be in the long-term interests of its customers. Moreover, customers will benefit if the timing and manner of ATCO's adoption is:

- not too early, leading to a failure to realise value;
- not too late, implying that customers will forgo benefits that would have been enjoyed sooner; and
- well informed, leading to a good fit between the new technologies and ATCO's regulated network service in the future.

5.5.3 Potential issues with investment

To achieve these benefits for customers, ATCO needs to invest time and resources in simply understanding the opportunities – including, and perhaps especially, understanding when a potential opportunity is illusory.

Projects to explore and test ICT applications with no up-front commitment to proceeding because of the relatively high degree of uncertainty about the future benefits arising from the expenditure, will fail standard regulatory prudency and efficiency tests.

5.6 Project tools

Reflecting the uncertainties associated with pursuing innovation goals and opportunities, including those in the longer term, there will be a range of small project tools that ATCO must perform to better understand whether its identified innovation goals and opportunities are likely to be feasible and should be further advanced.

To this end, we envisage the types of project tools that could be funded under a NIS include:

- Pre-feasibility studies
- Desktop technology / market opportunity assessments
- Feasibility assessments
- Engineering studies
- Service and business model development
- Market research
- Field trials and demonstration projects

We intend that our proposed NIS would provide a small level of funding for any of these types of tools. In this way, we envisage the NIS supporting a range of small-scale activities that will support on-going innovation in ATCO's network service provision.

Ultimately, expenditure may be required for a specific innovation-related project or program that must be assessed under the standard regulatory prudency and efficiency tests because of its size and greater certainty of future benefits. The NIS is intended to provide a small level of funding over time to enable a specific innovation-related project or program to be developed to the stage that it reaches the stricter expenditure assessment level.

5.7 Chapter key points

This chapter has identified possible goals that could guide ATCO's expenditure on potential future changes in the nature of its gas network services, assuming that these remain regulated services under the NGR/NGL framework. While characterised by a relatively high degree of uncertainty compared to current network service expenditure, it could nevertheless be prudent when considering the long-term interests of gas consumers in an increasingly dynamic energy market.

There are no funding mechanisms or associated incentives currently available under the NGR/NGL regulatory framework that are likely to facilitate ATCO pursuing the high level innovation goals identified in this chapter.

We apply our proposed NIS to several of ATCO's innovative projects in Chapter 6 of our report.

6 Design of NIS under national gas regulatory framework

The purpose of this chapter is to identify the key design features of a NIS that is intended to overcome ATCO's disincentive to investigate and pursue innovative projects under the existing NGR/NGL regulatory framework.

The NIS that we are proposing has been designed to satisfy sections 98(1) and (3) of Part 9 of the NGR, including being consistent with the Revenue and Pricing Principles and NGO in the NGL.

6.1 Key NIS design features

The purpose of this section is to identify the key design elements of the NIS and its interaction with the overarching incentives created for ATCO under the NGL and NGR drawing upon our analysis in Chapter 5 of our report.

We consider aspects of AGN's proposed NIS to have attractive design features.[50] We also consider that the AER's demand management innovation allowance (DMIA), while narrowly focused on demand management, has certain design features that can usefully be adapted and incorporated in the NIS to provide it with regulatory robustness.[51]

We understand that ATCO does not intend to propose any other incentive schemes in its AA5 submission. This simplifies the NIS design because the incentives it creates will not interact with any other specific incentive schemes.

This section identifies key features of our proposed NIS under the following headings:

- NIS objective
- Project eligibility criteria
- Administration of NIS allowance
- Compliance reporting requirements

Each of these design features is discussed further below.

[50] AGN (2016), Access Arrangement, For our Victorian and Albury natural gas distribution networks, 1 January 2018 to 31 December 2022, pp 25-26

[51] AER (2017), Demand Management Innovation Allowance Mechanism, Electricity distribution network service providers, December

6.1.1 NIS objective

Given the NIS is not a defined incentive scheme under the NGR, we consider it is useful to clearly state its purpose and clearly link it achievement of the NGO and Revenue and Pricing Principles as follows:

> The NIS objective is to provide ATCO with funding for trials and projects using innovative and new technologies with the potential to deliver medium to long-term improvements in gas network services that are in the long-term interests of WA gas consumers.

The NIS objective makes explicit that projects must demonstrate the potential for medium to long-term benefits – that is, over timeframes beyond a single regulatory period.

Establishing an overarching objective for specific incentive schemes and/or key regulatory instruments is a good regulatory design feature of Australia's national energy regulatory framework, which we have adopted. We note the NER establishes an overarching objective for the AER's DMIA scheme.[52]

6.1.2 Project eligibility criteria

To provide confidence that the only projects/trials etc that should receive funding under the NIS are those that satisfy the NIS objective and hence on in the long-term interests of gas consumers, we consider tight project eligibility criteria are required.

Hence, under our regulatory scheme design, ATCO must identify eligible projects with an identified innovative business purpose that will be assessed against and must satisfy the following criteria to receive funding under the NIS:

- It is a project or program for researching, trialling, developing, or implementing a piece of new equipment, a new arrangement or application of existing network infrastructure, or a new practice directly relating to:
  - an improvement in the operation or safety of the network; or
  - an improvement in customer service; or
  - a new commercial arrangement, or
  - a reduction to the carbon intensity of the gas distributed by the network; or
  - makes an incremental contribution to achieving any of the above changes; and
- It is innovative, in that the project or program:

[52] National Electricity Rules, Part 6, Section 6.6.3A(b)

  - is based on new, novel or original concepts and involves technology or techniques that differ from those previously implemented or used in the Western Australian Energy Market; or
  - facilitates the adoption of new technologies that can expand the existing range of uses for gas and/or the gas network; and
  - has the potential, if proved viable, to reduce long term network costs and prices and/or improve the quality of network services; and
- the potential benefit to gas network customers is material, considering the scale of innovation funding proposed and the level of uncertainty associated with the project or program; and
- the project or program relates to the services provided by means of the regulated network assets.

It is important to emphasise that in applying the eligibility criteria, it is important to distinguish between the purpose of a specific project or program, which we consider should always have an innovation focus, and project tools (eg trials, research, surveying) that are not inherently innovative but rather serve the broader innovation goal or purpose.

6.1.3 Administration of NIS allowance

We envisage the NIS being administered by ERA on an annual basis in the AA5 regulatory period and beyond, including checks and balances to ensure existing gas consumers only pay for approved trials/projects.

The administrative features we have identified for the NIS are consistent with the NIS objective and will provide certainty to ATCO and the ERA about how the scheme will operate. More broadly, this should facilitate the effectiveness of the NIS and ensure its consistency with achievement of the NGO and Revenue and Pricing Principles in the NGL.

Key administrative features of the NIS are as follows:

- an annual cap of $1 million (indexed each year of the regulatory period using the ERA-approved CPI forecast to maintain its value in real terms) will be set to limit how much ATCO will be able to spend on innovative trials/projects that satisfy the eligibility criteria under the scheme;
  - we propose an annual cap of this size to ensure that ATCO has sufficient funding to undertake meaningful trials/projects but that does not impose an unreasonable burden on existing gas consumers;
  - a funding envelope of this size is also consistent with the AER's DMIA;

- ATCO will each year seek ex-post recovery of actual costs it has incurred in that year under the scheme through the annual tariff variation mechanism;
  - this approach ensures that ATCO's customers will only pay for incurred costs on eligible innovative projects each year (with a one year lag in ATCO's cost recovery);
- each year of the regulatory period, ATCO can apply to the ERA for an up-front, indicative approval for planned expenditure under this NIS;
  - there is no requirement for ATCO to identify at the start of each regulatory period the suite of trials/projects that it intends to undertake over the full regulatory period, to maintain ATCO's flexibility to respond to changing market circumstances;
- eligible projects can be funded across regulatory years and periods provided the total NIS allowance is not exceeded in any AA regulatory period;
- any unused NIS must be handed back to customers at start of next AA regulatory period (ie the scheme incorporates a 'use it or lose' mechanism) to ensure ATCO will only recover through network tariffs, amounts that have been spent on approved projects; the NIS allowance should only provide funding for projects that have not been funded previously from another source (eg ARENA grants, ERA's AA determination);
  - the intent of this provision is to avoid 'double dipping' of funding for the same projects and consider that the onus should be on ATCO to demonstrate to ERA that this condition is satisfied; and
- the size of the NIS allowance should be reviewed by ERA as part of each AA determination.

6.1.4 Compliance reporting requirements

Annual compliance reporting under the NIS will ensure that ERA can determine ATCO is complying with the scheme's administrative details and, more broadly, the scheme's objective.

The key compliance reporting requirements are as follows:

- ATCO must submit to ERA annual reports on its activities, expenditures, and projects undertaken under the scheme;
- ERA will conduct ex-post reviews of ATCO's trials/projects to determine their compliance with the project eligibility criteria, which will determine ATCO's eligibility to receive funding for the specific trial/project under the scheme;

- as part of this reporting, ATCO will periodically advise ERA on whether innovative projects/trials it has undertaken remain likely to be in the long-term interests of WA gas consumers, including what ATCO has learnt from the projects/trials and how this has been applied within the business; and
- ATCO's annual compliance report is to be supported by a statutory declaration.

These reporting requirements are intended to provide confidence to ERA and WA gas consumers about the efficacy of the NIS and specifically that its objective is being med.

6.2 Consistency with NGR/NGL requirements

As noted in section 5.2 of this paper, the NGO provides for the national gas regulatory framework to promote efficient investment in, and efficient operation and use of, natural gas services for the long term interests of consumers of natural gas.

The Revenue and Pricing Principles further provide that a service provider should be provided with effective incentives in order to promote economic efficiency with respect to reference services the service provider provides, including through efficient investment in, or in connection with, the relevant pipeline.

Our proposed NIS has been developed having regard to the National Gas Objective and the Revenue and Pricing Principles in the NGL, as required under Rule 98 of the NGR including by:

- encouraging ATCO to undertake long-term research and R&D trials/projects that may not otherwise occur and that are likely to be in the long-term interest of WA gas consumers, including through more cost effective future network investments;
- removing barriers to innovation through facilitating innovative solutions that are likely to improve long-term safety, reliability and security of gas supply; and
- ensuring that current gas network customers bear only a small risk regarding the conduct of innovation trial projects, recognising the higher degree of uncertainty regarding the future benefits of these projects compared to conventional network investment projects.

We consider that the NIS design features identified above, particularly the project eligibility criteria, will allow identification of innovative trials/projects that would not be funded under the ERA-approved capex and opex allowances because the standard regulatory prudency and efficiency tests cannot be satisfied.

6.3 Applying the NIS assessment criteria

To test the robustness of our proposed NIS assessment criteria, such that any projects that are not genuinely innovative will be rejected, we have applied these criteria to a sample of innovative projects that ATCO is currently investigating. Table 5 presents a summary of the outcomes of our assessments.

Table 5 Outcomes of assessment of ATCO's innovative project sample

Project	Description	Assessment outcome
1. Zero emission readiness: distribution equipment specification and operation	Ensure the suitability of distribution equipment for a system conveying varying proportions of hydrogen.	✓ Project incorporates new, novel or original concepts and involves technology or techniques that differ from those previously implemented or used in the Western Australian Energy Market.
2. Zero emission readiness: measurement of energy delivery	Determine a system for accurately measuring delivered energy in a system with a disparate and dynamic hydrogen-methane blend.	✓ Project incorporates new, novel or original concepts and involves technology or techniques that differ from those previously implemented or used in the Western Australian Energy Market.
3. Zero emission readiness: customer acceptance	Test the workability of introducing zero-emission fuels into the network by testing customers' receptiveness, including identifying technical or social pre-requisites for acceptance.	✓ Supports the broader zero emission readiness goal, which in turn incorporates new, novel or original concepts and involves technology or techniques that differ from those previously implemented or used in the Western Australian Energy Market.
4. Long-term efficiency reforms: asset management and maintenance	Reduce costs though speculative investigations into alternative asset management and maintenance approaches.	✓ Illustration project incorporates novel or original concepts and involves technology or techniques that differ from those previously implemented or used in the Western Australian Energy Market.
5. Long-term efficiency reforms: metering innovation	Reduce costs and improve services with yet-to-be demonstrated metering technologies and service models.	✗ The scale of currently known opportunities is insufficient to justify funding innovation projects.
6. Long-term efficiency reforms: Virtual gas pipeline	Reduce costs by substituting virtual gas pipelines in lieu of possible network extensions.	✗ These services are supplied using unregulated assets and hence are beyond the scope of the NIS.
7. Electricity complementarity: Promote gas solutions to electricity problems	Grow gas demand by promoting customer engagement, understanding and acceptance of new appliances and solutions at the interface between the gas and electricity markets.	✗ Extends to potentially contestable services supplied using unregulated assets and hence beyond the scope of the NIS.
8. Track and understand transformative IT opportunities: Artificial Intelligence	Investigate and trial artificial intelligence applications to understand opportunities for deployment within the business to reduce costs and improve productivity.	✓ Project incorporates new, novel or original concepts and involves technology or techniques that differ from those previously implemented or used in the Western Australian Energy Market.

More details of our assessment are presented in the following sections.

6.3.1 Zero emission readiness: distribution equipment specification and operation

Requirement and rationale – Ensure the suitability of distribution equipment for a system conveying varying proportions of hydrogen.

ATCO's distribution system comprises many components including pipes, regulators, compressors, odourises and monitors, each of which may interact differently with hydrogen compared with natural gas. These differences need to be comprehensively identified, understood and managed, which may involve:

- Confirming that existing distribution equipment is suitable / unsuitable for use with hydrogen at various concentrations;
  - eg. confirming that odourising equipment will work with hydrogen and considering whether the placement of odourising stations fits with the likely positioning of hydrogen electrolysis stations.
- Determining the optimal specification of new distribution equipment to ensure good performance with hydrogen;
  - eg. identifying requirements for new control capabilities where equipment needs to be operated dynamically in response to varying concentrations of hydrogen.
- Determining the most efficient operation of each component of the distribution equipment according to the proportion of hydrogen being conveyed;
  - eg: determining how the operation of regulators and compressors should vary with the introduction of varying proportions of hydrogen.

Potential project elements

ATCO could evaluate equipment and operational requirements by undertaking the following types of tasks:

- Engineering reviews to
  - identify the inventory of network assets for which the introduction of hydrogen could introduce issues;
  - confirm suitability/ unsuitability for each class of asset and identify operational issues requiring attention;
  - identify parts of the system that are likely to be more tolerant to the introduction of hydrogen and hence offer greater promise for early commercial opportunities;

  - specify asset replacement requirements, system control capabilities and system operation protocols required to securely operate the system with varying proportions of hydrogen;

- Field trials in which different proportions of hydrogen are introduced into a gas network to test some of the above issues and solutions.

Benefits for network customers

The underlying driver for this project is a prudent gas network owner's response to the broader de-carbonisation objective of Australia's national energy policy

The project provides an opportunity for ATCO to identify and address likely future network problems associated with the transport of blended gases, thereby improving the prospects for successfully introducing hydrogen into the system and meeting changing customer energy requirements.

Subject to meeting technical and customer requirements, this project would potentially provide future service reliability and safety benefits to customers through a seamless transition in the characteristics of gas supplied using ATCO's regulated network consistent with the NGO.

Innovation and Risk

The project has innovative aspects, as well as risks that make it difficult to progress under the NGR/NGL regulatory framework as follows:

- ATCO is not aware of extensive progress in these areas, although academic work has been undertaken.
- Each network is different and while general research informs work of the kind proposed, it cannot provide a complete substitute for specific assessment carried out by ATCO in respect of the GDS itself.
- The projects are unusually speculative relative to ATCO's core network business because of the highly uncertain extent and timing of demand for hydrogen injection.

Other features

The expected project deliverables and duration are summarised in Table 6.

Table 6 Other features of a project to establish how to ready the network to receive hydrogen

Element	Project tools and timeline
Possible deliverables	• Reports from desktop review • Field trial outcomes reports
Duration	• 6 months for desktop review • 2 years for field trials

Conclusion

We consider that this project would satisfy the NIS assessment criteria because it incorporates new or original concepts and involves technology or techniques that differ from those previously implemented or used in the Western Australian Energy Market.

6.3.2 Zero emission readiness: measurement

Requirement and rationale – Address a technical hurdle to the zero-emission goal by determining a system for accurately measuring delivered energy in a system with a disparate and dynamic hydrogen-methane blend.

Hydrogen has a lower calorific value than natural gas and customers need to be charged based on units of energy delivered to each connection point. Gas meters measure the volume of gas flowing past the connection point and use a fixed conversion factor to report the energy consumed at the connection point.

In order for hydrogen injection to be commercially workable, ATCO will need methods and systems that can map where and when hydrogen is injected and how this affects the calorific value of gas at different points in the network at any given time.

Potential project elements

ATCO could develop the required methods and systems by undertaking the following types of tasks:

- Developing a mathematical model of how hydrogen injection at different parts of the system would be expected to affect gas blend at connection points
- Developing a testing model to confirm and refine the algorithms
- Specifying an IT-based system for determining the daily conversion factors appropriate to each connection point and the integration of these factors into the billing system.
- Testing and verifying the metering / billing integration and consulting with retailers to confirm suitability.

Benefits for network customers

By determining and verifying a workable metering/billing solution ahead of implementation, ATCO can confirm to the market that one of the technical challenges associated with hydrogen blending is solvable and ready to be used. In turn, this improves the business case for expanding the use of the gas distribution network into green gas markets.

This would provide future service reliability and safety benefits to gas network customers, while meeting a broader de-carbonisation objective consistent with Australia's national energy policy. Further, it reduces the risk of technical network problems arising during a rushed implementation. For these reasons, the project is likely to be in the long-term interests of WA gas consumers consistent with the NGO.

Innovation and Risk

A project of this type has innovative aspects, as well as risks, that make it difficult to receive funding under the NGR/NGL regulatory framework as follows:

- ATCO is not aware of prior implementation of solutions of this type in the field. In any event, the Retail Market Rules that govern system operation in the GDS would require specialised solutions for the local market.
- The projects are unusually speculative relative to ATCO's core network business because of the highly uncertain extent and timing of demand for hydrogen injection.

Other features

The expected project deliverables and duration are summarised in Table 7.

Table 7 Other features of a project to design a hydrogen measurement capability

Element	Project tools and timeline
Possible deliverables	A report including conceptual framework and mathematical algorithm, a detailed IT project specification
Duration	12 months

Conclusion

We consider that this project would satisfy the NIS assessment criteria because it incorporates new or original concepts and involves technology or techniques that differ from those previously implemented or used in the Western Australian Energy Market.

6.3.3 Zero emission readiness: customer acceptance

Requirement and rationale – test the workability of introducing zero-emission fuels into the network by testing customers identifying technical or social pre-requisites for acceptance.

As well as having a different calorific value to natural gas, hydrogen burns faster and with less colour. These differences will be more or less apparent at different ratios of hydrogen to natural gas and have greater or lesser importance depending on appliance types. It is necessary to confirm the technical suitability of hydrogen and hydrogen / natural gas blends for customer appliances from a technical perspective and the acceptability to customers of differences in behaviour / appearance / performance.

Potential project elements

ATCO could confirm the acceptability of hydrogen and hydrogen blends by undertaking the following types of tasks:

- Desktop reviews of potential issues requiring attention identifying:
  - appliances and uses of interest/concern and the implications for new and existing customers of hydrogen injection;
  - review of state of knowledge regarding effects of hydrogen in customer appliances;
  - potential technical issues for different appliances and an evaluation of the prevalence of any problematic appliances and cost of replacement/modification.
  - interactions with the WA technical regulatory regime associated with connection of gas appliances.
- Field trials:
  - introduce different proportions of hydrogen into gas supply in household or business settings; and
  - carry out customer testing, education and re-testing.

Benefits for network customers

The work provides an opportunity to identify and address potential technical network problems and customer acceptance issues, thereby improving the prospects for introducing hydrogen into the system. As noted, this could provide both service and cost benefits to customers (see Section 5.2).

Customers stand to benefit from the improved operational and investment efficiency that could emerge from a better understanding of the timing and drivers of customer

demand for hydrogen. Testing the acceptability of hydrogen in households and businesses provides an early opportunity to confirm whether this market is likely or unlikely to grow soon. If ATCO identifies important and unmet pre-requisites for customer acceptance, it could delay other expenditures pending those prerequisites being satisfied.

Further, the project reduces the risk of a customer backlash due to the perception of higher safely risks or service declines, which could occur if the introduction of changes in gas composition takes inadequate account of customer appliance design or broader acceptance considerations.

Prudent steps ARTCO takes to better understand the technical and customer implications of blended gas potentially being used in its regulated network is likely to be in the long-term interests of WA gas consumers consistent with the NGO.

Innovation and Risk

The project has innovative aspects, as well as risks that make it difficult to receive funding under the NGR/NGL regulatory framework as follows:

- ATCO is not aware of extensive progress in these areas, although academic work has been undertaken. Regulatory requirements for the connection of new gas appliances are different in Western Australia (type-B approval, provided by Energy Safety) and there would be a need to test how hydrogen blending would interact with these local regulatory requirements.
- The project is unusually speculative relative to ATCO's current network service, because of the highly uncertain extent and timing of demand for hydrogen injection, while recognising the potentially important role of hydrogen in future network service provision.

Other features

The expected project deliverables and duration are summarised in Table 8.

Table 8 Other features of a project to evaluate customer acceptability of hydrogen

Element	Project tools and timeline
Possible deliverables	A report from field trials and/or customer surveys.
Duration	1 year

Conclusion

We consider that this project would satisfy the NIS assessment criteria because it supports the broader zero emission readiness goal, which in turn incorporates new,

novel or original concepts and involves technology or techniques that differ from those previously implemented or used in the Western Australian Energy Market.

6.3.4 Long-term efficiency reforms: asset management and maintenance

Requirement and rationale – reduce costs though investigations into alternative asset management and maintenance approaches.

ATCO's operating and capital costs include significant levels of asset replacement and maintenance expenditures. Innovations in this area are capable of delivering significant cost reductions that could provide considerable benefit to WA gas customers in the long term.

For instance, ATCO has a recognised need to address the gradual embrittlement of its extensive network of PVC assets, which presents both safety and reliability risks for the network. ATCO anticipates that it may require decades of investment, totalling hundreds of millions of dollars, to replace existing PVC pipes with polyethylene. To manage this problem efficiently, ATCO is currently taking a risk management approach by prioritising replacements according to the risk of failure and considering partial replacements where this makes sense.

Notwithstanding the benefits of ATCO's replacement prioritisation approach, it is reasonable to expect that the cost of managing PVC assets will remain considerable for decades to come. If ATCO could develop a technique to remediate PVC assets in-situ or effect replacements more cheaply, this could ultimately save customers many millions of dollars in avoided or deferred capital expenditure. Analogous opportunities were identified in the case of leaking cast iron gas pipes found in cities such as New York and London, where a robotic solution was used to reseal old pipework and prolong its life by decades.[53]

Potential project elements

This project focusses on managing PVC assets in the long-term, although the projects could apply to any significant maintenance or asset management problem.

ATCO could attempt to develop new maintenance or replacement options to add to those it currently employs to manage its PVC assets, by undertaking innovative projects such as the following:

[53] International Business Times, 21 May 2015, "Robots being used to repair gas pipes underground rather than tear roads up", https://www.ibtimes.co.uk/robots-being-used-repair-gas-pipes-underground-rather-tear-roads-1502239 (accessed 12 July 2018).

- Engineering reviews to assess the field of robotic, relining and chemical technologies that could have application in addressing issues with PVC assets;
- Run a competition inviting engineering enterprises and/or universities to submit conceptual proposals to address the issues with PVC assets and offer funding to a successful submission to prototype their idea;
- Conduct trials of a working prototype.

Benefits for network customers

If the effort in developing alternative approaches to asset management was successful, customers would benefit from significant reductions in either operating or capital costs in future regulatory periods, consistent with the NGO.

Innovation and Risk

To again use the example of managing ATCO's PVC assets, investing in the development of a completely new option for replacing or remediating these assets would be a high risk option from an economic perspective, with potentially large future benefits to gas network customers.

However, from ATCO's financial perspective, in the absence of funding through approved expenditure allowances, the potential pay-offs would be modest, since it would only benefit from the difference between forecast and actual capital costs during the regulatory period in which the innovation arose. This mismatch between risk and reward makes the investment unlikely without some additional financial incentive for the business.

Other features

The expected project deliverables and duration are summarised in Table 9.

Table 9 Other features of Asset management and maintenance projects

Element	Project tools and timeline
Possible deliverables	• Engineering review report • Multiple technology-procedure designs (competition entries) • A prototype solution.
Duration	1 to 3 years

Conclusion

We consider that this project would satisfy the NIS assessment criteria because it incorporates new, novel or original concepts involving technology or techniques that

differ from those previously implemented or used in the Western Australian Energy Market.

6.3.5 Long-term efficiency reforms: metering innovation

Requirement and rationale – Reduce costs and improve services with new metering technologies and service models.

Gas services for most customers are metered using manually-read meters. These meters are expensive, reading is time-consuming, site access can be challenging and in higher density housing the space to accommodate metering installations is increasingly valuable.

Power, water and gas utilities all maintain meters at each customer's premises and some economies of scale and scope in metering services seems likely. Coordinated delivery of metering services could reduce the cost of communications systems and the space taken up by metering enclosures. Further, this could remove one disincentive for developers to install gas in new higher-density developments.

Coordination between monopoly service providers is often slow and difficult. Realising the potential benefits from metering integration may require considerable time and patience. Even if a strong business case can be made on efficiency grounds for each business, there may be further considerations relating to risk and control that could prevent or delay a shared solution. Such a risk militates against any single service provider investing in the preparatory work to progress such a solution.

Further, Western Power intends to commence its roll-out of smart meters in its next regulatory period and the momentum associated with this ambitious program may require that complicating considerations like multi-utility service models be set aside in the short to medium term.

Finally, applications to use the additional data and control afforded by remotely-read smart meters remain under-developed in the gas sector. While smart-meters for gas supply points already exist, the use-case for customers and gas networks is still developing.

Potential project elements

ATCO could take steps to improve metering service cost and quality by undertaking the following types of projects:

- Engineering reviews to identify the areas where metering service integration is most likely to be workable and beneficial;
- Engagement with service providers and stakeholders to

  - identify common goals, priorities and flag concerns and pre-requisites;
  - develop a road map for the establishment of shared metering services where efficient;

- Carry out field trials of end-point and back-end metering technologies to demonstrate effectiveness and highlight issues and use-cases.

Benefits for network customers

Multi-utility metering service provision offers the potential to create a significant and permanent reduction in capital and operating costs. This would provide clear and direct price benefits to gas network customers. Similar benefits would also accrue to the customers of other cooperating utility service providers, providing a basis for cooperative effort, although these benefits would not be relevant when considering whether the NGO was satisfied.

The deployment of additional data collection, data broadcast and control capabilities could provide additional value to customers, for instance in the form of improved network reliability. It may also provide a supporting capability that enhances the effectiveness of the integrated control solutions discussed in Section 6.3.7.

Innovation and Risk

The project has innovative aspects, as well as risks that make it difficult to receive funding under NGR/NGL regulatory framework as follows:

- There may be technical, operational and regulatory hurdles to be identified and cleared in order to proceed with service integration.
- Significant benefits appear to be in prospect, but ATCO lacks the requisite control to ensure that the project would be successfully concluded. Given this, the project exhibits a higher than typical risk profile for ATCO.

Other features

The expected project deliverables and duration are summarised in Table 10.

Table 10 Other features of metering innovation projects

Element	Project tools and timeline
Possible deliverables	• Engineering reports • Inter-utility metering service roadmap • Field trials of metering front-end and back-end technologies.
Duration	2 – 3 years

Conclusion

We consider that this project would not qualify under the proposed NIS because the scale of currently known opportunities is insufficient to justify funding such innovation projects. For instance, the scope to leverage benefits from better metering data has not been well explored or demonstrated to date. Further, we anticipate limited interest on Western Power's behalf in a multi-utility metering service model at present.

However, we anticipate that NIS eligibility for projects in this field may change over time, including as Western Power consolidates its smart metering program and looks to leverage new revenue streams from its communications and data management backbone.

We consider the key determinant for eligibility of any such metering innovation projects under the NIS is likely to be potential future material benefits to gas network customers, considering the scale of innovation expenditure proposed and the level of uncertainty associated with the overarching metering innovation project goal.

6.3.6 Long-term efficiency reforms: Virtual gas pipeline supply

Requirement and rationale – reduce costs by substituting 'virtual' gas pipelines in lieu of possible network extensions.

A 'virtual' gas pipeline links the existing gas network to an outlying area with a fuel requirement by using road or rail transport of compressed or liquified gas. The key components of such a virtual gas pipeline are:

- a compression[54] or liquefaction[55] plant connected to the main gas network;
- logistics, including trailers or rolling stock, prime movers and loading and off-loading facilities; and
- a let-down[56] or regasification[57] facility connected to the receiving gas customer or local gas network.

Virtual gas pipelines offer the scope to expand the gas customer base through the displacement of higher cost fuels, such as diesel. They allow for the gas network to transport gas part of the distance required to serve the customer, while avoiding prohibitively expensive network extensions.

[54] In the case of compressed natural gas (CNG)

[55] In the case of liquified natural gas (LNG)

[56] In the case of CNG

[57] In the case of LNG

Potential project elements

ATCO could develop the option of offering services by means of a virtual gas pipeline, by undertaking projects such as the following:

- Conduct engineering reviews to establish best technologies and logistical models
- Identify, design and price modular solutions.

Benefits for network customers

Gas customers in general stand to benefit where the most economically efficient supply technology is specified in all cases. However, given that a network extension would usually be funded by the capital contribution of the relevant customers, the substitution of the virtual gas pipeline would be unlikely to reduce the prices faced by all other network customers.

The only exception to this outcome would be if significant additional volumes of gas were supplied using the virtual pipeline, which could reduce volume-based gas network tariffs.

More significantly, we do not consider the non-network component of the virtual gas pipeline forms any part of the regulated network service and hence the NIS is not applicable to it.

Innovation and Risk

While the technologies required to establish a virtual gas pipeline are typically quite standard and well understood, there is likely to be some degree of endogenous innovation required to make this type of operation work efficiently.

If the assets involved were considered to be part of the regulated network, the risks arising from adopting a very different service delivery approach might be more than those for which ATCO's regulated return offers sufficient compensation. This reflects our view that, as noted above, the non-network component of the virtual pipeline is amenable to competition.

Conclusion

We consider that this project would not satisfy the NIS assessment criteria because it concerns services supplied using unregulated assets. That is, we assume that the non-network component of a virtual gas pipeline would not form part of the regulated network service, as required by one of the eligibility criteria.

The virtual gas pipeline would likely be a contestable service since it lacks the characteristics of a natural monopoly. Therefore, ATCO's return from supplying such a

service would be set by the market, as would any limits on innovation expenditures to realise this opportunity.

6.3.7 Electricity complementarity: Promote gas solutions to electricity problems

Requirement and rationale – grow gas demand by promoting customer engagement, understanding and acceptance of new appliances and solutions at the interface between the gas and electricity markets.

Several technologies appear highly prospective as potential sources of new demand for gas network services that generate electricity from gas or produce gaseous fuels that can be injected into the gas network.

Fuel cells convert the chemical energy stored in gas directly into electricity. Fuel cell technology has been constantly improving over the past several decades, to the point where compact and reliable units are conceivably commercially viable. Other gas appliances, like gas powered air conditioners, offer opportunities to reduce peak electricity consumption and thereby defer or avoid capacity augmentations. However, electricity customers may have limited understanding of where such units might be useful and how they can be most effectively, conveniently, safely and reliably integrated into homes and businesses.

Electrolysis splits water into oxygen and hydrogen using electricity. High capacity, gas network-connected electrolysis facilities offer the potential to balance output from renewable generation facilities. Used in conjunction with fuel cells and other gas consuming appliances, electrolysis can shift electrical loads from high to low demand periods. Used in combination with behind-the-meter photovoltaic generators, electrolysis units will allow customers to use a larger proportion of the energy they generate on-site. This will then necessitate gas storage – a service that ATCO's gas network may be well placed to offer.

Potential project elements

To promote engagement, understanding and acceptance of these technologies, ATCO could undertake specific projects such as the following:

- Evaluate equipment and operational requirements by undertaking field trials of fuel cells and electrolysis units to test reliability, interactions with other system components, installer experience and other parameters and publishing results.
- Demonstrate integrated control solutions that coordinate the operation of fuel-cells, photovoltaic systems, electrolysis units and gas appliances to deliver peak load and energy management outcomes in a variety of commercial and residential contexts.

Foster competitive service provision in these areas by partnering with multiple technology providers.

- Develop an online gas solution specification tool that suggests equipment and appliance types and sizing to address individual customer load management needs.
- Investigate business models and engineering issues and requirements associated with providing an energy storage service using the existing network.

Benefits for network customers

To the extent that the gas network's ability to complement electricity services is successfully promoted, the volume of gas transported on the regulated gas network will increase, which should in turn reduce the future volumetric gas network price consistent with the NGO.

Innovation and Risk

ATCO considers that lack of awareness and understanding of the opportunity to mitigate electricity supply costs using technologies that leverage the gas network may limit deployment in promising applications. However, there is no guarantee that addressing this constraint will automatically lead to increased up-take.

One key uncertainty affecting the future business case for these solutions will be electricity pricing practices of electricity networks and retailers. Another uncertainty concerns the future frequency and context of regulatory investment test processes, in which Western Power calls for non-network alternatives to network augmentations.

Conclusion

We consider that this project would not qualify under the NIS. While the project incorporates new, novel or original concepts and could deliver material benefits for gas customers, most of the identified project elements only indirectly concern services provided by means of the regulated network assets. We consider that the eligibility criteria would be most workable if read as excluding activities likely to support expansions by the business into contestable and non-regulated markets.

6.3.8 Track and understand transformative ICT opportunities: Artificial Intelligence

Requirement and rationale – track and understand opportunities to deploy artificial intelligence applications within the business to reduce costs and improve productivity.

Artificial intelligence refers to computer systems able to perform tasks normally requiring human intelligence, such as tasks involving decision-making or complex trend

analysis. This field of computer science has rapidly moved out of academia and into commercial contexts in the past five years and now enterprise applications are emerging.

For instance, in 2015, Woodside Energy deployed IBM's high profile super computer Watson within its business to draw together more than 20 years of engineering data from sources including testing, projects and messages. Once Watson had consumed this data, Woodside staff were able to pose highly technical questions and receive detailed answers in pursuit of insights offering step-change reductions in exploration and construction costs.[58] The company's artificial intelligence program is continuing with the development of applications in-house to further assist with surfacing and ordering data, corporate knowledge and trends.[59]

Recent analysis by the McKinsey Global Institute points to compelling opportunities for businesses to improve service quality and reduce costs through the adoption of artificial intelligence and significant risks to businesses that mishandle the conception, planning and implementation of projects in this area.[60] Among other success factors, McKinsey suggests that businesses take a portfolio approach, investigating projects over a range of timescales and levels of ambition.[61] Importantly, businesses are warned of the importance of cultivating an understanding of the actual capabilities of artificial intelligence-specific, real-world contexts and learning how it differs from conventional technological approaches.[62]

Potential project elements

ATCO could improve its understanding and capability in respect of artificial intelligence applications by undertaking preliminary investigations into this cutting-edge category of ICT products and services, which would involve the following types of tasks:

- Commission computer scientists to identify and evaluate opportunities to deploy artificial intelligence across ATCO's gas network business and then develop an artificial intelligence roadmap for the business.
- Conduct trials of artificial intelligence applications in niche areas of the business to evaluate potential opportunities and implementation issues.

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58 Australian Financial Review, 25 April 2016, "Woodside expands IBM Watson artificial intelligence as tech takes centre stage" https://www.afr.com/technology/enterprise-it/woodside-expands-ibm-watson-artificial-intelligence-as-tech-takes-centre-stage-20160422-gocq5i (accessed 12/07/2018)

59 IT News, 31 October 2017, "Woodside's AI avatar "escapes captivity"" https://www.itnews.com.au/news/woodsides-ai-avatar-escapes-captivity-476483 (accessed 12/07/2018)

60 McKinsey Global Institute, June 2017, *Artificial intelligence: The next digital frontier?*

61 McKinsey Global Institute, June 2017, *Artificial intelligence: The next digital frontier?*, page 32.

62 McKinsey Global Institute, June 2017, *Artificial intelligence: The next digital frontier?*, page 32.

Benefits for network customers

If preliminary investigations into opportunities to deploy artificial intelligence in the business build capacity and/or identify applications suitable for full-scale deployment, customers would benefit from potentially significant efficiency gains associated with future gas network service provision. This may take the form of operating cost reductions, avoided or deferred capital expenditure and/or improvements in the reliability and security of the network service consistent with the NGO.

Gradually building internal knowledge and capacity will also reduce the risk of inadequately specified or inefficiently implemented artificial intelligence projects in the future.

Innovation and Risk

Adopting artificial intelligence applications and building the capacity to undertake further development in this area would be a high risk, potentially high reward option from an economic perspective.

However, the speculative nature of such activities is not conducive to approval and funding under conventional regulatory expenditure allowances, even though there are potentially large future gas network service benefits for WA gas consumers.

Other features

The expected project deliverables and duration are summarised in Table 11.

Table 11 Other features of artificial intelligence projects

Element	Project tools and timeline
Possible deliverables	• Artificial intelligence roadmap for ATCO's business. • Trials of artificial intelligence applications in niche network areas.
Duration	1 to 2 years

Conclusion

We consider that this project would satisfy the NIS assessment criteria because it incorporates new, novel or original concepts and involves technology or techniques that differ from those previously implemented or used in the Western Australian Energy Market.

6.4 Chapter key points

We consider that the proposed NIS can identify innovative gas network projects that are likely to provide long term benefits to WA gas consumers, while filtering out projects

that would not satisfy this objective, including because they do not relate to the regulated gas network service.

Further, we note that the assessment criteria will remove projects that:

- do not require ATCO to be genuinely innovative in network service provision but rather reflect BAU processes; and
- are not likely (either in isolation or as part of a coordinated set of initiatives) to deliver future benefits to gas network users in excess of the costs the projects impose on those customers.

We also note that there are likely to be projects and programs associated with innovation goals and opportunities that ATCO has yet to identify and that could satisfy the NIS project eligibility criteria. A key element of the NIS is that it will facilitate an innovation culture within ATCO, including responding to a rapidly evolving energy market that could fundamentally change future gas network service provision. This has been the case for UK gas networks under Ofgem's small-scale gas innovation scheme, which we discussed in section 3.3 of our report.