

Annex

A17.03 Innovation Strategy

December 2019

As part of the NGGT Business
Plan Submission

Contents

Executive Summary	3	Chapter Five – Innovating to Decarbonise Heat	32
Chapter One – Our RIIO-1 Innovation Story	5	A Decarbonised Future for the UK	33
Strategic Context	6	Our RIIO-2 Approach	34
Building up to RIIO	7	Our RIIO-2 Innovation Themes and Topics	36
Our RIIO-1 Approach	8	Putting Consumers at the Heart of Innovation	39
Refocusing our RIIO-1 Priorities	9	Funding our Innovation Plans	41
		Innovation Governance: Building on Success	43
Chapter Two – Our Innovation Performance	11	Chapter Six – Next Steps	45
RIIO-1: Our Performance in Numbers	12	Appendices	47
Value Tracking Update	16	Appendix 1 – Technology Readiness Levels (TRL)	48
Our Innovation Survey	21	Appendix 2 – GNIS Comparison to RIIO-2 Themes	49
		Appendix 3 – Innovation in RIIO-2 Strategy Alignment	50
Chapter Three – Driving an Innovative Culture	22	Appendix 4 – RIIO-1 Project List	54
Embedding a Culture of Innovation	23		
Innovating Across the National Grid Group	24		
National Grid Board – Innovation Charter	25		
Chapter Four – Driving Collaboration	27		
Collaboration at the Heart of Innovation	28		
Engaging with the ENA and Other Networks	30		



Executive Summary

The purpose of this paper is to provide our RIIO-1¹ narrative for innovation in National Grid Gas Transmission (NGGT), to address some specific challenges on the topics shared with the RIIO-2 Independent Stakeholder Group and to present our RIIO-2 ambition and strategy.

Within National Grid, innovation is integral to both our core regulated business in the UK and US, and National Grid Ventures. We aim to make things better for customers and communities, while being more agile, flexible and responsive, and maximising value.

Our values build on and protect our strong foundations while looking to the future. They are aligned to our purpose and help our people understand how we are expected to achieve our purpose and vision for our customers and each other:

- **‘Do the right thing’** pulls together our foundational values: keeping each other and the public safe; complying with all the relevant rules, regulations and policies; respecting our colleagues, customers and communities; and saying what we think and challenging constructively.
- **‘Find a better way’** challenges us to focus on performance and continuous improvement for our customers, our shareholders and communities.

Innovation has continued to develop and be embedded into our Gas Transmission organisation across RIIO-1. Looking ahead to RIIO-2, innovation forms a pivotal role in delivering and operating a safe, efficient and reliable Gas Transmission network of the future that meets the needs of our stakeholders.

As we transitioned from six years of Innovation Funding Incentive (IFI) into RIIO-1 innovation funding, we set out with a goal to embed innovation into what we do. We have expanded our network of collaborators working with a wider range of third parties with expertise in a range of technical fields. We also work more closely with the other gas and electricity networks to deliver coordination across the innovation portfolios for maximum benefit to consumers.

We believe we are in a unique position, as owners and operators of the National Transmission System (NTS), to take a leading role on whole system energy thinking; working across both gas and electricity vectors, and between transmission and distribution networks.

To date, September 2019, we have invested £36.4m on 168 projects: 166 Network Innovation Allowance (NIA) projects (£24.7m) and 2 Network Innovation Competition (NIC) projects (£11.7m). This compares with £14m spent across the six years of IFI funding, indicating a significant increase in focus.

Through the introduction of key innovation themes, organisational and process improvements and a more stakeholder-focused approach, we have expanded the reach of innovation, unlocking new opportunities for third parties to innovate and enabling us to deliver value to our customers. To date our innovation portfolio provides a 4:1 return on investment based on an initial set of 12 case studies from our NIA portfolio. As further work to embed our successful innovation into the business continues, we expect to see this return increase.

Our focus for innovation has not just been large-scale deployments, often referred to as ‘Big I’ innovation, but also smaller-scale deployments and process improvements, ‘Little i’ innovation. We have remained committed to exploring innovation across the spectrum, recognising that value can be delivered from any scale of innovation.

We recognise for all the success across RIIO-1, we can do better. Projects have not always delivered successfully but we have looked to take learning from this and to update our processes and organisational structures to support this. Our innovative culture has significantly improved; however, we are not at a point where innovation is embedded to the same level in everything we do.

Innovation is a thread that underpins the business plan and runs through all other chapters and topics. This paper therefore is a standalone document which brings together all the relevant information; explaining the background and context of our RIIO-1 innovation portfolio and our RIIO-2 proposals and ambitions.

¹ RIIO (Revenue = Incentives + Innovation + Outputs).

As we move into RIIO-2 our driver in Gas Transmission is to be 'Innovating to create your network of the future and facilitate UK decarbonisation'. Innovation in RIIO-2 will be delivered under three broad areas, which align to our RIIO-2 Business Plan chapters as shown below:

 <h3 style="margin: 0;">Fit for the Future</h3> <p style="margin: 10px 0;">Safeguarding and preparing our assets for the challenges in operating for the next 50 years and towards a decarbonised future.</p>	 <h3 style="margin: 0;">Ready for Decarbonisation</h3> <p style="margin: 10px 0;">Focusing strongly on how the NTS will transport a blended mix of 'green' gases and focus on future technology to better manage the assets we own.</p>	 <h3 style="margin: 0;">Decarbonised Energy System</h3> <p style="margin: 10px 0;">Working predominantly on hydrogen: how hydrogen will interact with the NTS, how trading could be managed and whether direct offtakes for hydrogen can support the transport and commercial market.</p>
Chapter 13 – I want the gas system to be safe		
Chapter 14 – I want to take gas on and off the transmission system where and when I want		
Chapter 15 – I want you to protect the transmission system from cyber and external threats		
Chapter 16 – I want you to care for the environment and communities		
Chapter 17 – I want you to facilitate the whole energy system of the future, innovating to meet the challenges ahead		
Chapter 18 – I want all the information I need to run my business, and to understand what you do and why		
Chapter 19 – I want to connect to the transmission system		

Innovation is about taking risks – calculated risks that can drive change and deliver the greatest value to our customers. Our RIIO-2 strategy for innovation recognises this, but also acknowledges Business as Usual (BAU) funding may not be feasible where technical or commercial risk is too high, the outcomes are uncertain or there are several factors that could erode the efficiencies expected. We expect to work closely with Ofgem and other stakeholders to ensure the RIIO-2 innovation framework can account for the bigger challenges facing the energy sector and the value that allowance-based innovation such as NIA and NIC can bring to consumers. We are committed to delivering £4 value for every £1 spent on implemented innovation projects.

We welcome Ofgem's support for a strategic innovation fund, which would replace the existing NIC framework. This strategic fund is key to driving the large-scale change required in the energy sector to deliver a zero carbon system.

The strategic fund is an important part of our Innovation Strategy, alongside a revised NIA as set out by Ofgem. In particular we would like to stress the importance of retaining an allowance for agile and responsive innovation that is currently facilitated through NIA in RIIO-1. We believe a 0.75 per cent of revenue in the form of an innovation allowance (such as NIA) is vital to support the strategic ambitions for a decarbonised energy system. This would total RIIO-2 innovation allowance of approximately £30.9m. This would be alongside our investment in innovation as BAU. We encourage Ofgem to recognise the challenges we face in delivering a decarbonised energy system and consider our proposals to offer an ambitious, yet achievable, framework for innovation in RIIO-2.

Chapter One

Our RIIO-1 Innovation Story

To introduce our ambitions and strategy it is important to look back at the achievements before RIIO and through RIIO-1: the first RIIO price control period. A significant amount has been achieved over this period and the approaches developed should be built on to learn from the past and grow the function into RIIO-2. In this chapter we will discuss:

- Strategic context
- Building up to RIIO
- Our RIIO-1 approach
- Refocusing our RIIO-1 priorities



Strategic Context

The objectives of this paper are to provide a deep dive into our RIIO-1 innovation portfolio and to look ahead to our Innovation Strategy for RIIO-2. Innovation is one of the core elements of the RIIO price control and our approach has evolved significantly over the past six years. As we move into RIIO-2 innovation remains an important element in delivering the future network our stakeholders require.

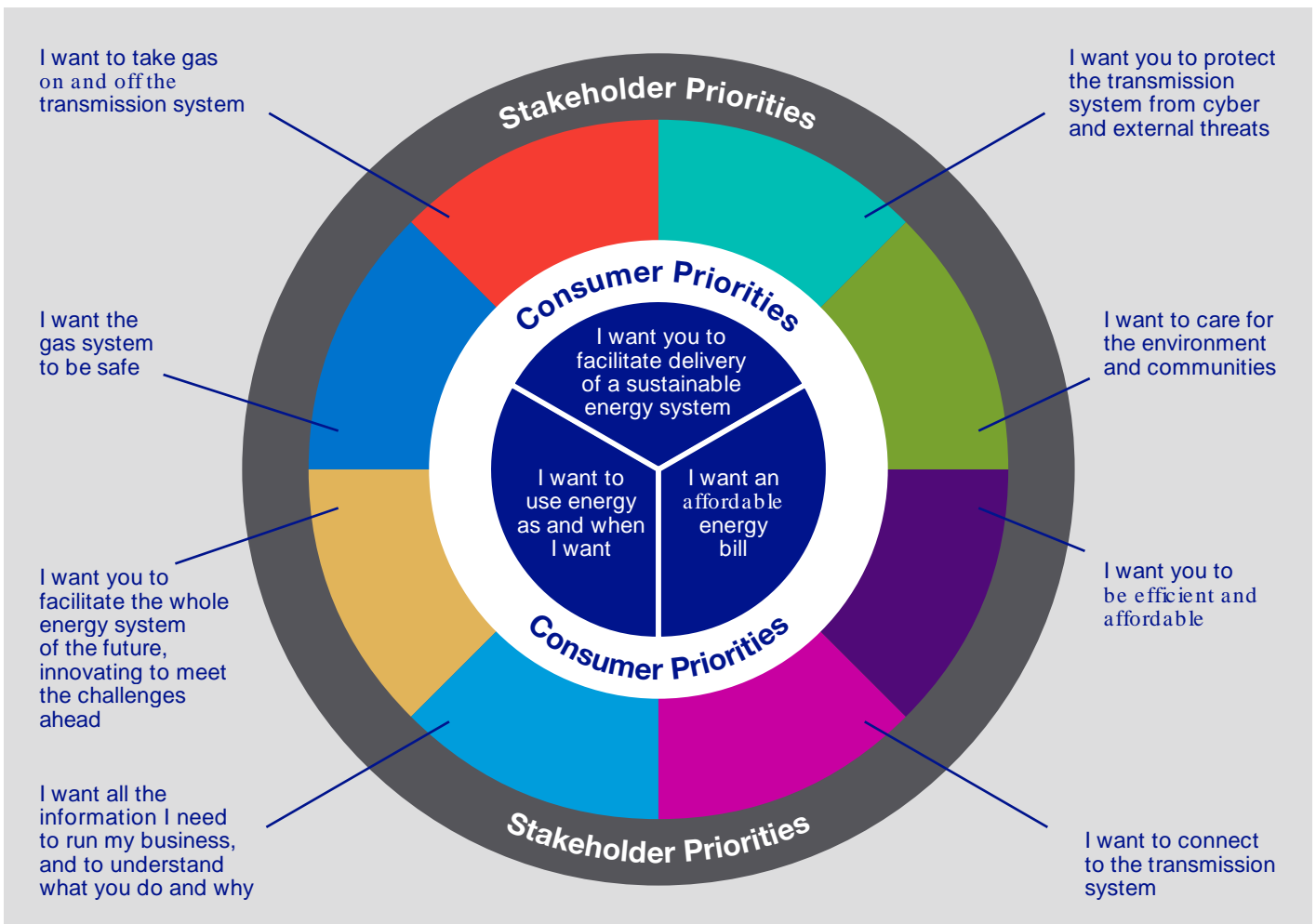
Innovation is a thread that underpins the Business Plan and runs through all other chapters and topics. Ofgem has tasked all the networks to demonstrate the application of innovation learnings and efficiencies from RIIO-1 into the RIIO-2 Business Plan, and to articulate the innovation ambition, through both BAU and allowance-based funding. In addition, we are seeking to address a range of questions and challenges raised by the Stakeholder Group.

Against a backdrop of an uncertain energy landscape we are

mindful that there is a careful balance to be achieved in delivering these priorities for consumers. We will make critical decisions regarding replacing, maintaining or decommissioning our assets, as well as driving forward innovation to ensure the best fit for future solutions.

This paper therefore is a standalone document, which brings together all the relevant information, explaining the background and context of our RIIO-1 innovation portfolio and our RIIO-2 proposals and ambitions.

The RIIO-2 Business Plan comprises seven chapters reflecting our stakeholder key priorities. Innovation is embedded in each chapter while the overall innovation approach and strategy sits within 'I want you to facilitate the whole energy system of the future, innovating to meet the challenges ahead'. Innovation is a line on each of the golden thread summaries for every chapter.



Building up to RIIO

Before RIIO-1, we had access to the IFI, which ran for six years from April 2006 until March 2012. IFI was a pivotal tool in helping to encourage a more innovative approach to the challenges that we, and the wider industry, faced. It helped deliver projects that enhanced safety and environmental performances, as well as driving efficiencies in the way tasks were undertaken. Our IFI expenditure was on average £2.8m per year, with just two staff members directly dedicated to the delivery of projects. We also worked predominantly with one supplier (now DNV GL) as a legacy from access to the 'British Gas Research' skills and expertise.

As part of RIIO-1, three funding mechanisms for innovation were introduced by Ofgem:

A Network Innovation Allowance (NIA) – to fund smaller innovation projects that will deliver benefits to customers throughout the RIIO price control.

A Network Innovation Competition (NIC) – an annual competition to select flagship innovative projects to fund that would deliver low carbon benefits to customers.

An Innovation Roll-out Mechanism (IRM) – to fund the roll-out of proven innovations that will contribute to the development in GB of a low-carbon energy sector or broader environmental benefits.

Moving on from IFI, it was clear the way we looked at our innovation portfolio needed to change in order to maximise the opportunities of the new funding mechanisms. Rather than focusing on the innovation of specific asset types, we began to profile our portfolio based on key themes. By focusing on these themes, we were able to connect our innovation portfolio directly to our RIIO-1 commitments to deliver safe, efficient and reliable energy networks to the consumer. 'Customer satisfaction' and 'Commercial' innovation up to the end of IFI only accounted for 2.6 per cent of our innovation spend. This was due to the asset-based focus of the IFI scheme, which made crossover into commercial and customer-focused outputs of projects difficult.

It was clear from what our stakeholders told us that this needed to change. With the introduction of our themes, greater focus and clarity was given as to where projects could help achieve a greater customer outcome.

A key change to our approach was to increase the level of ambition around innovation. With access to both the NIC and NIA we could access increased levels of funding across a broader range of topics. We needed to increase the appetite to undertake innovation projects that were deemed more uncertain but offered much greater levels of return to our customers. To achieve this, we needed to broaden our reach, be open to engaging with a wider range of third parties and listen to what challenges and opportunities our customers and stakeholders faced. This could help drive a strong pipeline of new innovative ideas that could be assessed against the business need to develop a strong innovation portfolio.

Building up to RIIO-1 we needed to increase the appetite for innovation across our organisation.

To support this level of change and transition from IFI to RIIO-1, our internal innovation structure changed from two people in our Asset Management function, to a model centrally coordinated by our Regulation function with technical expertise within the business units. We created two additional roles to ensure sufficient resource to support internal and external stakeholders through the innovation process. We established the Gas Transmission Innovation Governance Group (GTIGG) to manage the development and sanctioning of innovation projects, with representation from all core business functions. The role of GTIGG is to ensure innovation projects are robust, compliant with NIA governance and aligned to our strategic goals. Clarity across the innovation process has allowed for a coordinated approach to innovation investment and remains a vital part of our strategy moving forward.

Our RIIO-1 Approach

At the outset of RIIO-1, we identified three pillars that were key to delivering successful innovation within our business:

Identification and prioritisation of research areas – We committed to listen to our stakeholders and focus our efforts on delivering innovative solutions to address their needs.

Harnessing innovative capabilities – We would continue to build a more innovative culture within our company to make sure that we can deliver our company vision of being an innovative leader in energy management.

Collaboration with external parties – We recognised that we could not fully optimise the use of innovation funding using only our own resources. We committed to continuing to build strong links with research institutes, academia, suppliers, manufacturers and other institutions within the energy value chain to harness their capabilities.

With the refreshed internal structure of the team and governance in place, we were building the skills and capability to foster innovation within the business. The Innovation Team had clear accountability for the strategic alignment of outputs of the projects and managing the innovation process to ensure that it was fit for purpose for both the expanding scope of what can be funded through NIA and NIC and for the increased size of the available funding.

Collaboration and engagement with our stakeholders has been key to success for innovation in RIIO-1.

Key to succeeding in our innovation ambition was to engage with our stakeholders. We set out a programme of education and engagement, whereby we talked to third parties and presented the opportunity of NIA and NIC. We began to run innovation calls and attend conferences and other events to engage with third parties and help them to understand the opportunities for innovation and how they could get involved. This has been a challenging area – in many ways National Grid Gas Transmission (NGGT) has unique requirements and there was not a wide range of parties with the necessary background and skill set in some areas. As an example, a lot of work had been undertaken on robotics at low pressure, but very few companies had the expertise of a high-pressure gas environment. However, several strong relationships were built and the results of this engagement were clear. We saw an increase in the number of different third parties engaged in our innovation portfolio, with several new ideas within the pipeline from Small-Medium Enterprises (SMEs) that had never previously worked with National Grid. By the end of 2014/15 we had sanctioned 50 new projects under NIA across 29 suppliers.

We began to see an increase in the number of internal staff becoming involved in projects. We looked to ensure the governance process was robust, but meetings were positive and constructive, welcoming ideas from anyone and anywhere. We started to make use of an 'appreciate' scheme, which is a point-based system of reward between colleagues, to reward those bringing forward ideas, getting project sanction, hitting milestones and embedding solutions.

Projects that did not show positive results were still seen as beneficial, as some ideas may fail, but in doing so we make positive steps to further innovation. Within the past two years we have undertaken several projects using machine learning (ML) and artificial intelligence (AI) that have not been successful but have shown us where the technology limitations are now. This has been a challenging message where teams are under pressure to deliver their day-to-day roles. These projects could be perceived as not a good use of time and resources; however, the lessons we have learned will be used to steer future trials of these technologies.

We encouraged experimentation, a change for a company that is, historically and for good reasons, risk-averse. We recognised the need to foster a culture where we encouraged greater experimentation by managing the risk rather than avoiding it. We shared information across the business to help stimulate best practice and innovation in all aspects of our operations and looked to develop ideas.

Refocusing our RIIO-1 Priorities

In the early stages of RIIO-1, we expanded our reach to third parties and started to work closely with a much wider range of innovation providers, from relative small-scale specialist engineering companies to global corporations and consultancies, providing dedicated knowledge in areas such as pipeline inspection, integrity of high-pressure gas pipelines, and instrumentation and measurement. In addition, we developed more collaborative university projects, which provide benefits in terms of educating and raising the capability of academics and students, many of whom are subsequently employed either by us or other parts of the energy industry. This broad approach provides us with access to world-class expertise, working with specialists who understand the challenges and are continually striving to find tools, techniques and new ways of working to deliver value to our customers.

This has resulted in a rich mix of 76 third-party collaborators across innovation projects past and present, with a wide range of knowledge and experience, which is shared across the industry. Collaboration is at the heart of how we innovate. It allows us to unlock the most potential from all parties involved to deliver the best outcome. Collaborating with the other gas and electricity networks has been key to delivering projects that deal with common issues or offer wider benefits to the whole network. It allows us to branch out into wide-ranging innovation areas and develop a safe, reliable and efficient gas network for the future.

As the first year of RIIO-1 ended, we carried out reviews on how we had performed. As a result, we had made progress in establishing the foundations to be better at innovation – setting up our team, the processes and our GTIGG sanctioning committee. Having identified our three pillars to innovation, we were also making progress on identifying areas where we could innovate, harness our capabilities and collaborate with external parties. However, we found the quality of ideas and the subsequent project proposals were not always up to the expected level of quality and we were struggling to get internal business engagement and commitment of time to projects. As a result, we updated our processes to address the concerns – introducing guidance to complete the sanctioning documentation and devising a ‘One Page Summary’ to accompany project proposals, which set out a series of questions to answer to improve the quality of the submissions.

As each year of RIIO-1 has passed, we have conducted an iterative process to challenge ourselves, our performance and what our stakeholders think of us to ensure we improve to deliver the best service. We have also tightened our project management controls and conducted detailed analysis of our innovation projects to ensure the business case still stands and the project is set to deliver the expected outcome. The improvements include:

More Stringent Controls at our GTIGG Sanction Committee – We put a greater onus on proposals to identify business support and a clearer cost-benefit analysis. In addition, broadening

the business representation on the committee such as an IT representative to ensure, for example, any projects that require system modifications are adequately accounted for in our IT strategic workload and to ensure smoother transition into BAU.

Portfolio Rationalisation – From the outset of RIIO-1, the innovation portfolio was growing, with several projects initiated and some already completing, delivering knowledge and value to the business. However, there were several projects that had been identified that were underperforming with milestones slipping, greater uncertainty of success following initial trials and concerns around the resulting output. There was some reluctance from within the business units to close these projects early, a challenge with culture and the perception that this would be a ‘failure’. However, an initial portfolio rationalisation saw several close early with plans put in place for several others to bring them back on track to deliver the expected output. This rationalisation has formed part of our portfolio management, with annual reviews alongside the Ofgem progress and reporting cycle as well as monthly status reporting of projects.

Centralised Data Management – As the portfolio of innovation projects grew, so did the amount of data. There were five core spreadsheets that were used to manage the innovation portfolio by 2015/16 with information duplicated and hard to interrogate. Taking on learning from other internal departments and gas networks, we opted to implement a portfolio management tool called ‘Focal Point’ to manage all data relating to the innovation portfolio from initial idea, to sanction documentation, financial milestone management and performance tracking. This has unlocked significant value, allowing more detailed data interrogation, and has brought time efficiencies for the team. In addition, it manages the GTIGG process from action tracking to generating key performance indicators (KPIs).

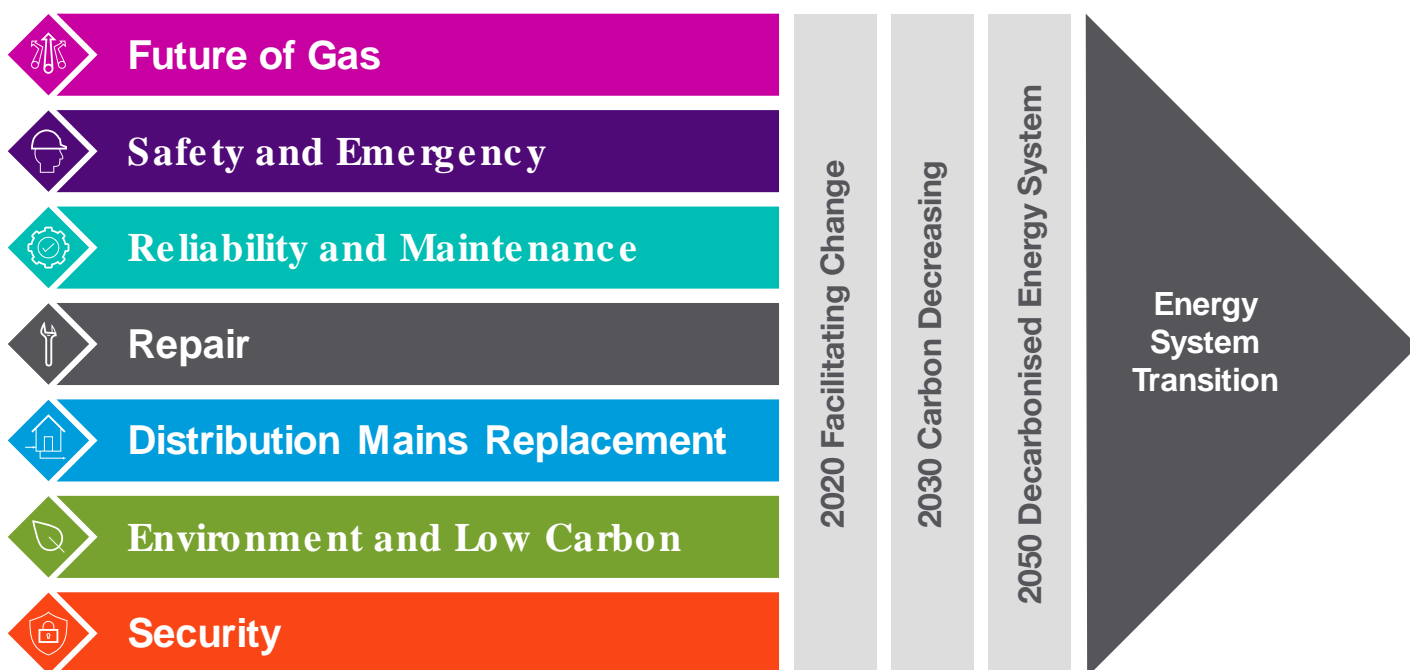
Innovation Team Structure and Resourcing – As the portfolio grew, more resources were required to deliver the innovation projects and support our increased stakeholder engagement. In 2017 it was decided that the centralised Innovation Team would be disbanded to embed a specific Innovation Team in Gas and Electricity Transmission business units. An additional two roles were created, bringing the size of the Gas Innovation Team to six. A wider organisational change across the Gas Transmission business in 2019 has resulted in the Innovation Team growing to eight with a dedicated Innovation Manager, Innovation Delivery Manager and six Innovation Project Managers.

Strategic Review of Innovation – One requirement for the Annual Summary is for us to outline how we have performed in the given year against our strategy set out for RIIO-1. As part of this review each year, we refined the strategic themes we had identified to respond to the changing needs of the business and the feedback from stakeholders as to the challenges they faced.

Gas Network Innovation Strategy Themes

In late 2017 to early 2018 we worked closely with the gas networks via the Gas Innovation Governance Group (GIGG) to develop a Gas Network Innovation Strategy, including a stakeholder consultation to help shape our focus. The resultant strategy, published in March 2018 (and due for a refresh in March 2020), sets out the strategic priorities across the gas networks and the cross-vector innovation opportunities. To read the full Gas Network Innovation Strategy click [here](#). To view an Executive Summary, click [here](#).

More stringent controls, better processes and clearer team structures have improved our performance across RIIO-1.



Note: The Repair and Distribution Mains Replacement themes relate specifically to Gas Distribution network challenges and are therefore excluded from categorisation against the Gas Transmission Portfolio.

Chapter Two

Our Innovation Performance

A summary of the performance from RIIO-1 is provided in this chapter. Overall it can be seen that investment in innovation is trending upwards with FY2017/18 and 2018/19 utilising all the allowance to date. From March 2012 until December 2018 there was a total of £22m spent over 154 projects spread across the themes. Significantly for the implemented projects which had a cost of £2.1m we have tracked a total of £9.2m in benefits. We have also spoken to our external innovation partners and asked them to complete a survey on our performance highlighting strengths and weaknesses within our processes. In this chapter we will discuss:

- RIIO-1 our performance in numbers
- Value tracking update
- Our innovation survey



RIIO-1: Our Performance in Numbers

Network Innovation Allowance (NIA)

Under RIIO-1, our NIA allowance annually was awarded at 0.7 per cent base revenue. This resulted in an allowance ranging from £4.3m to £5.5m per annum across RIIO-1, depending on the NGGT allowed revenue for the year. The allowance is reset at the start of each financial year, which means unused allowance in a given year does not roll over to the following year.

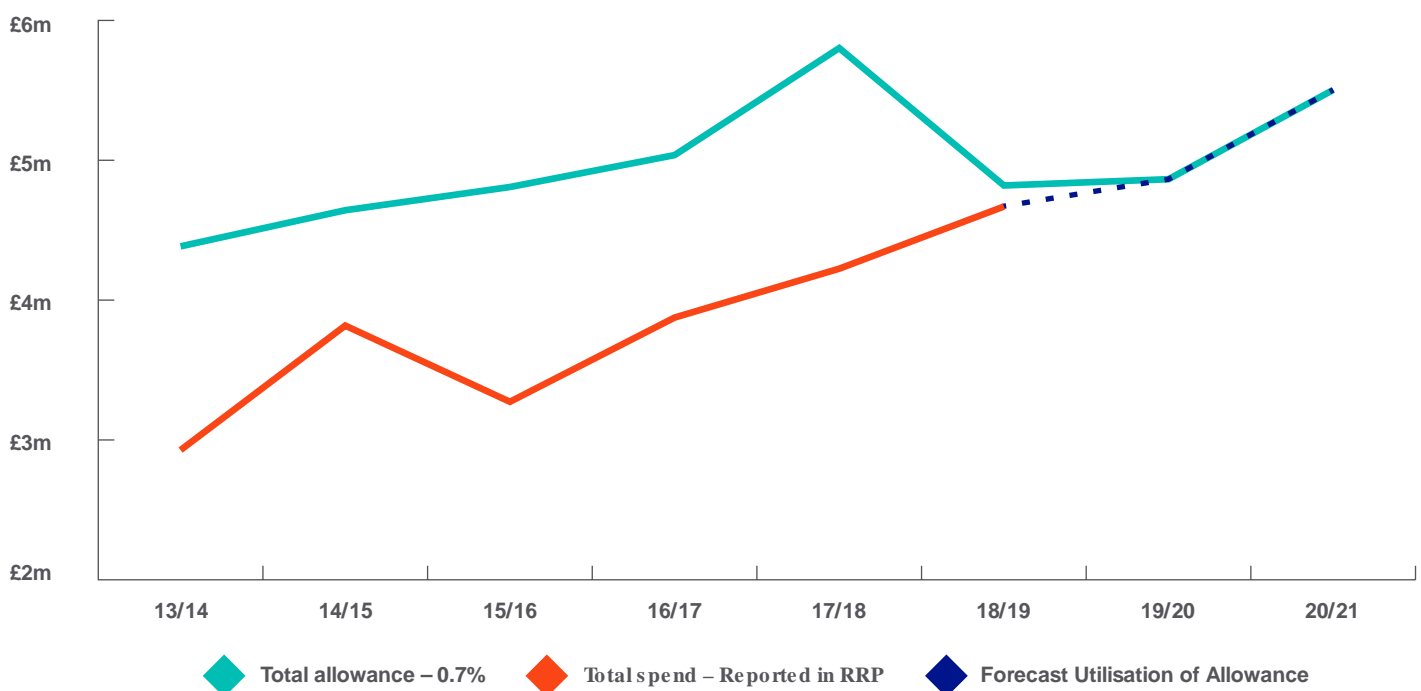
Our strategy has always been focused on identifying innovative ideas that could develop into projects that deliver value to our customers and satisfy a business need. We have never targeted innovation with the sole intention to utilise the full allowance in each year. As the spend profile shows, our utilisation of the available allowance has not been 100 per cent; however, innovation spend year on year has increased (except for 2015/16 – see note below) demonstrating how our innovation capabilities have developed.

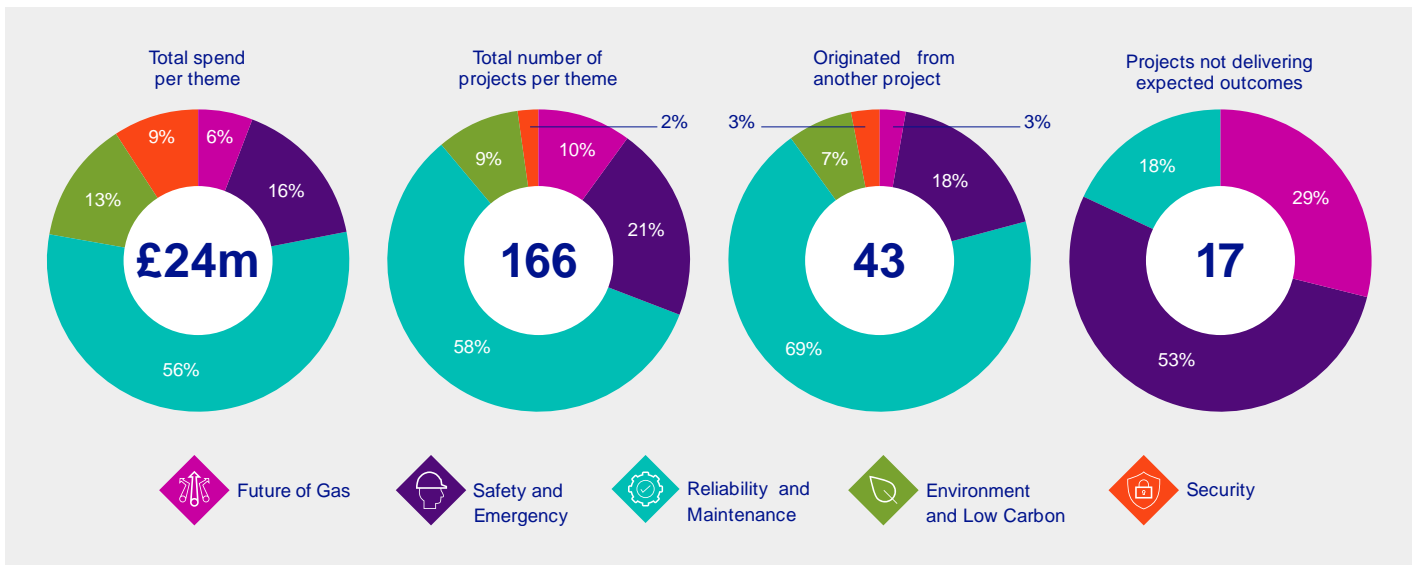
Looking to the end of the financial year 2018/19 we expect almost full utilisation of the £4.82m allowance, with a strong portfolio of projects delivering value.

In 2015/16 there was a dip in total innovation spend, which, as the data below shows, was an anomalous year. Without this anomaly, our innovation spend has steadily increased year on year. There were several factors that contributed to this. First, some large projects were closing while still showing an underspend, which meant that resources we had anticipated using on these projects were accounting for less spend than we expected. Also, team changes meant there were delays in fully resourcing the team, which had an impact on our ability to establish new projects.

Figures in this section are up to September 2019.

	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21
Total Allowance – 0.7 per cent Revenue	£4,385,000	£4,643,000	£4,809,000	£5,037,000	£5,802,000	£4,802,000	£4,865,000	£5,503,000
Total Spend – Reported in RRP	£2,928,027	£3,817,581	£3,273,128	£3,875,077	£4,224,525	£4,668,611	–	–
Forecast Utilisation of Allowance	–	–	–	–	–	–	£4,865,000	£5,503,000





Theme	Reported and forecast spend total	Number of projects	Collaborative	Originated from another project	Not successful
Future of Gas	£1,350,432	17	8	1	5
Safety and Emergency	£3,865,901	36	12	8	9
Reliability and Maintenance	£13,829,352	95	22	30	3
Environment and Low Carbon	£3,181,145	16	1	3	0
Security	£2,015,967	2	0	1	0
NIC Bid Prep *	£453,723				
Total	£24,696,520	166	43	43	17

* Previous Ofgem NIA Governance allowed for the cost of a NIC bid preparation of 5 per cent total NIC cost or £175k (whichever was lower) to be recovered. This was not classified as a project so does not form part of the project count, however, NIA spend was incurred, hence its inclusion. This data is correct as of December 2018.

Key Statistics

Spend across the themes has been varied, with the biggest spend and number of projects focused in the Reliability and Maintenance theme. This focus has been to meet the challenges of an ageing network and associated issues and to develop new opportunities to drive efficiencies for our customers by life extension of assets and identifying new approaches to relieve rather than replace assets.

As we transition through to the end of RIIO-1 and into RIIO-2, a much greater focus is shifting to the Future of Gas theme, which concentrates on the need for flexible networks, new sources of gas and the challenges in transporting this across our network to meet our customers' needs.

Compared with the Gas Distribution Networks (GDNs), NGGT has the lowest proportion of collaborative projects across its portfolio, with 26 per cent collaborative. However, it is important to note that this figure relates only to projects officially registered on the Smarter Networks Portal (SNP) with NGGT as a financial contributor. There are a number of projects that NGGT and conversely the GDNs are non-funding participants in, contributing time and expertise for key strategic workshops, knowledge dissemination sessions and other project-related activities.

NGGT operates in a highly specialised industry, operating at high pressures, with metallic pipelines, compared with the much lower pressures of the GDNs with predominantly PE (polyurethane) plastic pipe. A significant number of the challenges faced by the GDNs do not apply to NGGT and are associated to their domestic customer base including street works, repairs and mains replacement.

Our portfolio has developed and grown throughout RIIO-1, with key learning from previous projects feeding resultant projects. 43 of our projects (26 per cent) have originated from another project, whether the project is specifically a follow on, such as the Open Source SCADA Phase 1 and subsequent Open Source SCADA Phase 2 projects, or that specific learning has identified the need/opportunity for a follow-on project, such as the High Altitude Aerial Surveillance Project leading on to the Aerial Imaging Research Project.

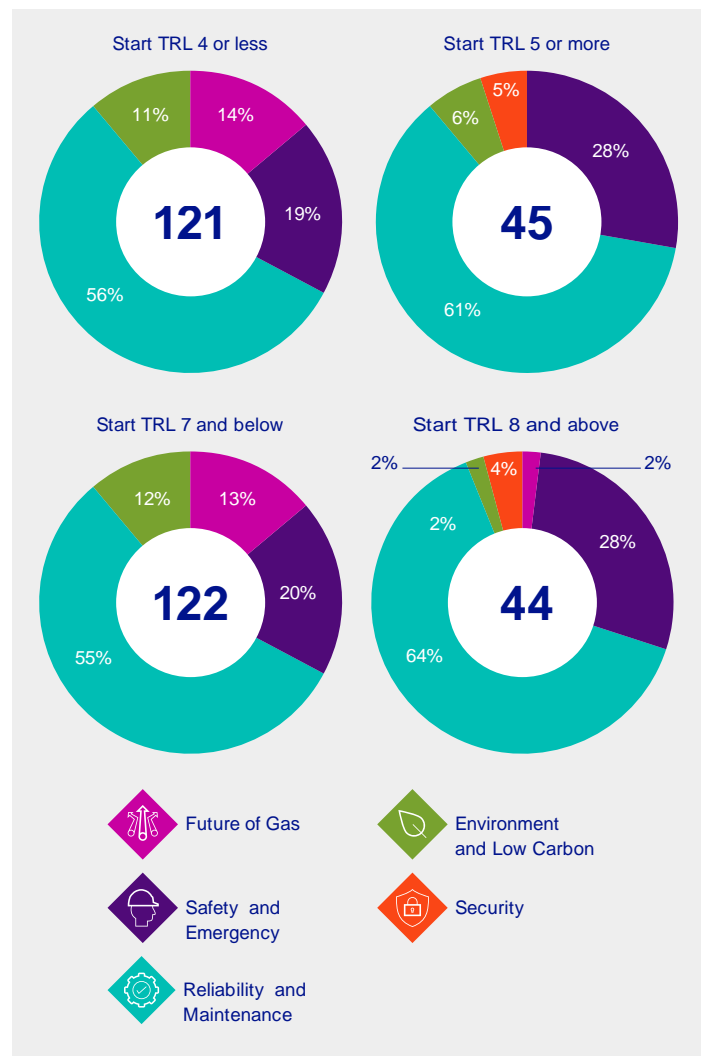
For all the successes that can come from an innovation project, there can be cases where projects have been unsuccessful. We define a project as being unsuccessful where the objective cannot be met, and subsequent expected value cannot be achieved. We monitor our projects to ensure they are still performing at the level we expect and that the outcomes expected are still possible.

If this is no longer the case, we will close the project as soon as possible, carrying out a lessons learned analysis as to the reasons why. This is demonstrated for example in the Artificial Intelligence for Pipeline Coating Project, where initial trials were positive, however, as further tests and trials were conducted it was clear the desired outcomes were not possible, and the challenges were too significant to continue.

The Technology Readiness Level (TRL) indicates how close a technology is to becoming both technically and commercially viable (information on the TRL levels is shown in Appendix 1). The NGGT portfolio has been focused on the earlier stage of research and development, with 73 per cent of projects starting at TRL 4 or less. These projects have been centred around developing and proving concepts and where necessary conducting laboratory/ offline testing.

These earlier stage projects developed significant levels of knowledge, with a number of further tasks originating as a result of the below TRL 4 research and development projects. Around 26 per cent of our projects are completed at TRL 8 or above, which means they have been demonstrated in live network conditions and are ready for potential use within our network. Where these projects have been developed, further work is often required to bring the project to the final stages for deployment. This also includes addressing training needs and policy/procedure updates.

Reported and forecast spend total	Start TRL 4 or less	Start TRL 5 or more	End TRL 7 or less	End TRL 8 or more
Future of Gas	17	0	16	1
Safety and Emergency	23	13	24	12
Reliability and Maintenance	68	27	67	28
Environment and Low Carbon	13	3	15	1
Security	0	2	0	2
Total	121	45	122	44



There has been an emphasis on research and development within our innovation portfolio, with projects that present more uncertainty and risk but have greater potential to develop value for our customers. In focusing on this earlier stage development, we have been able to advance our capabilities and understanding in a number of areas from robotics and valve remediation, through to the challenges that hydrogen presents to our network and development of open source SCADA cyber security.

This earlier stage TRL funding would not have been possible without an innovation funding mechanism, such as NIA, as the technical and commercial risks were too high and the outcomes too uncertain to justify BAU funding.

Network Innovation Competition (NIC)

During RIIO-1 NGGT took three NIC bids to full submission (Project VECTOR, Project GRAID and Project CLoCC) and took a further NIC bid to the Initial Screening Process (ISP) stage, (Haven Energy Bridge). The two successful projects, GRAID and CLoCC, had a combined total spend of £11.7m:

Project GRAID (Gas Robotic Agile Inspection Device) – Started 2014 – £6.3m. The project designed and developed a remotely operable robot that can be inserted into live, high-pressure (100 bar(g)), carbon steel pipework systems. Once inside the pipework the robot can undertake both visual and physical inspection of the otherwise inaccessible buried sections of the system. The spilt module robot is highly articulate and able to move freely throughout the pipework.

Project CLoCC (Customer Low Cost Connections) – Started 2015 – £5.4m. Project CLoCC has minimised the cost and time of gas connections to the NTS, with a focus on non-traditional NTS gas connections. This has been achieved through fundamentally challenging every aspect of the current connection process, building on worldwide ‘best in class’ technology and practice.

Both projects have now completed and achieved their objectives set at the beginning, showing that with great collaboration and engineering expertise these large, ambitious projects can have successful outcomes. They are now under development for utilisation through RIIO-2².

Our RIIO-2 Plan:

- We welcome Ofgem’s decision for a strategic innovation funding pot, dubbed ‘New-NIC’, and see this as a key component to our future innovation portfolio.
- We will seek to maximise the opportunities of this new funding pot, with large-scale collaborative projects that align to our three key innovation themes.

Our portfolio has been focused on early-stage research and development which has driven further work.

Business Funded Innovation

Outside of the incentives from Ofgem, both NIA and NIC, NGGT has also been a part of and led many other initiatives that promote innovative thinking and address specific challenges to the business. Some of the key projects include:

Aylesbury Compressor Site Emissions Reduction – Due to the Industrial Emissions Directive (IED) we are required to make all our large compressors compliant with the limits on how much nitrous oxide (NOx) and carbon monoxide (CO) industrial installations are permitted to generate. We looked at Aylesbury first, which has unique compressors installed, which were only non-compliant with the NOx aspects of the legislation. Rather than replacing the full compressor unit, both exhaust stacks could be removed, with new stacks installed in their place using an innovative technology called static catalysts. After thorough analysis, we established that the solution would cost nearly 5.5 times less than replacing the entire units, reducing the materials used, construction costs and the length of the project dramatically. We saved £53m against our Ofgem allowance for entire new units and more than 2,000 tonnes of carbon over the 20-year design life.

² NIA_NGGT0145 is a follow-on project for the GRAID robot looking to improve the sensor capability.

Value Tracking Update

Shallow Dig – Many of our valves are located many metres underground and would have required deep excavations at large expense to complete major maintenance work. Under our NIA project on Valve Sealant Line Grouted Tee we developed a technique to facilitate repair of corroded sealant lines, typically occurring at the wind and waterline interface. Applying this Grouted Tee technique, a costly full excavation to replace the main line valve can be substituted by just a shallow dig using vacuum excavation. The first use of the tool on three valves at Kings Lynn Tee avoided the costs associated with replacing the valves and saved £817,000 in total costs and 1,500 tonnes of CO₂. With this solution still in the early stages of implementation, the savings for the network and our customers will greatly increase in the future.

Project Richmond – The Richmond programme in NGGT is all about the route to better asset management – fixing the basics and getting our foundations set up so the business can continually improve. As well as considering the fundamentals of asset management, Richmond is about enabling the business – cutting away some of the problem handovers, making the data and information and how we make decisions more central, which in turn enables people to make their workloads easier. The style of their approach is different, as the team does not spend months tackling requirements – these are already known. Instead, they implement a more agile method of delivering the work. The work is broken down into bite-size pieces and worked on over two-week sprints. Business experts are involved throughout and there is a playback to the GT Leadership Team every two weeks, meaning no more than two weeks of work is invested without business input and direction.

Ideas into Action – Ideas into Action was created in 2016 to identify, validate and promote best practice across NGGT. The aim of the programme is to encourage all employees to submit ideas to the innovation .box account, large or small, about improving our ways of working and finding a better way. A simple submission process was established to ensure it was quick and easy for employees to submit ideas. Over 80 ideas have been submitted to Ideas into Action to date, from St Fergus to Warwick, demonstrating the number of good ideas in the business that were previously untapped. A specific example of a project was a unified approach to applying for the IET Regulation subscription; historically this was done individually but a central, digital licence was applied for saving just under £30,000 to date.

Our RIIO-2 Plan:

- Business-funded innovation has proven value delivered within RIIO-1 and the success of this is recognised as part of our ambitious plans for BAU-funded innovation from our TOTEX allowances in RIIO-2.
- Our Innovation Strategy focuses on an equal split of innovation investment across BAU TOTEX-funded and allowance-funded innovation.
- This approach will ensure a diverse and active range of innovation projects that are focused on delivering valuable outcomes for our stakeholders and driving efficiencies across the work we do.

Embedding Innovation and Quantifying the Value

We have focused effort to ensure innovation is no longer an add-on, but a key component when planning anything from our large construction projects to ad hoc works on site. This will ensure we are embedding innovation within existing business processes and successful projects are implemented wherever relevant.

A key success has been the update to our ND500³ process for investment. We have embedded innovation requirements within the process, ensuring that as part of the planning process, all completed innovation projects are considered for their suitability to be deployed as part of the work. We are also working closely with the Project Delivery Teams to develop a more robust process to identify areas where innovation could be developed to support specific issues that arise. For example, as part of recent construction work at our Peterborough and Huntingdon sites, the Composite Transition Pieces were identified as a suitable innovation to be implemented and have been installed as part of the wider site works.

³ NGGT process for managing regulated investments from inception through to closure. The only exceptions are fleet, property and IT investments.



Our recent organisational restructure has seen the creation of a Senior Innovation Manager role, which allows us to continue our focus on embedding innovation within our business operations and empowering our employees across the whole organisation to bring change and real innovation. Embedding successful projects within the business is by far one of the biggest challenges we face within innovation. It was identified by our stakeholders in our survey in 2016 as the area requiring the most improvement. We've been working hard to understand how to achieve this and implement changes that facilitate innovation to be embedded within the business at a greater pace.

Quantifying the value of innovation can be a challenge, especially where intangible benefits are generated, or benefits realisation overrun the current price control period, proving difficult to quantify the true value realised by a portfolio delivered, for example, within RIIO-1. By innovating, we can be more efficient in how we operate, which in turn can drive savings to our customers. Innovation can take some time to deliver a positive return, following investment in development and roll-out. This often results in benefits in the medium to long term, usually outside of the price control period, which can be difficult to justify for BAU-funded innovation, emphasising the value that the innovation funding mechanisms bring. This is especially true for service-based innovation as financial benefits are more difficult to quantify compared with asset-based innovation, as benefits are delivered for the wider system, and in some cases, outputs can only be implemented across the whole system.

£9.2m benefits have been realised to date across 12 projects, which represents a 4:1 return across a total PEA spend of £2.1m.

Innovation Value Tracking

There is no one-size-fits-all method for value tracking, so our approach has focused on developing a robust methodology that allows the flexibility to capture a range of benefits, both tangible and intangible, whilst ensuring the data is accurate and verified. We have developed a set of processes and controls that enable us to identify potential benefits and subsequently test the values we associate to these, ensuring figures accurately represent the value achieved. This is compared with the expected value set out within the Project Eligibility Assessment (PEA) at initiation.

We have been working hard to build on the Innovation Value Report that was first completed in March 2017. We worked closely with PwC to establish the checks and balances to verify our approach and have developed our processes to allow us to roll out the methodology across our projects when they are implemented.

Following an update to our portfolio management tool from Focal Point to Decision Focus Now (DFN), we track these and review the implementation process at predefined times depending on usage expectation.

Where projects have been implemented, they are categorised in three ways:

- **Implementation Complete** – Fully implemented and no further value is expected – one-off cost or benefit.
- **Annually Accruing** – Each year we expect a recurring value achieved. A validation exercise is undertaken to confirm the additional benefit has been achieved.
- **Per Use** – There have been specific applications that have been quantified and recorded, but further applications would require specific analysis.

Building on the publication of the first Innovation Value Report, each project that has been implemented has a case study completed, which is backed up by the source data, a checks and balances checklist and a 'Data Point Definition', which details the rationale and calculations used for all figures within the case study.

This approach was developed as a result of the work with PwC to produce the Innovation Value Report and ensures transparency in our value tracking process. The projects currently being tracked and with case studies completed are listed below. Our case study library can be found on our website: www.nationalgrid.com/gasinnovationvalue

These three tables detail the latest position of the value delivered by our portfolio and includes the value delivered from a range of scenarios including cost avoidance/savings, value delivered to our customers through reduced cost or time and efficiencies brought through process improvements:

Implementation Complete

Project Title	PEA Cost	Benefits Realised
Vent Stack Design	£180,000	£84,000
Hot Tap Buried Sample Probe	£610,000	£1,300,000
CP for Pipelines in a Tunnel	£32,000	Safety and new policy (CCP/9)
Total	£822,000	£1,384,000

Annual Accruing Benefits

Project Title	PEA Cost	Benefits Realised
Safety in PIG Trap Seals	£42,000	£50,000
A Greener Generation of Air Compressors	£175,000	£651,000
Total	£217,000	£701,000

Per use Benefits

Project Title	PEA Cost	Benefits Realised
Impact Protection Slabs	£32,000	£767,000
Customer Ramp Rate	£58,000	£80,000
BIM at Bacton BIM at Peterborough and Huntingdon	£490,000	£3,700,000
Improving CP Data with MiniLog	£20,000	£144,000
Portable Valve Actuation	£97,000	£680,000
Mini Grouted Tee	£147,000	£817,000
Total	£844,000	£6,188,000



Independent assessment, challenge and validation is key to providing a transparent benefit measurement process that our stakeholders can have confidence in.

Benefit Measurement Framework

The value of innovation cannot just be tracked by the return on investment; there are broader factors to consider, such as the change in culture, approach to innovation and quality of interactions. Culture is difficult to assess and capture, as is the quality of the relationships and collaborations network companies form through innovation projects. In March 2018, the Energy Innovation Centre (EIC) consortia engaged with Baringa Partners to develop a set of outputs that could be used to measure the outcomes of innovation. Initially, restricted to EIC members, the second phase was opened to all networks, which is when NGGT joined. The approach taken was centred on using a framework model to ensure a range of output measures covered the full suite of innovation activities that network companies undertake through the innovation life cycle. The approach will ensure the consistent and transparent measurement of innovation cost benefit and value delivered across all network companies.





The result is the first iteration of the Benefit Measurement Framework (as shown on the next page).

The framework provides a scorecard-based approach to allow an assessment of network companies' performance across a full spectrum of innovation activities, irrespective of funding source. The measurement framework is based around Outcome Measures, which are focused on outputs (bold text on the framework) and Secondary Indicators which are more supporting inputs. To date two networks have participated in trials of the framework and have demonstrated that it is possible to report against most of the measures.

Key to the development of the framework has been engagement with our stakeholders. We have attended engagement sessions with Ofgem, Ofwat, the Department for Business, Energy and Industrial Strategy (BEIS), Sustainability First and EnergyUK and there has also been an engagement session with the Citizens Advice Bureau. Feedback has been positive with support for the framework. One key point of feedback has been around how to ensure 'independence' in reporting network company performance. One solution is that requirements to report against the measures in the framework come under any innovation governance requirements that apply during RIIO-2.

Benefit Measurement Framework (Example Template)

Higher-level enablers of innovation

 Strategy and Vision	A clear innovation strategy linked to what consumers and stakeholders value – including plans for roll-out			
	A strategy is in place and has been approved by Ofgem	Trials which focus on improving areas of service that customers value	Number of innovation projects that are aligned with strategy	
 Organisation and Culture	000 Number of external parties involved in trials	000 A culture of innovation (survey)		00% Percentage of annual revenue spent on innovation projects
		000 Percentage of network company funding in innovation trials	000 Number of FTE working on innovation projects	
 Capability and Technology	000 Annual average number of innovation ideas	00% Distribution of the readiness level of projects by volume and funding		000 days Average time taken to deploy projects
 Results and Outcomes	00% Percentage of ideas taken forward	000 Forecasting and tracking innovation benefits		00% Percentage of mature innovation moved into BAU

Initiation and Evaluation

Demonstration, Iteration and Learning

Deployment and Optimisation

Progression of innovation over time

Our RIIO-2 Plan:

- Key to delivering value from innovation to our customers is to have a robust process for rolling out successful innovation. Our ambition for RIIO-2 is to embed a process that provides the tools to enable the business to take a completed innovation project and assess its suitability for roll-out and where relevant accelerate this roll-out to maximise the value gained.
- Our work to track the value of innovation is key to achieving this. We have established a robust process to quantify the value, validate the data and track throughout the lifecycle of the innovation. The challenge we face in RIIO-2 is to accelerate assessment of all innovation programmes and clearly articulate action plans to unlock any opportunities and ensure the turnaround of projects to allow swift implementation. Throughout RIIO-2 we will continue to complete value tracking and producing the case studies; building on the format from RIIO-1. We will also focus on many of the challenges we face with tracking benefits, such as being notified when an innovation has been used within the business. To address this, we are looking at the Procurement and IT system notifying the team directly when an innovation product has been ordered.
- Benefit Measurement Framework Development – With a successful proven concept for the Benefit Measurement Framework, we will seek to continue development and report on our innovative activities against this, using our Value Tracking Process to identify financial returns on projects.
- Following a collective workshop, all gas and electricity networks have agreed to come together under the Energy Networks Association (ENA) and detail a common way forward with respect to benefits reporting. It has been agreed that all networks will take on the Benefit Measurement Framework developed by Baringa as a starting point, with the agreement to carry out further refinement.
- The resultant framework, which will be the second iteration of the Benefit Measurement Framework would form the basis of the gas and electricity networks' proposals for Benefits Reporting in RIIO-2.
- Key to the success of our Innovation Value Tracking and Benefit Measurement Reporting will be independent validation and scrutiny. Our plans laid out in this strategy identify the need for the National Grid Gas Innovation Panel (NGGIP).
- NGGIP – The role of the RIIO-2 Independent Stakeholder Panel has been crucial to the development of our business plans and has added significant value, in particular to the development of this strategy. As we progress into RIIO-2, we are committed to securing an independent panel to challenge our innovation ambition, performance and strategy. Discussions around the role of the Independent Stakeholder Panel are ongoing. Once the roles and outcomes are confirmed we will seek to engage with this panel or establish a new panel with key representatives.
- The role of the NGGIP will be crucial to holding NGGT to account on Value Tracking and will play a critical role in scrutinising performance against the Benefit Measurement Framework and identifying an action plan for improvement year on year.
- To provide a baseline of the Benefit Measurement Framework in readiness for RIIO-2, we plan to publish an initial assessment of NGGT against the framework in 2020. This will be challenged in the first instance by the NGGIP; however, if circumstances mean this is not in place in time, we will engage with independent stakeholders for this initial publication.

Our Innovation Survey

In September 2016, we asked more than 100 of our external innovation partners and internal project leads to complete a survey to help us understand our innovation performance and where we can improve. We had excellent uptake, with responses from 43 per cent of our contacts, of which 29 were external and 18 internal stakeholders. The survey included questions on all aspects of the innovation project lifecycle, from idea generation through to implementation of project output. On average, across all measures, we scored 3.6 out of 5 – a good performance across our innovation activities to date.

As a result of the survey, we identified a focus on implementing successful outputs from the innovation portfolio. With just 23 per cent of respondents scoring us good or very good at transitioning projects into BAU, this was a key priority for us. The projects from the first few years of the NIA scheme have helped us identify blockers. Notable problems include procedural changes, amendments to specifications and work procedures, and procurement and contractual challenges when suppliers or products are not mainstream. Often these challenges can be overcome but do introduce significant delays. It became clear early on that checks to identify implementation actions earlier in the process would be very beneficial. However, there are still several improvements to be made in this area.

For a broad view of our performance in cultivating and delivering innovation, we wanted to engage with our stakeholders to understand how they thought we had performed.

Measure	Score out of 5
Support from RIIO team	4.3
Openness to new ideas	4.0
Support from GTO Team	4.0
Project administration	3.7
Technical knowledge	3.7
Knowledge dissemination	3.6
Technology scouting	3.5
Innovation sanctioning process	3.5
Project management	3.5
Commercial negotiation and contract	3.4
Advice/assistance from other NG reps	3.4
Transitioning projects into BAU	2.5
Average Score	3.6

Our RIIO-2 Plan:

- Innovation Survey throughout RIIO-2 – we launched our Innovation Survey in October 2019 with the results expected by the end of 2019.
- The purpose is to gauge how our stakeholders think we have performed and form a comparator for our September 2016 results. This will allow us to understand where we have improved, but more importantly to understand where we still need to improve.
- We will seek stakeholder feedback on a range of areas including ease of working with NGGT, ease of our processes, how receptive we are to new ideas and how well we embed successful innovation into our business
- We will share our results through a number of our communications channels, with full details published in our Annual Summary in July 2020.

Chapter Three

Driving an Innovative Culture

Having an embedded innovation team within National Grid Gas Transmission allows projects to be led through the Ofgem governance process. However, to ensure projects solve business challenges an innovation culture is required across all levels of the business. Every employee has the responsibility to think innovatively in their role and has the tools, space and backing to do so. Driving this culture is difficult and takes time but can lead to an effective innovation portfolio that is rolled out to the business deriving significant benefits. In this chapter we will discuss:

- Embedding a culture of innovation
- Innovating across the National Grid Group
- National Grid Board – innovation charter



Embedding a Culture of Innovation

Across National Grid we have a core set of values which drive our culture and help us deliver for our stakeholders and communities. We know that how we deliver is as important as what we deliver. If our purpose is the 'why', our values are the 'how'. They help shape our spirit, attitude and what guides us. We have to adapt and develop our values to align with the expectations of our customers and communities, without losing sight of the things that make us strong today.

There are two key commitments we have made, which drive our business culture and provide a foundation for innovation to play a key role:



Do the right thing

- Keep each other and the public safe
- Comply with all relevant rules, regulations and policies
- Respect our colleagues, customers and communities
- Say what we think and challenge constructively.



Find a better way

- Deliver excellent performance for our customers
- Share knowledge and implement best practices for continuous improvement
- Make decisions and implement quickly
- Embrace opportunities to grow ourselves and the business.

Our values build on and protect our strong foundations while looking to the future. They are aligned to our purpose and help our people understand how we are expected to achieve our purpose and vision for our customers and each other.

At the core of our culture we seek to do the right thing and find a better way, and this is where innovation is key. Innovation can unlock the potential and allow us to maximise the opportunities in everything we do. Embedding a cultural change such as innovation does not have a defined period. The efforts we have made over RIIO-1 to date have clearly begun to embed innovation into our core culture but there is still some way to go.



We have implemented clearer processes and lines of accountability to empower our teams and develop a diverse portfolio of projects with third parties of all sizes and geographical locations. Within certain areas of our business we have found a cluster of innovation has occurred. This may be due to a mix of reasons including there being a wider range of third parties with feasible ideas and colleagues with a greater focus and freedom to work on innovative programmes.

We have learned from how these successful clusters of innovation have developed in order to help areas of the business with little or no innovation to engage further to develop successful projects and identify new opportunities to innovate.

Our RIIO-2 Plan:

- Building innovation into our employees' personal objectives – Innovation objectives were introduced and then removed from some of our Gas Transmission Teams. However, they could give clearer lines of accountability and empower our employees to dedicate time and embed innovation into their roles, rather than having to work on innovation on top of their existing roles, which is sometimes the case.
- Clearer decision making and ownership regarding risk – We have progressed as an organisation to encourage an approach of risk mitigation rather than risk avoidance where new, unknown techniques and technologies are to be trialled that offer significant benefit to our customers. However, decision making around acceptance of risk can be unclear. We have committed to improving decision making across our organisation and to empower our employees to make decisions in a timely manner with the right information.

Innovating Across the National Grid Group

Innovation is integral to National Grid, in both our core regulated business in the UK and US, and National Grid Ventures.

In our core regulated business, innovation is an important factor in continuous improvement. We aim to make things better for customers and communities, while being more agile, flexible, responsive and maximising value. Our innovations are grounded in making tangible and necessary improvements:

- Increasing efficiency to minimise costs for energy customers
- Maintaining maximum reliability of energy supply
- Facilitating the transition to a decarbonised energy system
- Improving our customers' experience
- Improving safety.

We have a unique position at the heart of the energy system. This gives us the opportunity to facilitate engagement between people and organisations to boost collaboration and find and implement solutions.

Throughout RIIO-1 we have developed our methods to engage across our business areas in order to share best practice and any potential projects or ideas that could be of interest. This has meant working with our Electricity Transmission business within the UK, our Gas business within the US and our non-regulated business: National Grid Ventures and National Grid Partners (NGP) which have been recently formed. Prior to the formation of NGP, we utilised a knowledge sharing forum to link our UK and US businesses together to share innovative developments, identify common areas of challenge and understand how we can work better together. Following the introduction of NGP there are now regular meetings to share information and potential projects on a more regular basis. This investment part of the business also could invest in companies across the globe that can support National Grid in our challenges.

Our Gas business in the US is distribution focused and therefore many of the challenges they face do not translate across to NGGT in the UK. However, we have focused on areas of crossover such as robotics, notably when developing Project GRAID. We worked to share knowledge, linking on the CISBOT⁴ robot which has also been utilised in the UK by Cadent and SGN. In addition, we shared knowledge on the robotic development of Pipetel (<http://www.pipetelone.com/>) in the US to ensure any potential best practice was shared.

Our RIIO-2 Plan:

With the launch of NGP, we have strengthened our innovation capability across National Grid with a more focused view of innovation and a Centre of Excellence for Innovation is under development. NGP is 100 per cent funded by shareholders and plays an important role across National Grid by investing and managing equity investments in strategically relevant start-up ventures aimed at disruptive innovation. The team is working across all business entities to understand the challenges we face within innovation and identify common areas where we can collaborate to gain the greatest value for stakeholders.

There is a significant opportunity for a more coordinated and focused effort on innovation across our organisation. Throughout RIIO-2, NGGT will work closely with all organisations across the National Grid Group, leveraging opportunities to collaborate with:

- **National Grid Electricity Transmission** – focusing on innovating to overcome the challenges and exploit the opportunities for the whole energy system.
- **National Grid US** – sharing knowledge and experiences and focusing on best practice across the organisations, whilst exploiting opportunities to collaborate with US utilities alongside our US counterpart.
- **National Grid Partners (NGP)** – disrupting our ways of working and seeking the most cutting-edge and challenging innovations that have the potential for game-changing impact across our organisation.

⁴ CISBOT is a cast iron pipe-repair robot that seals the joints in natural gas pipelines from the inside.

National Grid Board – Innovation Charter

Our independent User Group and the Ofgem Challenge Group have set a high bar on our regulatory proposals. We are committed to innovation across our organisation and to support this we have set out an Innovation Charter to guide our activities across National Grid, which our Board of Directors has endorsed:

Ambition

We will innovate to create your network of the future and facilitate UK decarbonisation.

Approach

Our innovation approach is based on four pillars: Three 'what's' and a 'how'.

Fit for the future (2021-2030)

- Ensuring and preparing our assets so they can be used in a decarbonised future.

Ready for decarbonisation (2025-2050)

- Investigating how our network will transport a mix of gases and the technologies required.

Decarbonised Energy System (2021-2050)

- Looking at how a Hydrogen future will work commercially and the markets and system operation required, including interaction with other sectors such as transport.
- Delivering innovation benefits in RIIO-2 and embedding a culture of innovation across the business.

Commitment of the Board

Innovation is integral to our business. As the Board we will make things better for customers and communities, while being more agile, flexible, responsive and maximising value.

Therefore as Board members we will commit to:

- delivering on the ambition and approach outlined in the RIIO-2 business plan.
- take responsibility for setting a baseline and a five year measurable target for increasing the innovative culture of the organisation.
- an annual deep dive of progress against target, forward innovation workplan, tracking of innovation benefits, and embedding lessons learned.

Learning from Others

We needed to look outside our organisation to understand how others operate, compare ourselves and learn from this to develop our capabilities further and drive our strategic ambition in innovation:

Memberships – We are active members of the UK Onshore Pipeline Association (UKOPA), Marcogaz and Gas European Research Group (GERG). These organisations bring together academics, scientists and engineers to help address the challenges facing the whole global gas value chain such as reliability, health, safety and the environment. Additionally, we are members of the following groups.

Name	Description	Indicative cost p.a.
Pipeline Research Council International (PRCI)	Global collaborative research development organisation of, by, and for the energy pipeline industry	£200,000
European Pipeline Research Group (EPRG)	Registered association of European pipe manufacturers, pipeline operators, installation contractors and service-providing companies	£55,000
Risk Assessment Methodologies for Pipelines and AGIs	Specific research group into risk assessments for pipelines and above ground installations (AGIs)	£85,000

These committees allow National Grid to be a part of international discussions regarding the topics of decarbonisation, decentralisation and digitalisation, learning from the lessons of others and utilising best practice in the projects we are implementing. These groups also give insight into innovation culture in different types of organisations: those with state funded research departments and those with and without regulatory funding. One such example is communication between NGGT and SNAM6 based in Italy, which has successfully injected hydrogen into its transmission network to be used by two of its customers. The lessons learned from this project will help to lead our own hydrogen injection project.

Within the UK we are a member of the Risk Methodologies Group, which focuses on the risk side of the gas industry. Through this membership we were made aware of an impact protection slab innovation project and after further investigation have rolled this concept out to our own internal operations. The slab prevents the need for an expensive and time-consuming task of fitting a concrete slab over the pipeline, but still provides the protection needed above a buried asset. Since the inception of the new composite slabs there have been more than 150 fitted with a further 100 slabs being ordered, equating to a financial saving of more than £750,000 alongside the safety and time benefits. These tangible benefits will continue to be tracked and logged into RIIO-2.

International Benchmarking – For almost 30 years we have been active participants in a variety of different benchmarking groups. We were instrumental in establishing the Gas Transmission Benchmarking Initiative (GTBI). Participation in benchmarking groups such as GTBI allows us to share and gain knowledge across transmission system operators, identifying and learning from best practices. Our benchmarking lead was part of the same department as innovation for several years. Within this group, we have shown that we hold a leading position in terms of operation and maintenance. An example involves the current River Humber pipeline replacement project. GTBI membership allowed the opportunity to learn from the experience of another Transmission Service Owner (TSO) undertaking a similar construction project. Several lessons learned by that TSO were shared, resulting in our project design avoiding significant costs.

Our RIIO-2 Plan:

- **Continuation of International Benchmarking** – Our membership of GTBI will continue throughout RIIO-2, where we will seek to share ideas across the collective members and also explore good ideas we learn about through the channel. There are often opportunities for the business to present at the regular events hosted by GTBI and this should continue in the coming years.
- **Agile Workplace Environments** – Although technology can boost productivity and efficiency, few of those benefits can be realised without engaged employees to drive creativity and innovation. One solution to today's business challenges is the concept of the agile workplace. The environment that employees experience on a daily basis can impact innovation hugely. There needs to be space to think, tools to allow ideas to generate and develop and areas to showcase ideas which may lead to follow-on projects or extending user cases. Developing our working environment to aid innovation will continue into RIIO-2 and where possible space will be made available for this purpose.
- **Continued Participation in the Memberships** – These key professional memberships bring value to NGGT by leveraging global knowledge and thinking on key issues facing the Gas Transmission industry and related issues. NGGT is committed to funding projects under the memberships so that National Grid assets and locations are used to drive benefits for the business. One such example is a remote sensing project using satellite imagery across pipeline river crossings where NGGT has submitted the Feeder 9 Humber Estuary as a trial location. Images will be taken over a long period of time to show the changing landscape. This technology could also have the potential to ensure our assets are monitored regularly, helping to prevent third-party interference.

Chapter Four

Driving Collaboration

Stakeholders are at the heart of how we innovate. They have been key to the success throughout RIIO-1 and have an increasingly important role as we transition into RIIO-2. The Energy Networks Association (ENA) was set up to represent all gas and electricity networks and has facilitated collaboration between the members. The good work completed in RIIO-1 will now be built on as we prepare for RIIO-2, continuing the great events and workshops we attend and present at. In this chapter we will discuss:

- Collaboration at the heart of innovation
- Engaging with the ENA and other networks



Collaboration at the Heart of Innovation

Collaboration is at the heart of how we innovate. It allows us to branch out into wide-ranging innovation projects and develop a safe, reliable and efficient gas network for the future. We are always on the lookout for new ways to engage with colleagues, stakeholders and the wider gas industry. Throughout RIIO-1 we have developed strong partnerships and worked collaboratively to share learning between ourselves and other network licensees. Throughout our extensive engagement with stakeholders, NGGT has developed a set of Gas Transmission Stakeholder Priorities. These focus on delivering industrial and domestic consumer priorities to ensure we have a business plan fit for our stakeholders.

Working closely with our stakeholders we will continue to engage around our RIIO-2 plans to ensure our strategy for innovation delivers what they need and helps build the gas transmission network of the future. The RIIO-2 Independent Stakeholder Group has played a pivotal role in the development of our Innovation Strategy for RIIO-2. As we continue to develop the strategy we will keep this engagement ongoing.

Throughout RIIO-1 we have engaged with our stakeholders, reaching out through both formal and informal channels to ensure

that our innovation priorities and activities have remained aligned to our stakeholder needs. This includes direct email and telephone calls, calls for ideas via email, social media and engagement through the Energy Networks Association. We have remained committed to being accessible and transparent to our stakeholders and reach out at key moments, whilst endeavouring not to overburden them with excessive requests to engage and respond. We issued our Stakeholder Survey in September 2016 to more than 100 of our external innovation partners and internal project leads to help us understand our innovation performance and where we can improve. This helped us focus on areas to improve, including our processes for onboarding third parties and transitioning projects into BAU.

With the channels established to learn from external stakeholders and organisations, we have been able to feed this learning into our organisation, understanding how others innovate, how we can improve and a focus on developing and nurturing a culture of innovation within our organisation. Utilising existing channels and developing new forms of engagement, we have developed our communications channels significantly for innovation.

Type	Name	Detail
Conference – Presenting and Exhibiting	Low Carbon Networks and Innovation (LCNI)	NGGT has attended the LCNI conference since its inception in 2014 and has presented many of the innovation projects alongside a stand to display them. It is an excellent platform to share new knowledge generated across the networks and find fresh ways to collaborate.
	Utility Week Live	Bringing together more than 150 innovative SMEs from the UK's utility industries including water, gas and electricity companies. NGGT has exhibited and presented on several occasions. In response to stakeholder feedback the combined gas networks sought an alternative to LCNI 2019 and trialled dissemination of innovation through the Gas Innovation Showcase (GIS) at Utility Week Live. Feedback following the event has been positive with six times the footfall and a broader range of attendees than previous conferences. The joint stand was the highest rated feature at the show and allowed stakeholders access to all gas networks in one area. We are currently in discussions with the ENA and networks around the future of GIS at Utility Week Live.
	Network Innovation Collaboration Event (NICE)	The Network Innovation Collaboration Event brings together networks, stakeholders and SMEs to learn from others outside of the gas industry on how they innovate. We want to challenge not just what, but how we innovate so we can drive real change to our culture. By doing this we can be better innovators and deliver the decarbonised gas and electricity networks of the future.
Conference – Attending	Various	Engineers and the Innovation Team at NGGT have attended a variety of events throughout RIIO-1 to learn from industry experts, collaborate and network with peers. Some of the events are: World Gas Conference 2015, Pipeline Technology Conference, United Kingdom Onshore Pipeline Operators' Association (UKOPA), Pipeline Pigging and Integrity Management, Pipeline Maintenance and Integrity Management and the Big Bang Event. We are also active members of the Innovation Roundtable, an organisation that unites innovation professionals from large, multinational businesses at events throughout the year. It also focuses on the culture and behaviours of innovation in business that can be transferred between industries and is a shared challenge.

Continued on next page...

Type	Name	Detail
Call for Ideas	NIC Calls	With support from ENA, NGGT have been involved in several calls for NIC ideas. This method allows a consolidated approach to communicating to potential collaborators. The most recent of these calls focused on a joint gas and electricity NIC concept, which was well received.
	Idea Calls	Specific targeted calls for innovative ideas and challenges in specific areas, to broaden promotion of the team and our openness to receiving ideas no matter how big or small from anyone within the organisation.
	Idea Hacks	Targeted specific sessions that are focused on specific challenges and bring together business experts and third-party experts to explore options and develop ideas that can lead to innovation projects.
	Ad Hoc Ideas	The concept of a call for ideas can be used for assisting on specific topics and this has been carried out several times in RIIO-1.
Newsletters	Newsletters NGGT Innovation Newsletter	A summary of the progress on a wide variety of innovation projects and access to the team, currently the newsletter is for those who have expressed an interest internally within National Grid but there is a view to extend this to external stakeholders.
	Internal Comms	Alongside the specific Innovation Newsletter, projects are often featured on internal channels such as the Intranet, 'GT News' and 'At a Glance' newsletters, which are distributed across the wider National Grid company. In addition, we use our internal channel for communication with teams called 'Team Talk' to raise awareness of innovation projects and activities and encourage colleagues to get involved. We also attend specific business unit team meetings to provide more focused discussions on innovation relevant to that team.
External Website	Website	The team has an externally facing website (https://www.nationalgridgas.com/insight-and-innovation/transmission-innovation) which hosts project examples and a method of contacting the team.
Social Media	Twitter LinkedIn	NGGT and the wider company have social media handles which are used frequently to advertise and promote projects on these platforms.
Internal Events	Stand Down Events	To coincide with the Operations Team stand down days, members from Innovation have taken the opportunity to exhibit to the wider business on projects that directly impact their day jobs. These events generate a good amount of new ideas and help to promote and develop existing ideas that could be used in other areas across the network.
	Operational Site Visits	Visits by our Innovation Team to operational sites to see the opportunities and challenges our Operations colleagues face and to discuss potential areas for Innovation to support. Given the geographical diversity of the operational teams this has been one of the more challenging areas.
	Demo Events	For large-scale projects, such as the NIC projects (GRAID and CLoCC), demonstration events are hosted for both internal and external stakeholders. During the events, there is an opportunity to see the innovation in action and ask questions directly to the teams. Additionally, demonstration events have been hosted internally at the National Grid Head Office in Warwick such as an Innovation Week to show real examples and models of the projects to help tell the story and generate other ideas or applications.
	Internal Idea Hacks	Our internal innovation idea hacks drive improvement to our culture of innovation, bringing our organisation together to exchange ideas. As a result of these hacks, several smaller BAU innovation projects to improve processes and systems have begun.
	Engagement across NG Group	We have worked hard over RIIO-1 to engage across the NG Group, establishing forums such as the Innovation Steering Group for communications and brand, the coordination of deliverables such as the Annual Summary and showcases such as the LCNI conference. Wherever possible we have engaged with our ET and ESO colleagues to coordinate on engagement and have been working closely with ET on our RIIO-2 approach. We have also held sessions with National Grid Partners and our US colleagues in the form of deep dives and monthly catch-ups on innovation projects.

Engaging with the ENA and Other Networks

NGGT has developed a strong working relationship throughout RIIO-1 across the various network sectors, incorporating the Electricity Transmission and Distribution Networks:

- The ENA represents the gas and electricity networks and coordinates the Innovation Forums for gas and electricity. The ENA has remained a pivotal part of this relationship, allowing the coordination of activities and representing the energy vectors. These forums are key to sharing knowledge, collaborating on new and existing projects and coordinating idea calls, events and any other areas that require joint gas and electricity coordination.
- The GIGG is a forum that helps drive efficiencies and maximise value to the work we do. GIGG meets monthly to share knowledge on current innovation projects and discuss how we can work together to meet future challenges. The group represents innovation across the gas industry and has strong links into the equivalent electricity group (The R&D Managers Group). Within GIGG there is a regular agenda slot each month to discuss new projects, consider any potential overlap and to report on progress of key projects which have collaborative interest and value. Some highlights from collaboration with the group include the delivery of the Gas Network Innovation Strategy, several events such as the IGEM Affiliates Event in 2017 and the development of the Implementation Log to track innovation projects that are being rolled out. Collaboration across the group is discussed on a case-by case-basis, ranging from being a full-funding partner through to involvement in key strategic workshops and supporting specific outputs of a project. This aspect of the forum is one we would seek to strengthen particularly if there are multiple funding streams in RIIO-2 and the number or complexity of projects becomes greater.
- The R&D Managers Group meets quarterly and is equivalent to the GIGG group for electricity. Through GIGG, we have engaged in many cross-group activities to bring gas and electricity networks together to collaborate on common challenges. One of the notable outputs was the launch in 2018 of the joint call for NIC project ideas, which was coordinated by the ENA and invited cross-vector or vector-specific project ideas.
- Engagement with the EIC – Through the various workshops and work around the Benefit Measurement Framework, we have engaged with the EIC, gaining an insight into the perception of NGGT from the EIC and the SMEs they represent.
- Other forums and groups such as the Gas Futures Group, which has recently launched the Gas Decarbonised Pathways Project and the Hydrogen Programme Development Group (HPDG) which brings together the gas networks to focus on the challenges and opportunities that hydrogen presents. We continue to seek new ways to collaborate and develop our efforts to ensure that there is no duplication not only in the projects that we do, but in the associated work to identify new ideas, reach new partners and engage with our stakeholders.

Building on our Collaborative Efforts

Throughout RIIO-1 we have developed our capabilities to ensure that we reach a much wider representation of stakeholders than we had previously. In doing this, we want to ensure we have access to the appropriate third parties, with the most suitable ideas that meet the challenges of our customers and business. We recognise there is always room to improve and that within the first few years of RIIO-1 it took some time to grow our network of third parties and build the necessary relationships to deliver successful projects. It was noticeable that the asset experience and expertise for a high-pressure gas pipeline system were relatively niche, and outside of the experience of many third parties, even those who had worked with the GDNs.

However, our efforts over the past few years have led to a significant shift in the profile of third parties that we work with. Several new small SMEs have developed their own ideas and technologies, which we have supported through our innovation activities. An example is our 'Open Source SCADA' project with Lagoni Engineering, which aims to eliminate the complexity and cost that is inherent in SCADA7 systems, whilst improving our cyber security. Lagoni has brought a new perspective and has revolutionised how we can consider cyber security at our compressor sites. Working closely with NGGT Lagoni has been able to develop its capabilities in the gas sector, gaining a greater understanding of the challenges facing us and the other networks. This has resulted in another innovative solution focusing on cyber security at our above ground installations, known as Secure AGI.

A key element to diversifying and expanding our range of the parties that we work with has always been through engagement such as conferences and other events, calls for ideas through formal channels such as the ENA and more informal ones such as the use of LinkedIn and other social media platforms and existing mailing lists.

Innovation Survey October 2019

As part of our July plans, we set out our plans to launch a follow-up to our 2016 Stakeholder Survey. We remain committed to being as accessible as possible to third parties and a key component of this is to understand from our stakeholders how we can improve further to enable new and existing third parties to further innovate with us. We will share our results through a number of our communications channels, with full details published in our Annual Summary in July 2020.

We want to understand from our stakeholders how we can improve to unlock opportunities for a wider range of third parties to innovate with us.

Innovation Insights Newsletter Launch

Our new external newsletter 'Innovation Insights' was launched in October 2019, merging several existing communication channels, including our internal monthly update and Project GRAID and

Project CLoCC external newsletters. The first edition, which was circulated to 200 stakeholders and interested parties, featured the latest call for ideas, innovation events and the launch of our stakeholder survey. Each edition of the bi-monthly newsletter will feature a leadership article addressing some of the of the bigger themes in network innovation and highlight learnings from other industries. Going forward, our focus will be on working closely with our stakeholders to understand their needs and ensure the newsletter delivers the most relevant information to them and promotes opportunities to get involved in innovation.

To view our first edition please click [here](#).



Our RIIO-2 Plan:

- **Strengthening our innovation pipeline** – Key to successfully delivering our plan is continuing the growth of our pipeline of innovation ideas. To achieve this we will continue to expand our reach to third parties and ensure we are open and accessible to engage, share knowledge and information and provide guidance and support. This will be supported by specific actions including:
 - **Supplier open days** – Providing an update on our Innovation Strategy, areas of focus and key challenges. In addition, providing an opportunity to meet key business experts to discuss ideas and gauge interest. This includes Tier 1 and Asset Health Framework supplier open days.
 - **Clearer more focused channels for communication** – Providing a central communication route (via our team email account) alongside use of social media with the offer of follow-up conversations and face-to-face meetings where necessary.
 - **Broadening the range of events attended across a wider range of sectors** – To enable us to engage with a wider range of potential suppliers and a broader range of stakeholders to identify new opportunities.
- **Engagement and dissemination of our innovation projects** – We will continue building on the foundations set out in RIIO-1. Whether this is with the other members of the GIGG via the Gas Innovation Showcase or independently as NGGT at various events. We have found huge benefit from attending, presenting and exhibiting at such events, gaining new contacts, meeting up with existing parties and discussing new ideas with the potential to become active projects.
- **Annual Dissemination Event** – Following the success of the Gas Innovation Showcase, which replaced the Gas showcase at LCNI in 2019, we will work closely with the networks to develop a strong programme of dissemination events including a refresh of the current arrangements.
- **Improving the gas and electricity networks' information provision** – Driven by the ENA we will push for greater information sharing through improved tools that enhance the Smarter Networks Portal to allow value tracking and implementation monitoring of projects. In addition we will seek to engage with stakeholders around further improvements to make information around our innovation projects more accessible.
- **Improving our innovation website** – Building on from adding our case study library to the external website, our ambition is to develop the site into an innovation hub for all the latest news and project updates. This will include dedicated pages for our big-impact projects, for example our hydrogen portfolio, GRAID, CLoCC and Captivate, and will feature innovations developed and rolled out through BAU funding. Our aim is to include a space to capture innovation ideas, making it easier and faster to reach out and collaborate with the innovation team. Feature articles of interest to our stakeholders will also be included on the website, these will be promoted through our external newsletter and social media channels.

Chapter Five

Innovating to Decarbonise Heat

The decarbonisation of our future is vital and National Grid Gas Transmission has a role to play in this. Innovation in RIIO-2 must drive towards this aim and ensure that the business and the assets which it owns and operates are ready for this future. Innovation is key now more than ever to deliver the decarbonised energy system. Our vision, innovation themes and the topics that sit below these are set out in this chapter alongside how this will be funded using a combination of funding from within each business area and an allowance. In this chapter we will discuss:

- A decarbonised future for the UK
- Our RIIO-2 approach
- Our RIIO-2 innovation themes and topics
- Putting consumers at the heart of innovation
- Funding our innovation plans
- Innovation governance:
Building on success



A Decarbonised Future for the UK

Achieving net zero will require extensive collaboration across the whole system to identify, scale and deploy the right solutions for consumers for electricity, transport, heat and industry. Through the HPDG, we have agreed a forward workplan for hydrogen projects. This forum includes members from Ofgem, BEIS, the Health and Safety Executive (HSE), Cadent, Wales & West Utilities, Northern Gas Networks, SGN, Ofgem, ENA and National Grid. The main aim of the workplan is to provide evidence that the gas network is able to support the widespread conversion to hydrogen and is a viable pathway to the decarbonisation of heat.

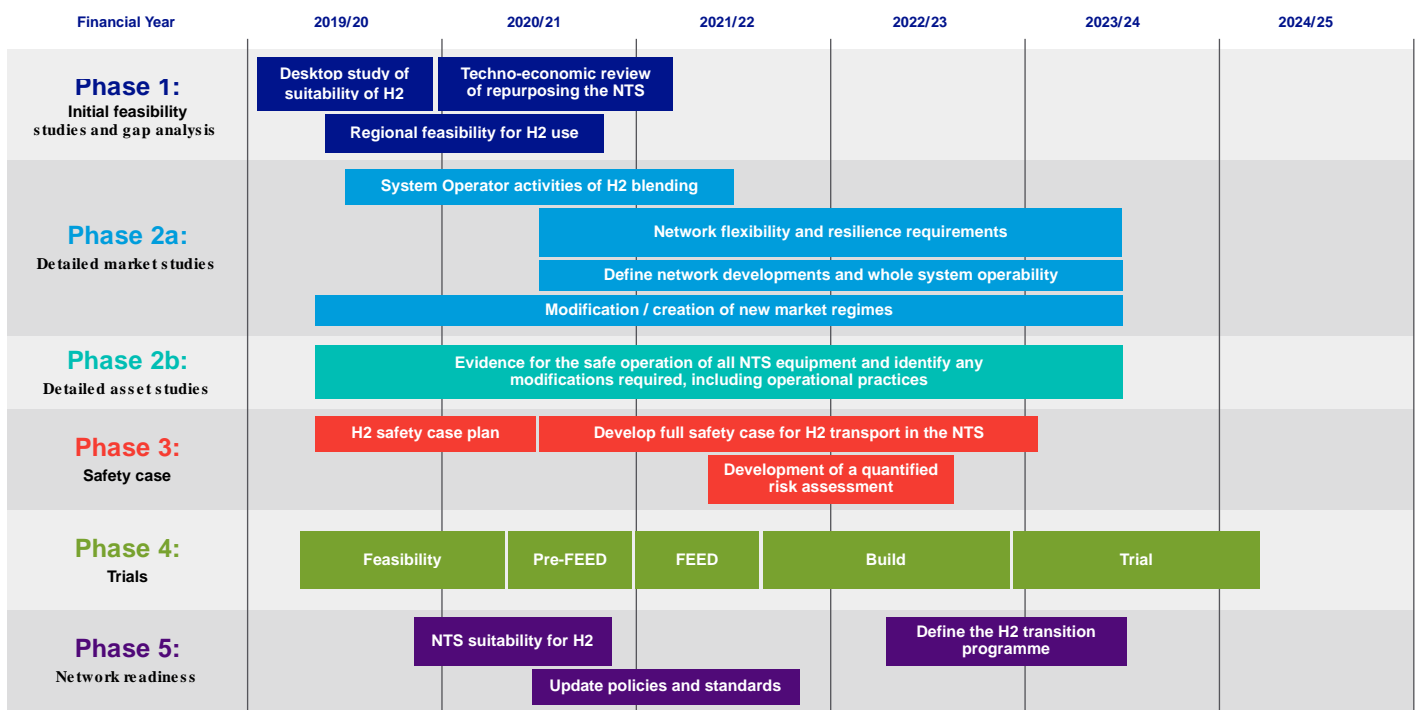
While we have a key role to play in the conversion to a hydrogen network, we also believe we should collaborate on other potential solutions, especially for heat but also for industry, transport and electricity. Examples could include (but are not limited to) other heat pathways, biogas and industrial cluster decarbonisation. We are committed to ensuring whole-system solutions are considered where possible and we understand that all networks are in a position where we should be working together to drive options forward. We will continue to work through the ENA open networks whole energy system work group.

The work group is exploring three main workstreams:

- Collaboration between network companies across Transmission and Distribution across Gas and Electricity
- Principles for a whole energy system cost-benefit analysis methodology for investment across energy vectors
- Opportunities to embed the principles of the Energy Data Taskforce.

We will partner with other networks and ensure our data, modelling and processes are consistent where possible, and we will continue to investigate the different pathways for the future energy system. BEIS will need us to carry out some of this work and to provide it with data and analysis. We are committed to working closely with BEIS and the UK energy networks to develop these plans and drive a decarbonised future for the UK.

The diagram below outlines an indicative hydrogen roadmap for Gas Transmission based on the work carried out with the HPDG:



Our RIIO-2 Approach

Innovation continues to form a pivotal part of the National Grid Group Strategy for RIIO-2 allowing the delivery of a safe, efficient and reliable Gas Transmission Network to meet the needs of our stakeholders. The NTS has a vital role to play in linking the whole gas energy network. It is central to a decarbonised energy system, with the potential ability to transport a variety of decarbonised gas mediums around the country.

The ambition of the Gas Transmission Innovation Strategy is to build and develop the work completed in RIIO-1, learn from the successes and failures of the past eight years and to ensure collaboration and dissemination across the utilities industry is promoted further. Our vision, aims and proposed themes set out in this paper will deliver the Innovation Strategy throughout the next price control period, building on the past whilst firmly focusing on the future.

Working closely with our customers, Ofgem, BEIS and third parties we will develop our strategy to ensure it is fit for purpose to deliver the decarbonised energy system the UK requires.

Closer coordination across the gas and electricity networks will be key to delivering a whole-system solution. We will ensure our activities are coordinated and welcome Ofgem's proposals for more centralised coordination across key stakeholders, policymakers and trade bodies. Recognising an ever-changing landscape, our innovation plans for RIIO-2 allow for flexibility while setting out a clear vision for innovation across RIIO-2 and beyond.

Our Innovation Vision

Innovating to create your network of the future and facilitate UK decarbonisation.

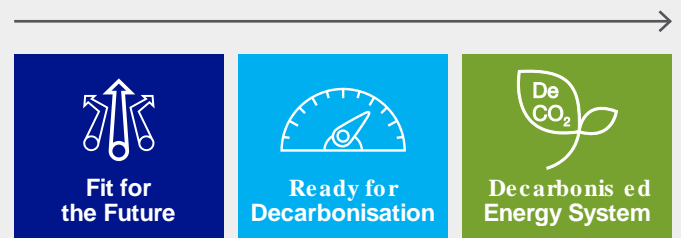
Our Innovation Aims

- Maximise investment in innovation through BAU investment and utilisation of available allowances to innovate towards a decarbonised energy system.
- Drive a programme of roll-out to ensure completed innovation projects are integrated and utilised within the business.
- Embed an innovation culture at all levels across NGGT.
- Become an industry leader in innovation that others strive to emulate.



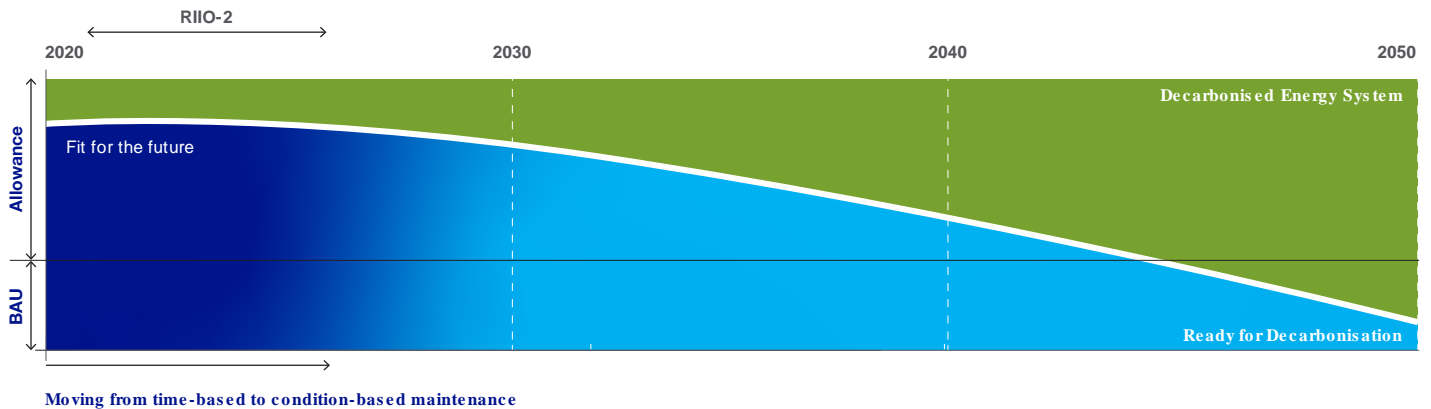
Our RIIO-2 Plan:

Our Gas Transmission Innovation Strategy can be summarised by the interaction of three main themes moving from present day to a position that the UK energy industry is completely decarbonised:



- Initially and under the name of 'Fit for the Future' we will look at innovation that can safeguard and prepare our assets for the challenges in operating for the next 50 years and towards a decarbonised future.
- As time progresses the focus will be replaced by 'Ready for Decarbonisation', where innovation will focus strongly on how the NTS will be prepared for transporting a blended mix of 'green' gases and focus on future technology to better manage the assets we own.
- Throughout this time and to an increased degree towards 2050, innovation under the category of 'Decarbonised Energy System' will become more prevalent. This theme focuses solely on how 'green' gases such as hydrogen will interact with the NTS, how trading could be managed and whether direct offakes for hydrogen could support industrial, transport and commercial markets.

RIIO-2 Innovation Theme interaction – The graphical representation below shows the interaction between our three innovation themes. Between 2025 and 2030 there is a transition of focus from ‘Fit for the Future’ to ‘Ready for Decarbonisation’. Innovation projects relating to ‘Decarbonised Energy System’ have already begun and will continue to develop at an increased rate between present day and 2050.



We are uniquely placed to drive decarbonisation and digitisation of the gas industry and will play a key role in delivering a sustainable whole energy system for the future. Our definition of the whole energy system includes the interactions and solutions between gas, electricity, transmission and distribution, whilst also taking account of the impacts of the heat and transport sectors.

Funding Innovation: considering risk – As with all innovation, a certain level of risk is inherent as new technology is trialled or studies are carried out into possible new solutions. For this reason, not all innovation can be funded as BAU. This is the reason that the allowance-funded innovation (NIA) as set out by Ofgem will be required to continue work in these areas. As shown on the graphic, BAU innovation funded from our RIIO-2 allowances that is ‘below the line’ will occur where the risks are at a level that is acceptable to the business and/or there is a guaranteed level of return to the customer that justifies the investment. Allowance innovation ‘above the line’ will only occur where there is additional incentive or funding available; an uncertainty at the success for this innovation is high, as are the risks, and a number of factors exist that could erode the return.

Within each theme are several topics that further detail the types of innovation that will be included at that time.

It should be noted that this is a view of the current market and other ideas, concepts and themes should not be disregarded if they do not fit into a defined topic; additionally topics in ‘Fit for the Future’ could move into ‘Ready for Decarbonisation’ after 2030.

Throughout RIIO-1 we have taken on board learning from our projects to help inform and develop more focused follow-on programmes of work. This has helped us to better understand the root cause of a problem we may be trying to solve in order to develop the most suitable solution. As part of our RIIO-2 strategy we will be building on these learnings to ensure future innovation projects benefit from the knowledge and experience generated throughout our organisation and the other energy networks, in order to develop a strong portfolio of projects that deliver value for our customers.

To build detail under the themes, we consulted within the business and with our external stakeholders, and utilised existing strategy documents to list various topics under each theme. The topics cover all the projects completed in RIIO-1 and allow for emerging technologies to be incorporated. It should be noted that the following is a snapshot in time for innovation and inevitably there are certain topics that are not covered but will become applicable throughout RIIO-2, and likewise topics should not be wholly restricted to the timeframes depicted.

Our RIIO-2 Innovation Themes and Topics

We have been developing our three core innovation themes focused around our vision for a decarbonised energy system, and the broad challenges we face. Building a system that is fit for the future is key, but in parallel we need to continue to develop and innovate on how this future system will operate. In order to derive the topics that fall under these themes, we have worked closely across our business to understand the challenges we face. In addition we have

considered external factors and developments in technology to identify how these play a crucial role in decarbonising our energy system. We have assessed the maturity of innovative options under each of these topics in order to identify where we believe innovation will be possible under BAU TOTEX funding and where an innovation allowance will be required. This resulted in a set of focused innovation themes and topics, as shown over the next three pages:



Fit for the Future 2021–2030

Safeguarding and preparing our assets for the challenges in operating for the next 50 years and towards a decarbonised future.

Modernising our Systems	Ensuring National Grid is operated utilising the latest in software and hardware across all its business functions. This also includes advances in wearable technology and smart Personal Protective Equipment (PPE).	
	BAU <ul style="list-style-type: none"> Innovative modules and additions to existing core software packages 	Allowance <ul style="list-style-type: none"> Implement new systems specific to the gas industry
System Readiness and Advanced Analytics	Embedded systems require a feed of rich data, leading to the ability to drive advanced analytics. Innovative solutions are required to collect huge quantities of high quality data and analyse it to provide business insight.	
	BAU <ul style="list-style-type: none"> Asset data collection techniques 	Allowance <ul style="list-style-type: none"> Bespoke analytics software
Asset Integrity Management	Confirming and maintaining the integrity of the NTS as the move towards a decarbonised energy system begins.	
	BAU <ul style="list-style-type: none"> Pigging and corrosion monitoring 	Allowance <ul style="list-style-type: none"> New methods of inspection Studies into the effect hydrogen could have on the NTS
Digitisation and Digital Twin	Migrating the large amount of hard-copy data and processes across GT and GSO into a digital format to facilitate more efficient interrogation. Investigating the part artificial intelligence can play in digitalisation.	
	BAU <ul style="list-style-type: none"> Storage solutions and data capture 	Allowance <ul style="list-style-type: none"> Smart drawings 'In-field' data capture and visualisation Digital twins and shadow control rooms
Cyber and Infrastructure	Protecting National Grid from the threat of cyber terrorism to all its operations.	
	BAU <ul style="list-style-type: none"> Core systems updated 	Allowance <ul style="list-style-type: none"> Research and trials into the latest prevention software
Robotics	Apply robotics to the operations of National Grid to automate functions or remove the need for the workforce to operate in hazardous environments.	
	BAU <ul style="list-style-type: none"> Drone application 	Allowance <ul style="list-style-type: none"> Swarm robotics Tools that remain in the network Autonomous robotics on site, in pipeline repair
Leak Detection and Emissions Monitoring	Early detection of leaks on the network and effective methods of monitoring emissions across the network.	
	BAU <ul style="list-style-type: none"> Monitor leaks from aircraft or drone 	Allowance <ul style="list-style-type: none"> Networks capable of notifying when a leak is occurring Remote monitoring of emissions using AI driven solutions
Decommissioning	The safe, controlled and efficient decommissioning of redundant assets. Effective use of decommissioned assets to aid in the understanding of the NTS and decision making for its future.	
	BAU <ul style="list-style-type: none"> New methods of removing hazardous materials from site 	Allowance <ul style="list-style-type: none"> Research and development centre on the site of a decommissioned site



Ready for Decarbonisation 2025–2050

Focus strongly on how the NTS will be prepared to transport a blended mix of 'green' gases and focus on future technology to better manage the assets we own.

Compressor Strategy	Making full use of the existing compressors to handle the changes in flow of gases around the NTS and looking towards mobile compressors.	
	BAU <ul style="list-style-type: none"> Small-scale amendments to the existing compressor strategy 	Allowance <ul style="list-style-type: none"> Mobile compressor units
Artificial Intelligence (AI) and Machine Learning (ML)	Using machines to automate tasks and making smart devices (AI) and for them to learn from the initial input of commands or information so they can make ongoing decisions without human intervention (ML).	
	BAU <ul style="list-style-type: none"> Data collection techniques 	Allowance <ul style="list-style-type: none"> Innovative algorithms AI/ML packages Investigating AI solutions to drive equipment reliability
Augmented Reality (AR)	Accessing a virtual data source whilst carrying out a task by wearing a device the user can interact with.	
	BAU <ul style="list-style-type: none"> Proven and safe AR equipment for National Grid examples 	Allowance <ul style="list-style-type: none"> Further applications of AR in the utilities industry
Smart Networks	Build on the sensor, robotics and new material industries to create a network that is aware of itself in terms of its operation and integrity.	
	BAU <ul style="list-style-type: none"> On site 'smart' assets 	Allowance <ul style="list-style-type: none"> Embedded sensors/wires on the pipeline integrated smart assets and dashboards
New Materials and Printing Parts	Research and trials into new materials that mimic the strengths of a material but none of the weaknesses. 3D printing of parts for the NTS both in workshops and out in the field.	
	BAU <ul style="list-style-type: none"> Develop 3D printing techniques Address legality issues 	Allowance <ul style="list-style-type: none"> Printing out in the field Self-healing paint Alternative and maintenance-free pipeline materials
Decarbonising Construction	Driving down carbon emissions during all stages of construction from design, through build, to considering the operation and maintenance once complete.	
	BAU <ul style="list-style-type: none"> Small-scale studies and trials Increased use of Building Information Modelling (BIM) 	Allowance <ul style="list-style-type: none"> New techniques and materials Digital twins Use of hydrogen machinery/generators



Decarbonised Energy System 2021–2050

Working predominantly on hydrogen: how hydrogen will interact with the NTS, how trading could be managed and whether direct offtakes for hydrogen can support the transport and commercial markets.

Hydrogen Mix/ Blending/Deblending	Understand the full potential of the NTS in terms of what blend of gases can be transported, how this will be facilitated, where will it come from and how it will be extracted.	
	BAU <ul style="list-style-type: none"> Transportation of a low per cent of blended gas across the UK 	Allowance <ul style="list-style-type: none"> Can the NTS be used to transport up to 100 per cent hydrogen? Allow specific quantities of a blended gas to be extracted Hydrogen connection and offtake studies
Impact of Hydrogen on NGGT	On a molecular level, hydrogen is very different to natural gas and its impact will need to be fully understood on all aspects of the network. This includes, but is not limited to, gas velocities, energy densities and impact on electrical and mechanical equipment.	
	BAU <ul style="list-style-type: none"> Extension of allowance-funded projects to up-scale across the NTS 	Allowance <ul style="list-style-type: none"> Detailed studies into the effect of hydrogen within the NTS
Pipeline Safety Case	Our current safety case to transport natural gas has been established. However, significant investment is required to prove the safety case with hydrogen in areas such as fracture propagation, thermodynamics and proximity distances.	
	BAU <ul style="list-style-type: none"> Small-scale studies into transmission-specific challenges 	Allowance <ul style="list-style-type: none"> Detailed studies that would benefit the wider high-pressure gas transportation industries
Whole System Demand Forecasting	Operating in a decarbonised energy system will require a full review of demand forecasting techniques and procedures. This will cover modelling scenarios with both hydrogen and natural gas, increased variability in supply and demand and network configuration options into the future.	
	BAU <ul style="list-style-type: none"> Small-scale advances in current modelling technologies 	Allowance <ul style="list-style-type: none"> New demand forecasting techniques and processes
System Operation for a Decarbonised Energy Network	The current System Operator (SO) business is based around a natural gas market that will be subject to potential changes. This will cover metering, gas quality sampling, flow measurement, SCADA, billing, software and training.	
	BAU <ul style="list-style-type: none"> Extension of allowance-funded projects to up-scale across the NTS 	Allowance <ul style="list-style-type: none"> New modelling techniques Specific studies on key areas that need to be addressed Innovative software advancements for the SO business
Hydrogen for Transport and Industry	Provide hydrogen or blended gases to fuel heavy transport networks such as rail, air, maritime and haulage industries. Provide large commercial customers with a direct supply of hydrogen or blended gases for their industries	
	BAU <ul style="list-style-type: none"> Feasibility studies into potential connection points 	Allowance <ul style="list-style-type: none"> Multiscale trials of connecting customers to a supply of hydrogen
Future Markets	Play an active role in any new gas markets that are set up to trade biogases, hydrogen or carbon dioxide.	
	BAU <ul style="list-style-type: none"> Small-scale studies into the impact of new markets 	Allowance <ul style="list-style-type: none"> Research into ways the NTS could facilitate the trade of carbon and hydrogen around the UK or globally
Hydrogen for Compressors and Power	Use of hydrogen within a compressor turbine and to power the prime movers used in compressor units. Providing hydrogen to power generation.	
	BAU <ul style="list-style-type: none"> Studies into whether this technology is available 	Allowance <ul style="list-style-type: none"> Pilot schemes to trial the technology
Carbon Capture and Storage	The process of capturing waste carbon dioxide, transporting it to a storage location and safely locking it away to prevent the release to the atmosphere.	
	BAU <ul style="list-style-type: none"> Feasibility studies into the impact and application of this technology 	Allowance <ul style="list-style-type: none"> Innovative CCS techniques including carbon mineralisation Transport of carbon through the NTS CO₂ removal from the atmosphere

Putting Consumers at the Heart of Innovation



Our innovation proposals directly support the three underpinning consumer priorities:

I want to use energy as and when I want

Innovation is essential to support the security of GB gas supply across the RIIO-2 period. Through focusing on delivering and embedding innovative solutions that improve the performance of the network, we will ensure we are minimising consumer bills.

I want you to facilitate delivery of a sustainable energy system

There are a range of views over the long-term role of the gas transmission system. Until the exact pathway for gas is more certain it is in consumers' interests to explore a range of different and innovative solutions and keep future energy options open.

I want an affordable energy bill

Our innovation proposals support an affordable energy bill. Innovation is important to ensure connected parties (including new market entrants) can operate safely and efficiently. Any restrictions on the network can lead to inefficiencies for our connected customers, which means their increased costs will ultimately be passed on to end consumers. Innovation to improve asset reliability is also important in keeping energy bills low for domestic and industrial consumers, enabling the lowest-cost gas supplies to enter the UK.

Supporting Vulnerable Customers

Our RIIO-2 Business Plan is driving opportunities through our consumer priorities to ensure we have the most direct impact to support vulnerable consumers. These are driving down consumer costs, supporting education and providing employment opportunities as well as through our influence in the supply chain. As the distribution networks and suppliers are best placed to have the most impact with vulnerable consumers, we also intend to explore whether we can work with them collaboratively on innovation projects to support consumers. This is particularly relevant as the whole energy system changes, to ensure no groups of consumers are 'left behind'. We also intend to collaborate with specialist organisations with the knowledge and expertise on supporting vulnerable consumers to understand what innovation projects would provide the best benefits.

We intend to work collaboratively with the distribution networks and suppliers who have the most impact on vulnerable customers to make a real change.

Our three consumer priorities are embedded across our RIIO-2 Business Plan and have driven the development of our innovation themes and topics. The table below highlights how our RIIO-2 innovation topics map against the three consumer priorities:

Innovation Themes and Topics		Consumer Priorities		
		I want to use energy as and when I want	I want you to facilitate delivery of a sustainable energy system	I want an affordable energy bill
Fit for the Future	Modernising our Systems	✓	✓	✓
	System Readiness and Advanced Analytics	✓		✓
	Asset Integrity Management	✓		✓
	Digitisation and Digital Twin	✓		✓
	Cyber and Infrastructure	✓		
	Robotics	✓		✓
	Leak Detection and Emissions Monitoring	✓	✓	✓
	Decommissioning		✓	✓
Ready for Decarbonisation	Compressor Strategy	✓	✓	✓
	Artificial Intelligence (AI) and Machine Learning (ML)	✓		
	Augmented Reality (AR)	✓		
	Smart Networks	✓	✓	✓
	New Materials and Printing Parts	✓	✓	✓
	Decarbonising Construction		✓	✓
Decarbonised Energy System	Hydrogen Mix/Blending/Deblending	✓	✓	
	Impact of Hydrogen on NGGT		✓	
	Pipeline Safety Case		✓	
	Whole System Demand Forecasting	✓		✓
	System Operation for a Decarbonised Energy Network	✓	✓	✓
	Hydrogen for Transport and Industry		✓	
	Future Markets		✓	
	Hydrogen for Compressors and Power		✓	
	Carbon Capture and Storage		✓	

Funding our Innovation Plans



On average across RIIO-1 there has been an increased utilisation of the innovation allowances, which can be attributed to a variety of factors. The skills and experience of the team has seen steady growth and has matured across the price control period, developing meaningful relationships with third-party business and SMEs, who now approach National Grid with innovation concepts on a regular basis. At the start of RIIO-1 we recognised that we were on a steep learning curve and were developing processes, building our network of third parties and identifying business needs that matched innovation opportunities.

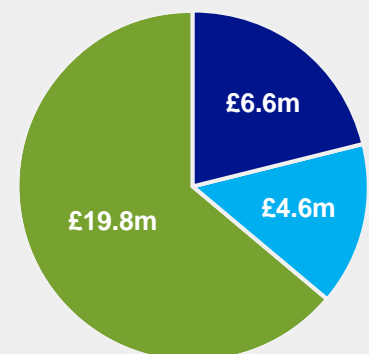
We have remained focused on the fact that NIA is just that – an allowance and not a challenge to maximise spend each year. As a result, we only sanctioned projects that we truly believed had an opportunity to deliver value to customers and fulfil a business need. As we approach RIIO-2, we are now in a different position, with end-to-end processes embedded and refined in the business. Innovation is now seen as part of our employees' jobs instead of an additional commitment to their day jobs. Our employees now understand the importance of the opportunities that innovation can bring.

As a result of the steady cultural development alongside process improvements, a stronger more focused profile, innovative ideas and clear business strategies, we saw full utilisation of our allowance for 2018/19, with the same expected for the remainder of RIIO-1. This utilisation is across a strong portfolio of innovation set to deliver real value to our stakeholders. This has driven the ambitious, yet achievable, targets to increase our innovation expenditure focused on key strategic areas that meet our stakeholder needs.

Our RIIO-2 Plan:

- We welcome Ofgem's support for a strategic innovation fund, which would replace the existing NIC framework, alongside a revised NIA. In particular we would like to stress the importance of retaining an allowance for agile and responsive innovation that is currently facilitated through NIA in RIIO-1.
- We believe a 0.75 per cent of revenue in the form of an innovation allowance (such as NIA) is vital to support the strategic ambitions for a decarbonised energy system. This would total RIIO-2 innovation allowance of approximately £30.9m. This would be alongside our investment in innovation as BAU. We encourage Ofgem to recognise the challenges we face in delivering a decarbonised energy system and consider our proposals to offer an ambitious, yet achievable, framework for innovation in RIIO-2.
- Our ambitious plans to increase innovation investment via BAU and allowance funding sources will help embed innovation within our organisation. Allowance funded innovation remains vital to mitigate against the risk of fragmented innovation funding across the networks, allowing a strong collaborative approach to innovation to remain and provide the opportunity to deliver large-scale collaborative projects that drive decarbonisation.
- The graphic below illustrates how we envisage our proposed £30.9m in innovation allowance over RIIO-2 (such as NIA) will be allocated across our three innovation themes.

£30.9m
Innovation
Investment
over RIIO-2



Our RIIO-2 Plan:

(Continued from previous page)

- Depending upon the speed of decarbonisation, we will remain flexible about the allocation of spend and review our strategy throughout RIIO-2 to ensure it meets the needs of our stakeholders and maintains the right level of pace required.
- Allocation of BAU and Allowance Funding – As outlined in the previous section ‘Our RIIO-2 Innovation Themes and Topics’ we have identified three key innovation themes and a number of topics under each. Here we have identified the types of innovation that we would expect to be funded as part of our BAU TOTEX allowance or via the allowance funding. This is just a guide, however, and we have a clear mechanism for identifying the funding route for innovation projects. Projects will be assessed on a case-by-case basis to ensure they are progressed using the most appropriate funding source and are not automatically classed as innovation allowance projects.
- Innovation Funding Route Criteria – The criteria for an innovation project to be funded via either BAU or allowance funding is outlined below:
 - BAU TOTEX Funding:
 - Higher TRL
 - Lower risk
 - Benefit within RIIO-2
 - Greater certainty of success
 - Allowance Funding (NIA):
 - Lower TRL
 - High risk
 - Benefit beyond RIIO-2
 - Less certainty of success
 - Collaborative large-scale projects
 - Decarbonised energy system
- Innovation Spend across the Industry – Considering our proposed innovation spend against companies in other sectors, we recognise that our proposal is lower than organisations that top the PwC list. However, we must consider our business purpose against those companies that invest the most. These highest spenders are focused in areas such as pharmaceuticals, automotive, retailing, software and advanced technology development. These organisations can have a quicker turnaround (‘fail fast’) and greater rate of return in a fast-moving, high-value consumer market. Our innovations are typically bespoke, niche technological areas with a longer lead time to embed results in the network, often exceeding our regulatory period.
- Additional Opportunities for Innovation Funding – Funding Competitions – We recognise the availability of other funding streams including funding opportunities from organisations such as InnovateUK, Horizon 2020, and Department for BEIS funding competitions. We will seek to develop our capabilities and maximise the opportunities these funding competitions provide. We will learn from across the industry, looking to others who have a track record in securing funding, such as the water utilities sector. We will embed this capability within our organisation to diversify the sources of our innovation funding.
- Additional Opportunities for Innovation Funding – Commercial Partnerships – We will seek novel commercial arrangements to deliver innovation, which could see third parties investing their own funds as part of NGGT innovation projects. Throughout RIIO-2 we are committed to exploring these alternative routes to leverage further funding to facilitate decarbonisation.
- Our Innovation Workforce – The model for innovation within NGGT will be for a centralised team with specific focuses on the Gas Transmission (GT) and Gas System Operator (GSO) functions to provide the right levels of support to facilitate innovation. Within GT, a partnership model will operate whereby we have innovation experts linking to technical experts in our specific business functions, whereas in GSO we will see a whole process approach with specific technical experts focused on innovation and responsible for managing the end-to-end innovation process.

Innovation Governance: Building on Success

We have been building on the lessons learned over RIIO-1. These include the matured team structures, developing relationships with external contacts across a large variety of sectors and embedding processes and behaviours which are championed by the Senior Leadership Team at National Grid. All these factors will contribute to the efficient and effective investment of innovation in RIIO-2. A notable area where lessons have been learned and implemented effectively is in our process to vet ideas within our innovation pipeline. This has allowed us not only to ensure quality project ideas are within the pipeline, but also to educate third parties on what is required. This in turn has resulted in a greater number of quality ideas from a wider range of third parties than previously seen.

Our governance process has benefited from several iterations throughout RIIO-1 and the business is aware of the prerequisites and vetting process that a project goes through to get sanctioned.

Our financial processes have also been streamlined, giving the team a better view of when payment milestones are due, and effective tracking across multiple financial years.

We have identified 17 projects throughout RIIO-1 that have unfortunately reached a point where the expected outcomes are no longer achievable. Where this occurs, we have paused the project, reviewed the root cause of the issues and agreed next steps and lessons to be learned for future projects. With our processes in place to review the performance of projects throughout their lifecycle we have been able to identify these early on and terminate them, allowing us to recover planned expenditure to be reinvested in other innovations in our pipeline. Investment in innovation towards the energy system transition will require acceleration throughout RIIO-2, coupled with the work on ensuring our network is fit for the future.

Process Step	Description
Idea Received Assessed against strategy and funding route identified	Upon receipt of an idea, an assessment will be carried out within the Innovation Team to identify whether it fits within our strategy and at this point identify whether this is an idea that would be funded via BAU or allowance funding.
Project Proposal Project deliverables, costs, risks and benefits are identified	The required project proposal, plan and associated financial and cost-benefit assessments will be mirrored for the project under either funding route.
Sanction via GTIGG Project taken to relevant committee for review and approval	GTIGG will remain as sanctioning body for allowance-funded projects but will also include oversight of BAU-funded projects, which will have funding approved by the relevant business area but will be challenged against our Innovation Strategy via the GTIGG group.
Project Initiation Contractual and procurement activities completed	Pending approval via either route, the projects will be initiated with contracts and associated financial and procurement activities completed.
Project Delivery Monthly reporting of progress against deliverables	The portfolio of innovation projects funded by either route will be coordinated as one with all standard project management milestones adhered to.
Project Closure Close-out reporting and identification of next steps	Complete close-out reporting and assessment of the outcomes against expectations to determine the success of the project. Reassess the cost-benefit analysis. Track the value and benefits of the project.
Implementation Assessment Report back to GTIC on the planned implementation	Analysis of updated cost-benefit analysis and report back to our Business Sanctioning Committee (Gas Transmission Investment Committee – GTIC) regarding next steps and plans for implementation.

Our RIIO-2 Plan:

- NGGIP** – The role of the RIIO-2 Independent Stakeholder Panel has been crucial to the development of our business plans and has added significant value, in particular to the development of this strategy. As we progress into RIIO-2, we are committed to securing an independent panel to challenge our innovation ambition, performance and strategy. Discussions around the role of the Independent Stakeholder Panel are ongoing. Once the role and outcome are confirmed we will seek to engage with this panel or establish an offshoot panel with key representatives.
- Innovation Sanctioning Process** – Currently our proposed process for sanctioning innovation projects builds on the success of our existing sanctioning committee (GTIGG) used in RIIO-1. Our GTIGG sanctioning process will remain centralised, managing BAU and allowance-funded innovation, ensuring projects align to our strategic ambitions and expect the required level of return on investment. To ensure the most efficient and effective innovation process there will not be a differentiation at the outset of the innovation process whereby we gather ideas and engage with our employees. There will be an ongoing process to engage with third parties to generate a diverse selection of innovative ideas and opportunities that meets our strategic aims set out in our strategy.
- Improving Innovation Reporting** – As we progress into RIIO-2 we will continue to develop and improve our reporting methods to provide our stakeholders with the information they require. A key reporting mechanism we would support transitioning into RIIO-2 is the Annual Summary document. The Annual Summary provides a key point of reflection on performance from the past year whilst also providing a strategic assessment and identifying focus for the following year. With the development of the Benefit Measurement Framework under way, the most suitable mechanism to report this would be via the Annual Summary.
- An enhanced Innovation Annual Summary should provide:**
 An NGGIP review of:
 - Our performance against our strategy, commitments and actions
 - A measure of our innovation activity against the Benefits Measurement Framework
 - A refreshed Innovation Strategy based on stakeholder feedback and reassessment of stakeholder priorities and innovative opportunities
 - A summary of our key projects throughout the year
 - The NGGT action plan against the NGGIP review – setting out actions for the year ahead, identifying areas for improvement.

Innovation Annual Summary

Published each year, the Annual Summary is a key publication by NGGT Innovation. The links below will take you directly to the Annual Summary for each year since 2013/14:

2018/19 Annual Summary – [Click here](#)

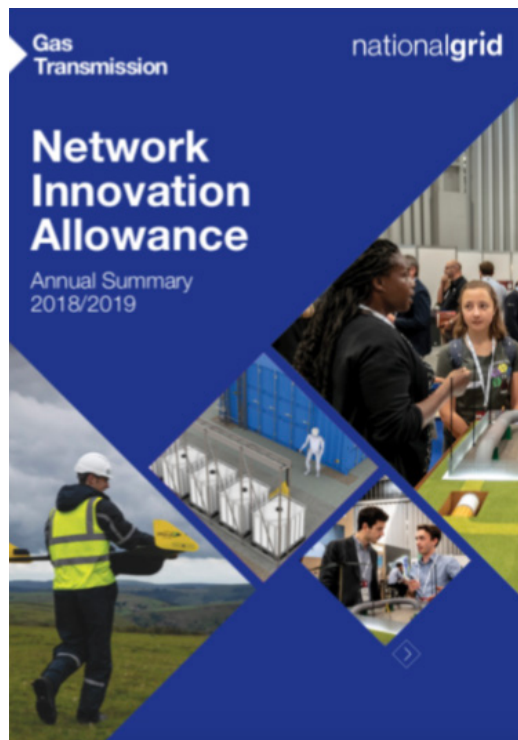
2017/18 Annual Summary – [Click here](#)

2016/17 Annual Summary – [Click here](#)

2015/16 Annual Summary – [Click here](#)

2014/15 Annual Summary – [Click here](#)

2013/14 Annual Summary – [Click here](#)



Chapter Six

Next Steps...

Our next steps are primarily linked to our regulatory framework discussions. We will continue to engage with stakeholders on our strategic themes and develop these in line with learnings from the RIIO-1 innovation activities. We will also undertake the necessary engagement with Ofgem on the development of the innovation framework. In this chapter, we will discuss:

- Continuing our external engagement
- Mobilising our Innovation Strategy



Next Steps

This strategy has set out a clear and ambitious pathway for innovation into RIIO-2. Over the remainder of RIIO-1 we plan to engage and educate our stakeholders and complete a number of key activities which will build on our strategy and enable a smooth transition into RIIO-2. Our plans are summarised below:

Continuing our external engagement

Stakeholder engagement sessions will continue to focus on the Innovation Strategy and identify further feedback to be incorporated into future versions of the document.

We will be collating the results of our second Innovation Survey to gauge how our stakeholders think we have performed and form a comparator to the previously completed survey from 2016. We will share our results through several of our communications channels, with full details published in our Annual Summary in July 2020.

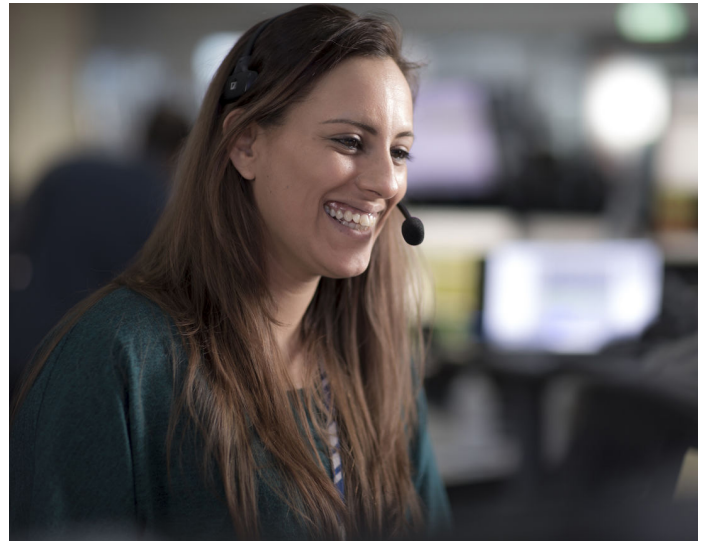
Our bi-monthly external newsletter was launched in October 2019, and will be built on during RIIO-2. It features leadership articles on the wider themes of network innovation and highlights learnings from other industries.

The Innovation Team will continue to attend events across the UK which focus on new ways of working and during these interactions will seek feedback on the overall strategy for RIIO-2 where appropriate.

During early 2020 we plan to formally launch our Innovation Strategy, with an event open to all stakeholders where they can learn more about our plans, the opportunities and share their ideas with us. We are also planning several supplier engagement days, providing the opportunity to meet with our experts and focus on specific innovation areas of interest.

We will continue engagement with Ofgem and the other gas and electricity networks to develop the framework for the new NIA and strategic NIC funding in RIIO-2. This also includes being a part of the joint NIC call which is being organised through the ENA.

To provide a baseline of the Benefit Measurement Framework in readiness for RIIO-2, we plan to publish an initial assessment of NGGT against the framework in 2020.



Mobilising our Innovation Strategy

With our Innovation Strategy fully developed, we are accelerating the implementation across the business. During 2020 we will be reaching out across the whole of Gas Transmission to refocus on innovation, telling the story to-date and the opportunities for RIIO-2. The first activity will be going to each of the team meetings across Gas Transmission to engage the teams and set expectations.

We are currently assigning each sub-topic to a specific owner within the Innovation Team and identifying the relevant business expert(s) to be the champion for this sub-topic. This will allow for clearer articulation of the problems and opportunities within this space, allowing for faster and more effective assessment of relevant ideas and acceleration of these ideas into active innovation projects.

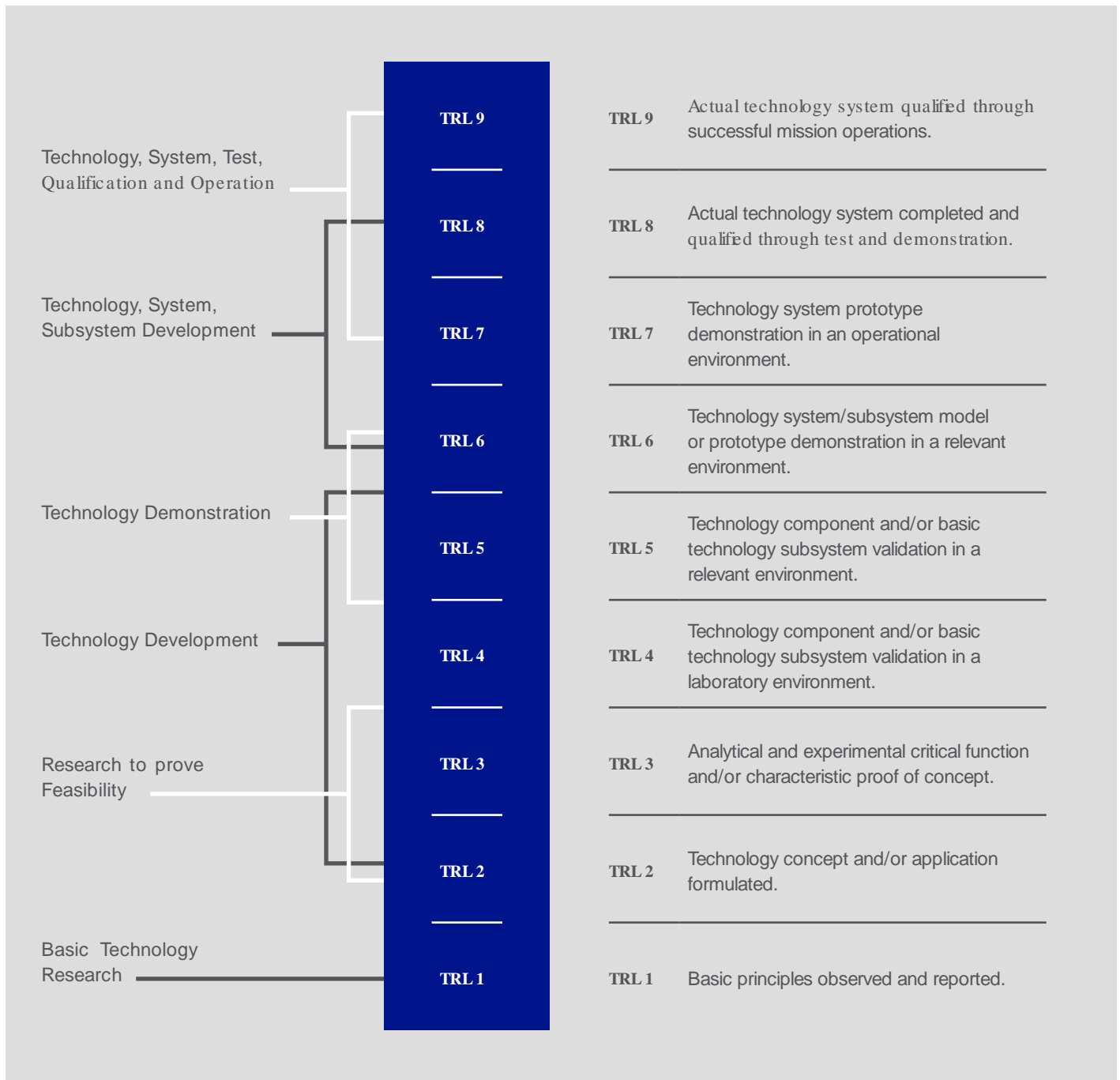
In the first few months of 2020, we plan to run internal showcases for innovation, focused sessions on key topics (such as hydrogen), and set up a permanent Innovation Hub and Showcase. Alongside a Hydrogen Hub, this will provide more detail on our current activities and set new challenges, ask questions and get people thinking about innovation.

Appendices

- Appendix 1 – Technology Readiness Levels (TRL)
- Appendix 2 – GNIS comparison to RIIO-2 themes
- Appendix 3 – Innovation in RIIO-2 strategy alignment
- Appendix 4 – RIIO-1 project list











Technology Readiness Levels (TRL)



GNIS Comparison to RIIO-2 Themes

Refreshed every two years, the Gas Network Innovation Strategy (GNIS) is a collaborative strategy produced by the ENA in conjunction with all gas networks. This strategy sets out the strategic ambition and innovation needs of the networks across a number of themes. The table below shows how our innovation topics under our three innovation themes map against the GNIS published in March 2018:

RIIO-2 Innovation Themes and Topics		Gas Network Innovation Strategy Themes				
		 Future of Gas	 Safety and Emergency	 Reliability and Maintenance	 Environment and Low Carbon	 Security
 Fit for the Future	Modernising our Systems			✓		✓
	System Readiness and Advanced Analytics			✓		
	Asset Integrity Management	✓		✓		
	Digitisation and Digital Twin		✓	✓		
	Cyber and Infrastructure					✓
	Robotics			✓		
	Leak Detection and Emissions Monitoring		✓	✓	✓	
	Decommissioning		✓		✓	
 Ready for Decarbonisation	Compressor Strategy			✓		
	Artificial Intelligence (AI) and Machine Learning (ML)	✓	✓	✓		✓
	Augmented Reality (AR)	✓	✓	✓		✓
	Smart Networks		✓	✓		✓
	New Materials and Printing Parts		✓	✓	✓	
	Decarbonising Construction		✓		✓	
 Decarbonised Energy System	Hydrogen Mix/Blending/Deblending	✓				
	Impact of Hydrogen on NGGT	✓		✓		
	Pipeline Safety Case	✓				
	Whole System Demand Forecasting	✓				
	System Operation for a Decarbonised Energy Network	✓				
	Hydrogen for Transport and Industry	✓	✓	✓		
	Future Markets	✓		✓		
	Hydrogen for Compressors and Power	✓		✓		
	Carbon Capture and Storage	✓				




Note: The Repair and Distribution Mains Replacement GNIS themes relate specifically to gas distribution network challenges and are therefore excluded from categorisation against the Gas Transmission Portfolio.

The Gas Network Innovation Strategy can be found here: [Gas Network Innovation Strategy](#)




Innovation in RIIO-2 Strategy Alignment

This section illustrates how the Innovation Strategy themes and sub-topics have been derived from the need identified within each of the Business Plan chapters.




13. I want the gas system to be safe

Theme	Relevant Topics	Commentary
 Fit for the Future	<ul style="list-style-type: none"> • Modernising our Systems • System Readiness and Advanced Analytics • Asset Integrity Management 	<p>Within this theme, we will be focusing on the safety systems and ensuring they represent the industry best practices in a variety of areas including network emergency simulation. Once the systems are in place we must ensure they are populated with accurate data to drive insight and analytics.</p>
 Ready for Decarbonisation	<ul style="list-style-type: none"> • Smart Networks 	<p>Looking towards the future we would like the National Transmission System to become 'smart' in terms of real-time network monitoring and notifications.</p>
 Decarbonised Energy System	<ul style="list-style-type: none"> • Pipeline Safety Case 	<p>As the network moves towards decarbonisation the consequences of biogases and hydrogen blends in the network will need to be understood.</p>




14. I want to take gas on and off the transmission system where and when I want

Theme	Relevant Topics	Commentary
 Fit for the Future	<ul style="list-style-type: none"> • Modernising our Systems • System Readiness and Advanced Analytics • Asset Integrity Management • Digitalisation and Digital Twin • Cyber and Infrastructure • Robotics • Leak Detection and Emissions Monitoring • Decommissioning 	<p>Many of the current systems we use in this area require modernising and populating with enough data to drive analytics and insight. Significant is the concept of digital twin and digitalisation, which will be key for RIIO-2. Additionally, such topics as robotics, leak detection and researching new materials will be developed further in RIIO-2.</p>
 Ready for Decarbonisation	<ul style="list-style-type: none"> • Compressor Strategy • Artificial Intelligence (AI) and Machine Learning (ML) • Augmented Reality (AR) • Smart Networks • New Materials and Printing Parts • Decarbonising Construction 	<p>While topics such as AI and ML are becoming widely used, the applications of such technologies for National Grid still require further development to provide significant benefits. The need for carbon capture and storage will also increase as viable hydrogen production facilities are developed.</p>
 Decarbonised Energy System	<ul style="list-style-type: none"> • Impact of Hydrogen on NGGT • Whole System Demand Forecasting • System Operation for a Decarbonised Energy Network 	<p>These topics will focus specifically on how the introduction of biogases such as hydrogen will impact the operation of assets. The impact of this change will also need to be understood for the system operation side of the business in terms of modelling and forecasting these new scenarios.</p>




15. I want you to protect the transmission system from cyber and external threats

Theme	Relevant Topics	Commentary
 Fit for the Future	<ul style="list-style-type: none"> • Modernising our Systems • Digitalisation and Digital Twin • Cyber and Infrastructure 	Updating and modernising our systems will be key to preventing cyber threats but also to ensuring they are secure now and into the future.
 Ready for Decarbonisation	<ul style="list-style-type: none"> • Artificial Intelligence (AI) and Machine Learning (ML) • Smart Networks 	Utilising AI and ML could lead to advances in threat detection and prevention. Smart networks refers to a network that is self-monitoring and can provide notifications of threats, such as vibration monitoring within our pipelines.
 Decarbonised Energy System	<ul style="list-style-type: none"> • System Operation for a Decarbonised Energy Network 	As we move to a decarbonised energy network, digitalisation within the SO must be protected from cyber threats.




16. I want you to care for the environment and communities

Theme	Relevant Topics	Commentary
 Fit for the Future	<ul style="list-style-type: none"> • Leak Detection and Emissions Monitoring • Decommissioning 	Efficient and intelligent leak detection across not just our sites but also the wider pipeline network and ensuring that our decommissioning activities are carried out in a way that is conscious of the local environment.
 Ready for Decarbonisation	<ul style="list-style-type: none"> • Compressor Strategy • Smart Networks • New Materials and Printing Parts • Decarbonising Construction 	New materials and construction techniques can offer environmental savings. These should be trialled and developed throughout RIIO-2, while embedding those that have been successful in RIIO-1.
 Decarbonised Energy System	<ul style="list-style-type: none"> • Hydrogen for Transport and Industry • Carbon Capture and Storage 	NGGT should be able to facilitate the early adopters of hydrogen within the transport and industrial areas. This can start to provide environmental benefits by reducing their carbon emissions.




17. I want you to facilitate the whole energy system of the future – innovating to meet the challenges ahead

Theme	Relevant Topics	Commentary
 Fit for the Future	<ul style="list-style-type: none"> • Modernising our Systems 	Replacement of key software used to communicate commercial information to and from shippers.
 Ready for Decarbonisation	<ul style="list-style-type: none"> • Compressor Strategy 	The needs of the compressor fleet on the National Transmission System is changing in response to the changing global gas markets, therefore, our compressor strategy will need to react to this.
 Decarbonised Energy System	<ul style="list-style-type: none"> • Hydrogen Mix/Blending/Deblending • Impact of Hydrogen on NGGT • Pipeline Safety Case • Whole System Demand Forecasting • System Operation for a Decarbonised Energy Network • Hydrogen for Transport and Industry • Future Markets • Hydrogen for Compressors and Power • Carbon Capture and Storage 	The use of hydrogen and biogases is widely seen as the only viable option for a decarbonised gas network of the future. It is therefore vital that National Grid understands how this will affect its business and prepare for the introduction of this gas medium. The implications will be significant, affecting all areas of operation, maintenance and future markets. Linked to this will be the introduction of large-scale carbon capture and storage and the potential role NGGT could play in transporting carbon to storage locations both on and offshore.

18. I want all the information I need to run my business, and to understand what you do and why

Theme	Relevant Topics	Commentary
 Fit for the Future	<ul style="list-style-type: none"> • Modernising our Systems • System Readiness and Advanced Analytics • Digitalisation and Digital Twin 	Ensuring that our core and bespoke systems are updated or replaced and then populating them with rich data to provide analysis to the business at a variety of levels to assist in its daily activities.
 Ready for Decarbonisation	<ul style="list-style-type: none"> • Artificial Intelligence (AI) and Machine Learning (ML) • Augmented Reality (AR) • Smart Networks 	Understand how the latest trends of AI, ML and AR could be brought into a gas transmission business to provide real benefit.
 Decarbonised Energy System	<ul style="list-style-type: none"> • Whole System Demand Forecasting • System Operation for a Decarbonised Energy Network 	Using new systems and software to assist in moving to a decarbonised energy system as many of the existing systems are restricted to natural gas only.

19. I want to connect to the transmission system

Theme	Relevant Topics	Commentary
 Fit for the Future	<ul style="list-style-type: none"> • System Readiness and Advanced Analytics • Digitalisation and Digital Twin 	<p>These topics include digital platform enhancements to improve our customer self-service capability ('BAU innovation'), digital twin technology for customer connections and taking a whole energy approach to connections through enhancements of online tools.</p>
 Ready for Decarbonisation	<ul style="list-style-type: none"> • Artificial Intelligence (AI) and Machine Learning (ML) • Augmented Reality (AR) • New Materials and Printing Parts 	<p>Use AI, ML and AR to improve our customers' connection experience. Using new and/or printed materials to facilitate connections to the network.</p>
 Decarbonised Energy System	<ul style="list-style-type: none"> • Hydrogen Mix/Blending/Deblending • Hydrogen for Transport and Industry • Future Markets • Hydrogen for Compressors and Power • Carbon Capture and Storage 	<p>Develop commercial and asset-related requirements for future hydrogen customer connections and an impact assessment of hydrogen blending for existing connection assets.</p>

RIIO-1 Project List

This section highlights all projects completed throughout RIIO-1 including a description, which Business Plan chapter they align to and a link to the [Smarter Networks Portal](#) where you can find out more information about each project.

Project Reference	Title	Description	Chapter Number
NIA_NGGT0001	Alternatives to venting	Research into development of new best practice for lowering methane emissions during planned venting activities on the National Transmission System (NTS).	16
NIA_NGGT0002	Development of AC OHL survey system and evaluation of ER probes	Deliver a suitable over-line AC survey system, which when implemented will enable the improved detection and assessment of AC-induced corrosion in gas pipelines.	14
NIA_NGGT0003	PRCI – Pipeline Research Council International 2013	Establish best practice technologies and techniques to allow safe, reliable, efficient and economic use of the gas network with a reducing impact on the environment through a membership to the Pipeline Research Council International.	14
NIA_NGGT0004	Development of a risk-based asset management tool	Risk-based asset management tool incorporating novel visualisations of risk profiles across the National Transmission System (NTS).	18
NIA_NGGT0005	EPRG – European Pipeline Research Group 2013	Establish and share best practice technologies across European Transmission Owners to allow the safe, reliable, efficient and economic use of the gas network, reducing any impact on the environment.	14
NIA_NGGT0006	Turbine and Ultrasonic Meter Uncertainty and Error Analysis Tool	This project aims to deliver an uncertainty tool for turbine and ultrasonic meters.	14
NIA_NGGT0007	Risk Assessment Methodologies for Pipelines and AGIs 2013	Research into the enduring management of safety risks on pipelines and above ground installations. The project includes the implementation of the results via tools and methodologies that are equally relevant to the UK gas industry.	13
NIA_NGGT0008	Develop novel mitigation method for high-frequency main pipework vibration	Evaluate a series of cost-effective approaches to attenuate high-frequency vibration within transmission pipework.	14
NIA_NGGT0009	Removable Composite Transition Pieces (CTP)	The research and development of a removable composite gas transition seal unit.	14
NIA_NGGT0010	Backup DC drive electronic starter	Develop a safer and more reliable alternative to the resistance-type motor starters currently installed on compressor sites.	13
NIA_NGGT0011	Composite Pipe Supports	Develop a suitable alternative design of pipe support for use on the NTS.	14
NIA_NGGT0012	Development of a new design vent silencer	Research, development and testing of a proposed high-pressure venting silencer with the Industrial Noise and Vibration Centre.	16
NIA_NGGT0013	Evaluation of inspection techniques for sleeved crossings	Evaluate a number of guided wave ultrasonic inspection techniques for their suitability in use on above ground inspection of sleeved pipe sections.	14
NIA_NGGT0014	Daily gas demand forecasting	Develop new methods for forecasting the daily gas demand from the National Transmission System.	18
NIA_NGGT0015	The need for pressure de-rating prior to in-service welding	Confirm whether hot tap welding to pipelines operating at pressures above 70 bar can be carried out safely.	14
NIA_NGGT0016	Pipeline risk ranking Phase II	The desired result will be a fully validate pipeline risk ranking model.	14
NIA_NGGT0017	Heat in the soil form – Assessment of heat in soil caused by buried infrastructure	To understand the ecological and environmental risks attached to the introduction of heat into soils from buried assets.	16
NIA_NGGT0018	Optimisation of severe winter strategy for pipeline isolation valves	Deliver a risk-based approach for the prioritisation of retrofit measures to address isolation valve reliability during periods of sustained severe winter conditions.	18
NIA_NGGT0019	Toughness of fittings	The intent is to demonstrate that a fit-for-purpose material selection process has been adopted encompassing the latest thinking and techniques.	14
NIA_NGGT0020	Variable envelope compressors	Investigate methods for varying the performance envelope of centrifugal compressors, primarily adjustable inlet guide vanes.	16

Key:

Chapter 13 – I want the gas system to be safe. **Chapter 14** – I want to take gas on and off the transmission system where and when I want. **Chapter 15** – I want you to protect the transmission system from cyber and external threats. **Chapter 16** – I want you to care for the environment and communities. **Chapter 17** – I want you to facilitate the whole energy system of the future – innovating to meet the challenges ahead. **Chapter 18** – I want all the information I need to run my business, and to understand what you do and why. **Chapter 19** – I want to connect to the transmission system.

Project Reference	Title	Description	Chapter Number
NIA_NGGT0021	Epoxy sleeves in place of heavy wall pipe	Assess the use of epoxy sleeves to provide pipeline protection at road crossings.	14
NIA_NGGT0022	NTS Constraint Modelling	Provide a unified set of automated NTS capacity forecasting tools, utilising the latest statistical methods and algorithms enhancing National Grid's capacity management of the NTS.	18
NIA_NGGT0023	Development of 'AGI safe'	Development of 'above ground installation (AGI) safe' software package allows better quantitative risk assessments, resulting in more efficient designs; this led to a one-off saving of £84k at Peterborough Compressor Station.	15
NIA_NGGT0024	BIM (Building Information Modelling)	Develop and trial an intelligent 3D modelling process based on Building Information Modelling (BIM) level 2 maturity, within an existing construction project.	14
NIA_NGGT0025	Architectural Design of Compressor Site	Explore three environmentally sensitive architectural design alternatives that will be suitable for a typical compressor site.	14
NIA_NGGT0026	Study to determine Stress Concentration Factors (SCF) for alternative design on branch connections	Establish whether the Stress Concentration Factors (SCF) of a number of alternative designs of branch connections are bounded by those used in the pipework stress analysis code IGEM/TD/12.	14
NIA_NGGT0027	Pig trap door seals	Failure modes analysed, and new training package developed and implemented. An annual accrual of £10k can be attributed to this project based on avoidance of failures.	13
NIA_NGGT0028	P9 semi-mechanised hot tap welding	Introduction of a semi-mechanised welding process, coupled with improved NDE weld assessment.	14
NIA_NGGT0029	Assessment of hydrophobic treatment for gas compressor air intake valves and screens	Research effectiveness of conventional hydrophobic coatings for gas turbine air intakes.	14
NIA_NGGT0031	Direct Replacement Preheat Package (DRPP)	Research and develop a highly efficient Direct Replacement Preheat Package (DRPP) at Pressure Reduction Installations (PRIs).	14
NIA_NGGT0032	Gas quality limits in emergency situations	This research programme forms the basis of the assessment process developed to provide the NEC with the required evidence for them to be able to authorise the admission of greater quantities of Schedule 3 Part II gas into the network in accordance with their statutory responsibilities.	14
NIA_NGGT0033	Hot tap buried sample probe	Deliver a field demonstration of a combination of three new probe designs and construction techniques.	14
NIA_NGGT0034	External contamination detection and measurement at entry points	Develop and trial a device that is suitable for the detection and quantitative measurement of liquid contamination at the entry points to the NTS gas transmission system.	14
NIA_NGGT0035	Investigation of flow physics in gas pipe network	Create comprehensive fast transient models of National Transmission System components.	18
NIA_NGGT0036	Standards Mapping Tool (SMT)	Develop a Standards Mapping Tool (SMT) to assist management of the standards suite within GTAM and areas of the business.	18
NIA_NGGT0037	Compressor balance of plant environmental study	Research and develop a novel operational practice that has the potential to deliver environmental gain and net financial benefits.	16
NIA_NGGT0038	Novel vibration measurement technologies	Research the capabilities of novel vibration measurement sensors and systems used for assessing the risk of vibration-related fatigue failure of process pipework, specifically for sites with high levels of electromagnetic interference.	14
NIA_NGGT0039	Renewable power on remote installations	To support the delivery of this strategy a source of renewable energy is to be investigated for these remotely located sites in order to send signals to and from the Gas National Control Centre (GNCC) to open and close the valve remotely.	16
NIA_NGGT0040	Metering and gas quality training simulator	Utilise software simulation techniques to generate realistic gas quality and metering scenarios to reinforce and test understanding of principles of the training being delivered.	14
NIA_NGGT0041	On site chemical analysis of pipeline materials	Determine if current portable Optical Emission Spectrometry (OES) or X-ray Fluorescence (XRF) equipment will meet National Grid requirements for material sampling and reduce operational costs.	14
NIA_NGGT0042	Ramp rate study system	To automate and standardise the ramp rate study process by developing a software system that automates some of the ramp rate study tasks and integrates various software tools used in the process.	14
NIA_NGGT0043	MiniLog stray current monitoring devices for cathodic protection reliefs	Demonstrate and evaluate the benefits of the MiniLog product.	14

Project Reference	Title	Description	Chapter Number
NIA_NGGT0044	SCT pipeline inspection system	To develop the SCT inspection system such that it can be used as a complementary tool to other pipeline inspection systems such as in-line inspection (ILI), Direct Current Voltage Gradient (DCVG) and Close Interval Potential Survey (CIPS).	14
NIA_NGGT0045	Acoustic emission measurements in valve leakage detection and quantification	Investigate the self-relieve system on the Cameron type 31 valve and assess possible solutions, and model and validate the use of leak detection equipment for above ground and below ground process valves.	16
NIA_NGGT0046	Manual Phased Array (MPA) for small diameter offtake weld inspection	Determine if MPA can be used to detect the presence of subsurface defects in the fillet and butt welds of small diameter branch offtakes, and if so, to develop the method into a fully specified practical technique.	14
NIA_NGGT0047	Resource and asset reuse toolkit	Develop a toolkit that facilitates an increased level of resource and asset reuse within National Grid.	18
NIA_NGGT0048	Feasibility study for alternative pipeline materials	Investigate the feasibility of using alternative materials, construction processes and technologies for pipelines in the National Grid Transmission Network.	14
NIA_NGGT0049	Investigation into the use of constrained-layer damping	To investigate the performance and the limitations of constrained-layer damping technique.	16
NIA_NGGT0050	Network investment stakeholder engagement	Develop a tool that will communicate the investments that National Grid is proposing on the network to external and internal users in an engaging manner.	18
NIA_NGGT0051	Wireless gas detection assessment	Innovation assessment project to determine whether wireless gas detection can be used in gas transmission compressor cabs.	14
NIA_NGGT0053	Pipeline noise mitigation	Tests and subsequent results of a selection of different noise mitigation technologies: Identification of a new technique, or techniques, that could be put forward to become a 'best available technique'.	16
NIA_NGGT0054	Pipeline damage measurement using handheld laser scanners	Assess the performance of handheld laser scanners for measuring damage to pipelines when compared with methods currently used in T/SP/P/11 and T/SP/P/20.	14
NIA_NGGT0055	Above ground installation integrity decision support tool	To develop a decision support tool for above ground installations, which would be fully validated and used to prioritise resources to the highest-risk installations.	14
NIA_NGGT0056	Feasibility study of onsite non-welded interlocking pipe construction	Feasibility of utilising onsite non-welded interlocking pipeline construction technique for UK gas transmission purposes.	14
NIA_NGGT0057	Building Information Modelling (BIM) investigation into enhanced techniques	To understand BIM techniques and tools and how they can add value to the way National Grid operates.	14
NIA_NGGT0058	Variable Envelope Compressor Economic Study (VECES)	Establish if there is a substantial economic business case for utilising Variable Envelope Compressors on the UK Gas Transmission System.	16
NIA_NGGT0059	Renewable power trial and demonstration	To demonstrate and monitor a renewable power installation in order to determine whether the available technologies are suitable as sole power sources for installations in a range of different climates.	16
NIA_NGGT0060	Gas generator preservation assessment	Research to allow National Grid to update the gas generator preservation strategy.	14
NIA_NGGT0061	PRCI – Pipeline Research Council International 2014	Establish best practice technologies and techniques to allow safe, reliable, efficient and economic use of the gas network with a reducing impact on the environment through a membership to the Pipeline Research Council International.	14
NIA_NGGT0062	EPRG – European Pipeline Research Group 2014	Establish and share best practice technologies across European Transmission Owners to allow the safe, reliable, efficient and economic use of the gas network with a reducing impact on the environment.	14
NIA_NGGT0063	Investigation into novel robotics locomotion techniques	To investigate robotic locomotion techniques suitable for high-pressure gas installations.	14
NIA_NGGT0064	High Altitude Aerial Surveillance (HAAS)	To develop and prove a high altitude aerial surveillance system as a viable alternative to current helicopter patrols. Understanding the market and using this technology in the future can help to avoid future incidents and repair costs.	14
NIA_NGGT0065	Pipeline and farm equipment loading review	A review of implications and potential solutions to modern heavier agricultural equipment crossing steel pipelines.	14
NIA_NGGT0066	Meter Validation Assessment Tool (MVAT)	Develop a comprehensive meter assessment tool.	18

Project Reference	Title	Description	Chapter Number
NIA_NGGT0067	Sensitivity and specificity of Stress Concentration Tomography (ICASE award)	To investigate sensitivity, reliability and repeatability of data generated through the SCT technology, particularly in relation to conventional in-line inspection data.	18
NIA_NGGT0068	Risk Assessment Methodologies for Pipelines and AGIs 2014	Research into the enduring management of safety risks on pipelines and above ground installations. The project includes the implementation of the results via tools and methodologies that are equally relevant to the UK gas industry.	13
NIA_NGGT0069	Pipeline installation techniques	To review current and emerging pipeline installation techniques.	14
NIA_NGGT0070	NTS block valve connections	To provide an engineering solution for customer connections onto block valve sites.	19
NIA_NGGT0071	Spatial district heating analysis and impact on gas and power demand	To inform scenario development and downstream investment decision processes within National Grid. To provide a platform to engage other interested parties including iDNs, DNO, regulators and Government.	18
NIA_NGGT0072	Portable valve actuation	To understand the potential benefits, impacts and whole life cost savings that can be achieved across the transmission network by the implementation of a portable actuation solution and a phased replacement strategy.	14
NIA_NGGT0073	Investigation into LPRC pipeline material	Comprehensive market review of LPRC products, and define specific performance requirements relating to the operation and management of such technology.	14
NIA_NGGT0074	Next generation Predictive Emission Monitoring Validation (PEMS)	Assess the suitability of the PEMS model in predicting NOx and CO emissions over a range of operating and ambient conditions by comparing predicted emissions with actual measured values taken by a dedicated measurement device.	16
NIA_NGGT0075	Enhanced operational forecasting	Research, develop and deliver an offline, prototype, supply-and-demand forecasting tool to continue to provide effective operational strategies.	18
NIA_NGGT0076	Gas quality study for NTS unconventional gas supplies	Studies into whether the National Transmission System (NTS) could handle higher levels of oxygen similar to other areas of the downstream gas network.	19
NIA_NGGT0077	Cathodic Protection (CP) for pipelines within a tunnel	To investigate options for CP of pipelines within a tunnel and develop a specification.	14
NIA_NGGT0079	Remaining Useful Life (RUL) determination for compressors	Determine the feasibility of applying different mathematical and statistical analysis to existing available historic data in defining Remaining Useful Life to optimise maintenance and improve asset management decisions.	14
NIA_NGGT0080	EPRG – European Pipeline Research Group 2015	Establish and share best practice technologies across European Transmission Owners to allow the safe, reliable, efficient and economic use of the gas network with a reducing impact on the environment.	14
NIA_NGGT0081	PRCI – Pipeline Research Council International 2015	Establish best practice technologies and techniques to allow safe, reliable, efficient and economic use of the gas network with a reducing impact on the environment through a membership to the Pipeline Research Council International.	14
NIA_NGGT0082*	Risk Assessment Methodologies for Pipelines and AGIs 2015	Research into the enduring management of safety risks on pipelines and above ground installations. The project includes the implementation of the results via tools and methodologies that are equally relevant to the UK gas industry.	13
NIA_NGGT0083	Geospatial Information System (GIS) Pipeline Costing Tool	Pilot a method for generating quantitative information in relation to relative gas pipeline corridor costs to support down selection of preferred corridors.	14
NIA_NGGT0084	Valve sealant line Grouted Tee	Develop and qualify a Grouted Tee that is suitable for sealant line intervention work and to develop and qualify a compression fitting epoxy encapsulation sleeve.	14
NIA_NGGT0085	New techniques for the measurement of pipeline depth of cover	Investigate the feasibility of using a new methodology to identify areas of reduced depth of cover on a buried pipeline.	15
NIA_NGGT0086	Mathematical baseline and error detection techniques for the analysis of Unaccounted For Gas (UAG)	Explore alternative mathematical techniques to develop a set of robust models for the determination and monitoring of biases in UAG data.	18
NIA_NGGT0087	Selective Catalytic Reduction (SCR) Pre-FEED environmental and technical study	Provide a clearer understanding of the potential technical challenges associated with implementing an SCR project on a National Grid compressor station and identify initial approaches to overcoming these challenges.	16
NIA_NGGT0088	Nitrogen sleeve epoxy end-seal repair solution	To find a simple and cost-effective solution, to facilitate the repair of leaking nitrogen epoxy end-seals.	14

Notes:

* Project not registered.

Project Reference	Title	Description	Chapter Number
NIA_NGGT0089	Asset Information Models (AIM) for component/pattern recognition	A demonstration of saving through the building of a retrospective 3D model of an existing site using component recognition.	18
NIA_NGGT0090	Infrared photography for maintenance	Evaluation of the effectiveness of infrared cameras for maintenance, inspection and diagnostics when applied to compressor station plant assets.	14
NIA_NGGT0091	Installation risk and technology assessment model	The objective of the model is to develop the framework for a new low-cost connection strategy for in-line inspection across the entirety of the NTS installations.	14
NIA_NGGT0092	Utilisation of 3D Laser Scanners for pipeline damage and coating assessments	A full field assessment of a 3D laser scanning system in terms of pipeline damage assessments and coating evaluations.	14
NIA_NGGT0093	Ultrasonic testing of thin wall pipeline girth welds using high-frequency probes	To determine if by using higher-frequency probes acceptable results can be achieved to allow their use on thin wall pipe weld inspection.	14
NIA_NGGT0094	Gas quality 2020	Deliver an assessment of the likely impacts of legislative or supply changes on gas quality and the downstream impacts on the National Transmission System.	14
NIA_NGGT0095	Technical standards strategy	Innovative processes to support an agile technical standards management approach. Determine industry practice (pipeline operators and other industries) for the management and application of technical standards, and report findings.	18
NIA_NGGT0096	Seam weld identification	Investigate additional inspection technologies to enable identification of the Electronic Resistance welds (ERW)/High Frequency Welds (HFW) bond line and its position around the pipe circumference.	14
NIA_NGGT0097	Permanent PE slab protection	Use of polyethylene (PE) instead of concrete slabs to protect pipelines. Cheaper, safer and quicker to install. Additionally, the slabs are better for the environment. To date £767k has been saved in total.	13
NIA_NGGT0098	Composite pipe supports Phase 2	Develop a lightweight alternative pipe support for use on the NTS.	14
NIA_NGGT0099	Gas transmission network output methodology analytics	Pilot and select a monetised risk model(s) for trial on several asset categories.	18
NIA_NGGT0100	PRCI – Pipeline Research Council International 2016	Establish best practice technologies and techniques to allow safe, reliable, efficient and economic use of the gas network with a reducing impact on the environment through a membership to the Pipeline Research Council International.	14
NIA_NGGT0102	Acoustic Resonance Technology (ART)	Deliver a full assessment of the ART inspection tool through an ILI demonstration of an agreed NTS pipeline section.	14
NIA_NGGT0103	Artificial intelligence for pipe coating inspection	Improve quality and consistency of asset condition assessment data associated with the CM/4 process.	14
NIA_NGGT0104	Cognitive technology for technical standards	Assess and demonstrate the application of cognitive technology in an asset engineering sphere of knowledge.	17
NIA_NGGT0105	Risk Assessment Methodologies for Pipelines and AGIs 2016	Research into the enduring management of safety risks on pipelines and above ground installations. The project includes the implementation of the results via tools and methodologies that are equally relevant to the UK gas industry.	13
NIA_NGGT0106	EPRG – European Pipeline Research Group 2016	Establish and share best practice technologies across European Transmission Owners to allow the safe, reliable, efficient and economic use of the gas network with a reducing impact on the environment.	14
NIA_NGGT0107	Project EVA – Extreme Value Analysis	Develop an innovative approach to modelling extreme value risks that support investment decisions ongoing or as part of the Network Development Process (NDP).	14
NIA_NGGT0108	Combined CP and P remote monitor	Scope, design and prototyping of low-maintenance combined CP and pressure remote monitoring solution.	14
NIA_NGGT0109	Epoxy Grout investigation and analysis	Assess and qualify a new type of epoxy grout such that it is suitable for pipeline repair and epoxy tees.	14
NIA_NGGT0110	Advanced manufacturing (3D printing) of NTS-ready components	Explore advanced manufacturing techniques and define ongoing strategy for National Grid.	17
NIA_NGGT0111	Aerial Imaging Research (AIR)	Ongoing monitoring of selected aerial imaging technology fields and the periodic reassessment of technological maturity.	14

Project Reference	Title	Description	Chapter Number
NIA_NGGT0112	Noise mitigation tool	Evaluate pipework noise abatement techniques with the potential to improve the management of corrosion and simplify maintenance. Produce a toolkit to enable National Grid to evaluate cost and effectiveness of pipework noise abatement techniques.	16
NIA_NGGT0113	Induction heating	Evaluate induction heating techniques to assess the suitability to improve welding process within National Grid.	14
NIA_NGGT0114	Open source SCADA platform	Design and develop a standard SCADA system using open source technology that removes the complexities and demonstrates reduced TOTEX costs currently associated with SCADA systems.	15
NIA_NGGT0115	Valve care toolbox	Develop a 'toolbox of options' available for addressing valve stem corrosion.	14
NIA_NGGT0116	LiDAR to support NTS pipeline management	Assess two providers of LiDAR services to evaluate the capability of the techniques to support the ongoing management of gas transmission networks.	14
NIA_NGGT0117	NDT of welds by ultrasonic techniques	Investigate if recent advances in manual phased array non-destructive systems can be utilised to locate weld defects by developing a suitable test block that can then be used to show whether the subsequent techniques are capable of finding the relevant defects.	14
NIA_NGGT0118	Compressor data analytics	Test and evaluate a statistically-driven method of optimising compressor operation at sites and network-wide. Develop, trial and evaluate data analytics to provide prediction notification of running trip and fail-to-start for compressor units.	18
NIA_NGGT0119	PRCI – Pipeline Research Council International 2017	Establish best practice technologies and techniques to allow safe, reliable, efficient and economic use of the gas network with a reducing impact on the environment through a membership to the Pipeline Research Council International.	14
NIA_NGGT0120	EPRG – European Pipeline Research Group 2017	Establish and share best practice technologies across European Transmission Owners to allow the safe, reliable, efficient and economic use of the gas network, reducing impact on the environment.	14
NIA_NGGT0121	Risk Assessment Methodologies for Pipelines and AGIs 2017	Research into the enduring management of safety risks on pipelines and above ground installations. The project includes the implementation of the results via tools and methodologies that are equally relevant to the UK gas industry.	13
NIA_NGGT0122	EMAT – In-line coating disbondment detection assessment	Evaluate the effectiveness of using electromagnetic acoustic transducers (EMAT) for in-line coating disbondment detection.	14
NIA_NGGT0123	RUL determination for compressors 2	To model Remaining Useful Life (RUL) for each gas turbine by investigating the relationship between compressor health/performance to identify indicators of potential failure.	14
NIA_NGGT0125	Generation of intelligent P&IDs from Plant3D models	To automatically generate accurate an intelligent 2D schematic line diagram from a 3D model and provide a mechanism to validate and ensure data accuracy and consistency between data stored in the Ellipse asset database, the 3D model and within the P&ID.	18
NIA_NGGT0126	In pipe NTS liquid monitoring systems	Address the problem of detecting liquid ingress at NTS entry points through the development and testing of a prototype analyser which identifies the presence of liquid by means of a video identification system.	14
NIA_NGGT0127	Valve pits insulation	Replace the existing fibreglass with 4cm-thick plastic-coated insulation sheets in the gussets of the steelwork around the pits and assess the effectiveness of the new material.	16
NIA_NGGT0128	Open source SCADA platform Phase 2	Design and develop a standard SCADA system using open source technology that removes the complexities and demonstrates reduced TOTEX costs currently associated with SCADA systems.	15
NIA_NGGT0129	Investigate integrity of plain dents in grade L555 pipe	Comprehensive testing on plain dents to determine tolerance levels of L555 (X80 grade) pipeline. Incorporate the findings into P11 inspection procedures and update associated training.	14
NIA_NGGT0130	EPRG – European Pipeline Research Group 2018	Establish and share best practice technologies across European Transmission Owners to allow the safe, reliable, efficient and economic use of the gas network with a reducing impact on the environment.	14
NIA_NGGT0131	Overpipe geogrid protection against third party damage	Trial and demonstrate the suitability of over-pipe geogrid protection.	14
NIA_NGGT0132	PRCI – Pipeline Research Council International 2018	Establish best practice technologies and techniques to allow safe, reliable, efficient and economic use of the gas network with a reducing impact on the environment through a membership to the Pipeline Research Council International.	14
NIA_NGGT0133	Risk Assessment Methodologies for Pipelines and AGIs 2018	Research into the enduring management of safety risks on pipelines and above ground installations. The project includes the implementation of the results via tools and methodologies that are equally relevant to the UK gas industry.	13

Project Reference	Title	Description	Chapter Number
NIA_NGGT0134	Mobile condensate tanks	Prove the suitability of mobile condensate tanks as a replacement to fixed assets and provide a more holistic approach to condensate management across the NTS.	14
NIA_NGGT0135	Techno-economic feasibility of solid state CO ₂ capture	The object of this project is to carry out a techno-economic (TEA) and life cycle analysis (LCA) of the CO ₂ LOC process developed by Cambridge Carbon Capture (CCC) and compare it to other carbon capture utilisation and storage (CCUS) technology options.	16
NIA_NGGT0136	Destructive testing of set-in and set-on nozzle connection welds	Determine with the selection of a suitable non-destructive ultrasonic system and using suitably controlled techniques.	14
NIA_NGGT0137	Monitoring of real-time fugitive emissions (MORFE)	Develop the distributed emissions monitoring system into a more robust methodology and to use it as a reference system for classifying the performance of new low-cost sensor schemes to be developed under this project.	16
NIA_NGGT0138	Secure AGI – Intrusion Detection System (IDS)	To engineer a fit-for-purpose ICS intruder detection system solution, with inbuilt RTU and control and protection functionality, which will be tailor-made for use in a live AGI.	15
NIA_NGGT0139	Hydrogen in the NTS – foundation research and project roadmap	Answer key questions around the suitability of the NTS to transport hydrogen and develop a scope to test the assumptions made in the assessment.	17
NIA_NGGT0141*	Sarco Stopper	To develop an adequate vapour barrier isolation solution that allows operatives to complete pipe asset repair and maintenance activities without the risk of explosive gases propagating into the working area, while keeping any residual product in the main pipeline.	14
NIA_NGGT0142	Valve Care Toolbox 2	To develop the Valve Care concepts following the completion of Stage 1 of the VCT programme.	14
NIA_NGGT0143	Project Cavendish	To undertake a feasibility study to help support the potential of the Isle of Grain as a location for hydrogen production and storage.	17
NIA_NGGT0145	GRAID ART	Carry out a test using the revised Acoustic Resonance Technology (ART) algorithms and electronics to confirm operation on Coal Tar Enamel (CTE) pipework. Assess the feasibility and concept of incorporating ART onto the GRAID robot.	14
NIA_NGGT0146	Captivate – proof of concept	To complete the build and commissioning of CCC's containerised carbon capture demonstrator and install, commission and run trials using boiler-house flue gases on a National Grid gas site.	16
NIA_NGGT0147	Flow loop test for hydrogen	To evaluate the resistance to hydrogen embrittlement of conventional grade steel in wide use and commonly used girth welds. To evaluate changes in metallurgy of NTS representative pipe when exposed to a hydrogen rich gas mix under pressure.	17
NIA_NGGT0148	Gas quality blending services	A modelling study to determine the technical feasibility of a gas quality blending service at the St Fergus and Bacton entry terminals.	14
NIA_NGGT0149*	IGEM GQWG extension	Set up of a core group to drive the production of the standard and ensure appropriate representation from across the industry and supply chain.	17
NIA_NGGT0150	Non destructive testing of welds using ultrasonic Time of Flight Diffraction Techniques (TOFD)	Determine the selection of a suitable non-destructive testing technique that makes it possible to accurately size and reference defects within pipeline girth welds.	14
NIA_NGGT0151	EPRG – European Pipeline Research Group 2019	Establish and share best practice technologies across European Transmission Owners to allow the safe, reliable, efficient and economic use of the gas network with a reducing impact on the environment.	14
NIA_NGGT0152	PRCI – Pipeline Research Council International 2019	Establish best practice technologies and techniques to allow safe, reliable, efficient and economic use of the gas network with a reducing impact on the environment through a membership to the Pipeline Research Council International.	14
NIA_NGGT0153*	Risk Assessment Methodologies for Pipelines and AGIs 2019	Research into the enduring management of safety risks on pipelines and above ground installations. The project includes the implementation of the results via tools and methodologies that are equally relevant to the UK gas industry.	13
NIA_NGGT0154	Spatial GB clean heat pathway model	Provide a coherent modelling framework for regional energy demand-and-supply mapping that captures competition between low-carbon technologies and the impact that consumers, communities, distribution networks, and regional and national bodies will have on the national heat decarbonisation strategy.	17
NIA_NGGT0155	Hydrogen injection into the NTS	To understand what will be required to physically trial hydrogen within the National Transmission Network and to summarise all the potential ways this could be completed.	17

Notes:

* Project not registered.

Project Reference	Title	Description	Chapter Number
NIA_NGGT0156*	Hydrogen deblending in the NTS	National Grid, and the gas distribution networks intend to evaluate, develop and demonstrate the concept of implementing hydrogen blending and point-of-use 'deblending'.	17
NIA_NGGT0157*	Sample line assessment and tech watch	Survey of a representative sample of gas analysers to understand ways of improvement for planned replacement activities.	14
NIA_NGGT0158	Combined CP and pressure remote monitoring Phase II	Follow-on project to trial the technology in the field to monitor both CP current and pressure from the same terminal.	14
NIA_NGET0114	Industrial and commercial gas and electric scenario modelling	Select the best available techniques for developing various scenarios, collating data and developing new information to account for various complex inter-related market trends to provide a depth of analysis that will significantly enhance demand scenarios for these sectors.	18
NIA_NGET0135	Enhanced sensor development (ICASE Award)	Demonstrate the capability of a remote pipeline asset monitoring hub, incorporating energy harvesting and low-power sensor techniques.	14
NIA_NGET0144	Integrated electricity and gas transmission network operating model (ICASE Award)	Extend classical power system models to an integrated network operation model that considers the tighter interaction of electricity and gas systems.	14
NIA_NGGD0007	Development of DANINT FWAVC software for New Gas Chromatograph	Review and trial engineering software for data management of gas composition, Calorific Value and Volume Data.	14
NIA_NGGD0009	Orifice plate deformation	To improve the measurement of volume and energy flow through orifice plate metering systems by ensuring that orifice plate deformation is calculated correctly.	14
NIA_NGGD0019	Pipeline failure rate determination due to inland natural landsliding	Enable National Grid to better quantify the risk of natural landslides affecting its high-pressure gas network.	14
NIA_NGGD0022	Study of crater formation threshold during gas leakage on high-pressure pipes	To develop and validate a methodology and a model in order to determine the limit between crater formation and dispersion of gas in soil for high-pressure pipes.	14
NIA_NGGD0094	Composite repairs to complex shapes	Guidance detailing the design and installation requirements for the repair of part-wall, blunt, metal loss defects associated with complex geometry components.	14
NIA_SGN0092	Pit protect	Prove the viability of using a purpose-designed pit wall coating and associated deployment equipment to prevent pit wall water ingress on the GB gas network.	14
NIA_SGN0094	Energy map and plan	This project aims to complete a study that clearly articulates the net benefits to GB consumers and the GB economy of retaining the use of gas networks within the energy infrastructure mix.	16
NIA_SGN0113	Quality impacts on industrial and commercial applications	Applied research into the effects of a wider gas Wobbe Index including blended hydrogen mixtures (up to 20 per cent H ₂) on Industrial and Commercial gas users.	18
NIA_SGN0134	Feasibility study into 2% hydrogen blending at St Fergus and H2 pipeline and hub at Aberdeen	To develop the understanding associated with injection of 2 per cent hydrogen into the NTS.	17
NIA_SGN0140	Derivation of a risk-based approach to high pressure filter and pig trap closure inspection frequencies	Use modern techniques and tools to develop new defect acceptance and allowable defect limits to feed into a new Examination Specification. Development of a risk-based inspection regime for cast steel filter bodies and cast steel pig trap closures.	13
NIA_SGN0144	Assessing the gas network decarbonisation pathway	Examine alternatives to support the development of policy and regulatory change around decarbonisation of gas networks. Develop a shared view of the pathways and decision points for changes to the networks, and their operation, to support decarbonised gas among the GB gas network licensees.	17
NIA_WWU_045	Eye in the sky	Using drones to inspect energy infrastructure flying Beyond Visual Line Of Sight (BVLOS). Benefits of this project will define an operating model for utilities to apply for BVLOS flying and inspection, potentially reducing the number of helicopter surveys giving both a financial and safety saving.	13

Notes:
* Project not registered.

**National Grid Gas Transmission
National Grid House
Warwick Technology Park
Gallows Hill
Warwick
CV34 6DA**

www.nationalgrid.com/innovation