Gas
Transmission

Delivering your future gas transmission system

National Grid Gas Transmission's draft business plan 2021-26

nationalgrid

July 2019

Who we are and what we do

We are National Grid Gas Transmission (NGGT) and we are proud to own, manage and operate the high-pressure gas national transmission system (NTS) in Great Britain (GB). Our network is a gas superhighway that connects our nation; we balance supply and demand on a day-to-day basis to make gas available when and where it's needed. We develop, maintain, and operate an economic and efficient network and we facilitate competition in the supply of gas in GB to keep energy costs to consumers as low as possible.

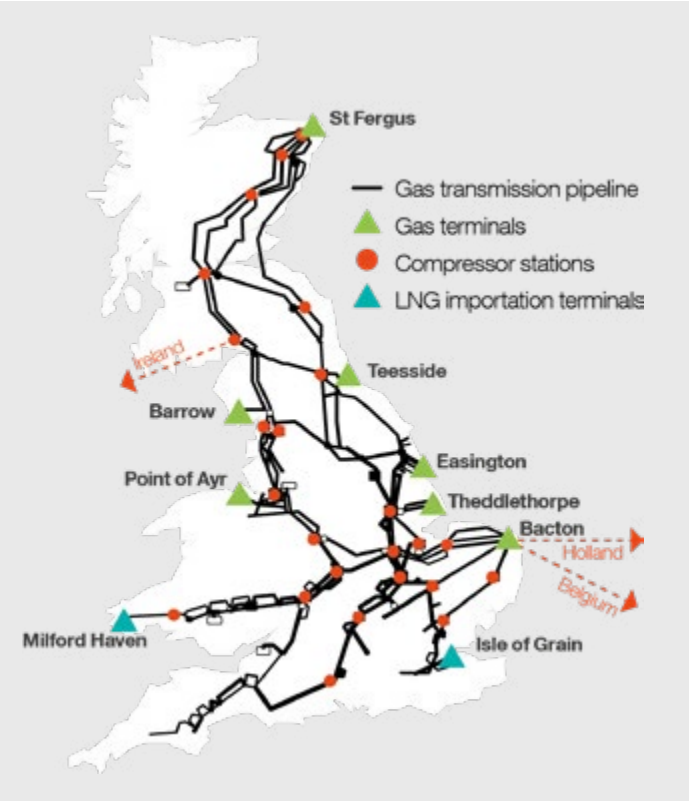
We are at the heart of the energy system as the combined gas transmission system operator (TSO), undertaking both the gas transmission owner and system operator roles. Today, gas delivers three times as much energy as electricity; it keeps 80% of the UK's 28 million homes[1] warm and comfortable, generates electricity and fuels industrial and manufacturing processes. Failure to supply gas (especially to vulnerable consumers), and any major uncontrolled release of gas from the high-pressure network, are both potential threats to life and property.

The network includes pipes and compressor stations. They connect production through terminals to the distribution systems. In the UK, gas enters the transmission system through importation, reception terminals, storage facilities and interconnectors. From our Gas National Control Centre (GNCC), we meet changing customer needs by optimising the physical configuration of assets and utilising commercial tools. Compressor stations located along the network play a vital role in keeping large quantities of gas flowing through the system to the areas of demand. The network must be kept constantly in balance, which is achieved by buying, selling and using stored gas.

Part of a leading FTSE 100 company with a social purpose

We are part of National Grid plc. We support the highest standards of governance required by the London and New York stock exchanges. We are committed to being a responsible business. We want to be a force for positive social and environmental change so we act responsibly in everything we do, and also in the way we do it. This belief is fundamental to the way we work at National Grid.

Our gas transmission network



Our gas transmission network comprises approximately:

7,660km
of high pressure pipeline

600
above ground installations

24
compressors sites

[1] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/729317/Energy_Consumption_in_the_UK__ECUK__2018.pdf

National Grid Gas Transmission
Welcome to our draft business plan

We are an organisation with a purpose: we bring energy to life.

That purpose drives our vision to do two things: exceed the expectations of our customers, shareholders and communities today and make possible the energy systems of tomorrow.

We believe our nation should have a clean, reliable energy system to help address the effects of climate change, improve the quality of the air we breathe and power growth and prosperity in our economy for future generations.

We are committed to continue delivering a safe, reliable and resilient network for homes, businesses and communities both today and into the future. And to play our part in decarbonising Great Britain's energy system so that the transition to a clean energy system is fair and leaves no-one behind. We want to achieve all of this at the lowest possible cost for current and future bill payers.

Even though the precise pathway to achieve the government's recent commitment to Net Zero[2] by 2050 is uncertain, it is clear gas has an important role to play in supporting the transition to low carbon electricity, heat, industry and transport at the lowest cost and with least disruption to consumers. We are fully committed to playing our part in this transition.

That is why this draft plan matters. Against the backdrop of uncertainty, it covers a crucial five-year period from 2021 to 2026. It sets out what we will do to support a reliable, cleaner whole energy system, improve services for our customers and it describes our commitments to enhance the environment.

The plan we have set out will help us to make a positive impact on society for the benefit of everyone. We balance the needs of today's and tomorrow's consumers by delivering our commitments. We will keep our portion of domestic consumers' energy bills at or below £10[3] in the short-term, and invest for the longer-term to keep energy flowing, maintain security of supply in a digital age and enable the transition to low carbon electricity, heat and transport.

We are proud to provide an essential service and our core values reflect the responsibilities that go with that:

Safety above everything **We always do the right thing** **We find a better way**

We continue engagement with you on this draft plan and will take comments on board for our next draft plan in October.

[2] https://www.gov.uk/government/news/pm-theresa-may-we-will-end-uk-contribution-to-climate-change-by-2050
[3] Excluding inflation

Part 1
Executive summary

1. A message from our Chair

Great Britain is highly dependent on a safe, reliable and resilient gas transmission system.

Presently, 80% of homes rely on natural gas for heating as do many businesses, commercial properties and public buildings such as schools and hospitals. Gas is also crucial for many large-scale industrial processes. Gas is used for 40% of electricity generation, supporting the removal of coal and providing flexible back-up for intermittent generation.

For the future, we recognise the urgent need to tackle climate change. We support the government's commitment to Net Zero by 2050 and recognise gas has an important role to play in supporting the transition to low carbon electricity, heat, industry and transport. It provides the reliability and flexibility to support growth in renewable generation and it gives Great Britain options to decarbonise commercial vehicles and industry. Perhaps most importantly, gas can also help to decarbonise heat, the biggest source of UK carbon emissions, at the lowest cost and with least disruption to consumers.

To provide this essential service to society today and into the future we have carried out our largest-ever listening exercise with you for this draft plan, which reflects our collective thinking. For the first time, we have built our plan around your feedback. Our independent stakeholder user group scrutinised our proposals as we have built our plan, challenging us to respond directly to your views; we hope the resulting draft is both easy to understand and clear on what we will deliver to you and why it matters. Our plans must deliver long-lasting benefits for energy consumers.

Our commitment to you is to maintain a world-class gas network that supplies gas when and where it's needed while keeping our costs as low as possible, in a way that's sustainable and safe. We will do this for today's and tomorrow's customers and consumers and we'll help to deliver the least cost pathway to decarbonise our energy system.

To meet this commitment, we must address some challenges. Within the changing energy landscape, we are managing an ageing network with many assets at the end of their design life. Now's the time when we must make some important decisions on replacing, maintaining or decommissioning them. These decisions have long-term impacts on cost, risk and the level of network capability we offer to stakeholders, so we will be engaging closely with you about our network capability framework. We will also consider further the potential implications of the government's commitment to Net Zero by 2050 and discuss that with you over the summer.

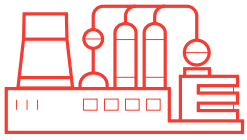
Finally, this is a draft plan, reflecting the input we have received so far. We are still listening to your views and we will engage further before making the final submission to our regulator, Ofgem, in December.

Nicola Shaw
Chair of National Grid
Gas Transmission

2. How we have delivered in RIIO-1

Our RIIO-2 plan is based on our strong track record for delivering value for consumers in the current regulatory period. We have taken learnings from RIIO-1 to inform how we can better deliver in RIIO-2, carrying forward delivery performance, cost performance and innovation benefits.

Annually, we produce a regulatory report pack that is provided to Ofgem and published on our on our website. This has allowed all stakeholders to understand how we have performed throughout the RIIO-1 period and it is available here[4].

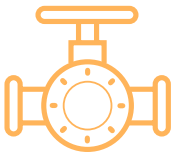


Keeping the gas flowing

We have maintained reliability and efficiently facilitated the delivery of 99.9896% of gas requirements for customers, allowing consumers to use gas as and when they want.

Improving customer and stakeholder satisfaction

Our customer and stakeholder satisfaction scores are increasing. Customer satisfaction has gone from 7.1 to 7.8, and stakeholder satisfaction from 7.7 to 8.1.



Investing in the health of our assets

We met our Network Output Measures (NOMs) targets by investing £100m more than our regulatory allowances to maintain the health of our assets.

Protecting the gas network

We have upgraded the physical security of key infrastructure sites and improved our data centres to protect against external threats.

Innovating to reduce costs

We have provided value of £4 for every £1 invested in innovation.

Serving new customers

Our Customer Low Cost Connections (CLoCC) project substantially reduces the time and cost to connect for new customers.

Reduced environmental impact

All-time low rate of nitrogen oxide (NOx) resulting from the investment strategy we have made on the network.

World-class safety performance

We have achieved zero injuries to the public and world-leading safety performance.

Delivering value for money

We have driven efficiency across our business, including a £45m saving by the end of RIIO-1 through our UK efficiency programme.

[4] https://www.nationalgridgas.com/about-us/business-planning-riio/how-were-performing
https://www.nationalgridgas.com/sites/gas/files/documents/National%20Grid%20Gas%20SO%20Incentive%20Supporting%20Information%202017-18%20v10.pdf

3. Building a stakeholder-led plan

We have built our plan by listening and incorporating feedback from our customers, stakeholders and consumers. Over the last two years, we have carried out our most extensive ever listening exercise to understand your priorities and future requirements. We have undertaken engagement connecting with more than 500 stakeholders, 3,000-plus domestic consumers and 1,000 major energy users.

Together with National Grid Electricity Transmission (NGET), we were the first network to establish our independent stakeholder user group. They have been challenging and reviewing how we engage with stakeholders in developing our business plan.

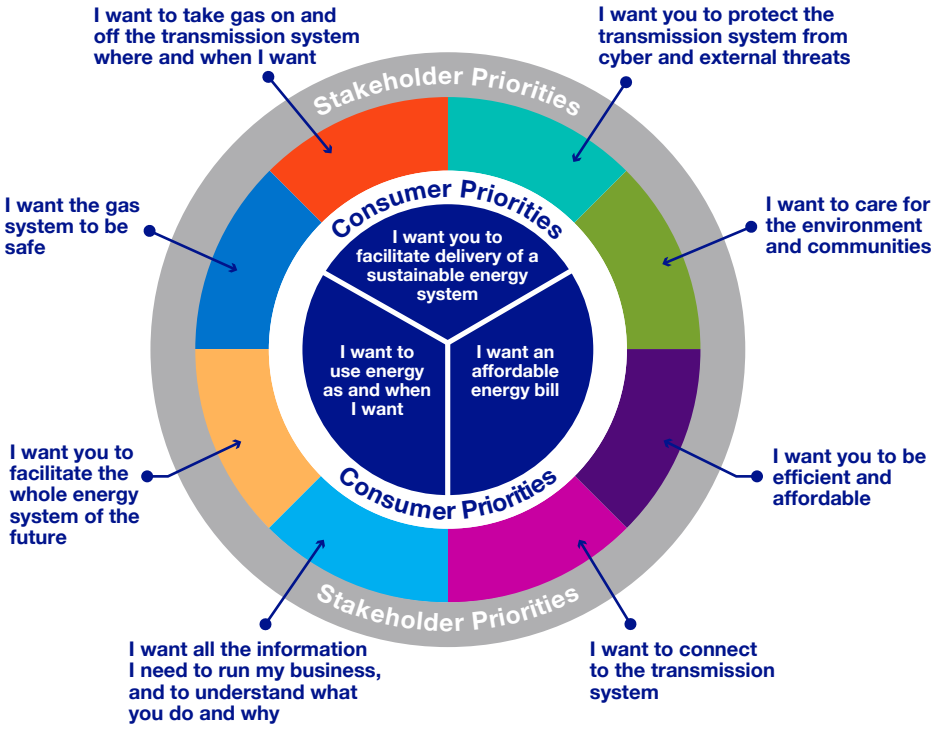
We have provided more information about our emerging ideas for our business plan to you, our stakeholders, than ever before including a consultation in February 2019[5]. Thank you for your feedback.

What you've said

We've built our draft business plan around what you've said. As consumers, you've told us your three main priorities:

- **I want an affordable energy bill** – Our network and facilitation of the market allows our customers to supply gas to where and whom they want, helping keep wholesale costs low to the ultimate benefits of consumers.
- **I want to use energy as and when I want it** – Consumers expect us to provide a highly reliable service.
- **I want you to facilitate delivery of a sustainable energy system** – You want us to support the energy system transition whilst minimising disruption to your life and our impact on the environment. Throughout our stakeholder engagement we have promised to continue to listen and respond to your feedback. And throughout our consumer engagement programme we identified that the environment, particularly as we move towards a decarbonised energy system, is very important to consumers. We therefore amended our third priority to better reflect this. It was previously 'I want you to minimise disruption to my life.'

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 most fit for the future solutions. We will continue to engage on these important topics over the summer, alongside exploring with domestic consumers the overall acceptability of our plan.



[5] https://www.nationalgridgas.com/document/125911/download

4. Our draft proposals and costs for RIIO-2 at a glance

This plan has been shaped by what we have heard against the priorities of our stakeholders and consumers; it is ambitious, innovative and will be challenging to deliver. We will work towards its goals with you, so that our actions are transparent, and we can deliver effectively on our commitments.

Our draft proposals forecast an average annual total cost in RIIO-2 at £599m (excluding pass through costs, potential customer triggered network reinforcement and real price effects). Below, we have presented what we plan to do against each stakeholder priority, organised into Ofgem's three output categories:

Maintain a safe and resilient network

I want the gas system to be safe
Forecast cost £14m per year

- Maintain our world-class level of safety whilst continuing to pursue our goal of zero harm to protect the public, our assets and people
- We will comply with legislation through routine and preventive safety activities

I want to take gas on and off the transmission system where and when I want
Forecast cost £288m per year

- Deliver the network capability that meets our stakeholders' needs
- Invest £888m in our asset health programme to maintain our current level of reliability and availability
- Invest in systems and capabilities to optimise operation of our network to ensure customers' requirements are met

I want you to protect the transmission system from cyber and external threats
Forecast cost £123m per year

- Invest £617m to improve resilience to cyber and physical attacks on the transmission system

Deliver an environmentally sustainable network

I want you to facilitate the whole energy system of the future – innovating to meet the challenges ahead.
Forecast cost £21m per year

- Play a leading role in the whole energy and decarbonisation debate
- Invest in capabilities and systems to understand the most efficient options for the future whole energy system
- Drive innovation to enable solutions for decarbonising the industry

I want you to care for the environment and communities
Forecast cost £72m per year

- Deliver two new commissioned compressors in RIIO-2 and complete five more by 2030 to improve air quality and reduce NOx emissions
- Reduce the carbon footprint of our business
- Take action at 77 redundant sites and assets, seeking to enhance the natural environment where possible
- Continue our support for the communities we work in and commit 0.3% of what we spend on major projects to supporting community initiatives

Meet the needs of consumers and network users

I want to connect to the transmission system
Forecast cost £2m per year

- Be more responsive to the needs of connection customers, improving our customer satisfaction scores
- Embed the improvements resulting from our Customer Low Cost Connections (CLoCC) project into business as usual, enabling standard connections for less than £1m in under 12 months

I want you to be efficient and affordable*

- Commit to 4% efficiency on our total capex across RIIO-2
- Build in 7.4% operational cost efficiency from our RIIO-1 UK efficiency programme
- Commit to a further 5.6% operational cost efficiency across RIIO-2
- Continue to benchmark, market test and use native competition throughout RIIO-2

I want all the information I need
Forecast cost £13m per year

- Enable competition and foster innovation by sharing our data openly wherever possible
- Collaborate and share data with network companies to build a whole system view
- Invest in our people and systems, to develop new capabilities allowing us to support more information sharing
- Provide more transparency around our financial and operational performance

***Business support costs to deliver against our key priorities – forecast cost £65m per year**

Pass through costs such as licence fees and tax – forecast cost of £170m per year

5. Consumer benefits

Our proposals will deliver consumer benefits as shown below in relation to our three consumer priorities:

Maintain a safe and resilient network

I want the gas system to be safe

"I want to use energy as and when I want" – our commitment to safety-related inspections, maintenance and asset replacement avoids unplanned downtime of network elements, which could disrupt continuity of gas supply.

"I want you to facilitate delivery of a sustainable energy system" – focus on zero harm protects society from potential disruption and damage to public health, business, transport and the natural environment.

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

"I want to use energy as and when I want" – enabling a wide range of supplies ensures gas is reliably available.

"I want you to facilitate delivery of a sustainable energy system" – it is in consumers' interests to keep future energy options open which we will deliver by determining and delivering the network capability our stakeholders need.

"I want an affordable energy bill" – reliability enables access to the lowest cost gas supplies, impacting the wholesale cost energy consumers incur.

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

"I want to use energy as and when I want" – improve the safety and resilience of the network to ride through and recover from malicious events that threaten to disrupt continuity of GB energy supplies.

Deliver an environmentally sustainable network

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

"I want you to facilitate delivery of a sustainable energy system" – defining the solutions for decarbonising heat, providing the costs and implications for consumers, to support a pathway that minimises disruption.

"I want an affordable energy bill" – whole energy system collaboration offers networks the potential to respond to changing needs and reduce consumer costs. Focusing on delivering and embedding innovation to deliver the energy transition ensures the most effective long-term solutions are taken forward.

I want you to care for the environment and communities

"I want you to facilitate delivery of a sustainable energy system"– cutting greenhouse gas emissions reduces our impact on climate change, with clear benefits for society including improved air quality. Improving biodiversity and reconstructing the environment when we have demolished a site brings positive benefits to nature and communities.

"I want an affordable energy bill" – responsible demolition protects future consumers from the costs of disposing of assets they may not have benefited from whilst promoting environment net gain activities.

Meet the needs of consumers and network users

I want to connect to the transmission system

"I want to use energy as and when I want" – making it easier for new sources to connect, so diverse domestic and international sources of gas can access our network efficiently.

"I want you to facilitate delivery of a sustainable energy system" – make it easier for lower carbon biogas and gas-powered vehicle refuelling stations to connect, assisting decarbonisation with minimal disruption to consumers.

"I want an affordable energy bill" – where possible we provide capacity without building new assets, facilitating liquidity in the competitive wholesale energy markets which keeps costs low for consumers.

I want you to be efficient and affordable

"I want an affordable energy bill" – embedding efficiencies, focusing on the most efficient and effective solutions and reducing returns from day one of the new price control will keep costs down for consumers.

Uncertainty mechanisms ensure spend is directed at maximum consumer benefit even when circumstances change.

Facilitation of the wholesale market, has a positive impact on the wholesale energy cost for consumers. Balancing costs between current and future consumers ensures fairness.

I want all the information I need

"I want an affordable energy bill" – our information and insights provide value for consumers by ensuring that the gas market runs smoothly. It also promotes competition in the wholesale market.

6. What drives our costs?

RIIO-2 expenditure

To achieve the outcomes our stakeholders want and need, our draft proposals forecast our average annual total costs in RIIO-2 at £599m, (excluding pass through costs, potential customer triggered network reinforcement and real price effects) an increase from £403m in RIIO-1.

£352m (per year) of our totex plan for RIIO-2 relates to three areas of investment:

- expenditure to maintain reliability with many assets at the end of their technical design life
- expenditure to increase resilience by protecting the transmission network from rising cyber and physical security threats
- expenditure to meet emissions legislation compliance by 2030.

The proposed investment directly links to our commitment to maintain a world-class gas network that supplies gas when and where it's needed, while keeping our costs as low as possible, in a way that's both sustainable and safe.

We are also mindful that to meet this commitment, we must get the balance right between network reliability and the cost to consumers today and into the future. Within the changing energy landscape, we are managing an ageing network with many assets at the end of their design life. The decisions we make today have lasting impacts on cost, risk and the level of network capability we offer to stakeholders. The plan reduces network capability in the future due to decisions we are making now and we want to ensure these trade-offs are fully understood. We will consult further with you to discuss the implications of these plans to ensure our proposals meet your needs.

A summary of the key drivers and levels of investment, based on stakeholder feedback to date, is:

- **Managing an ageing network with many assets at the end of their design life (£178m pa)**. We're experiencing more condition-related issues. We have started to deal with these issues in RIIO-1 by investing £100m over our allowances. For RIIO-2, we have provided evidence that we will need to increase our spending to maintain the health of our assets. We have tested the deliverability of our plan in the long term over a 10-year period, applied efficiencies derived through our focus on enhancing our capability in RIIO-1 and will continue to deliver our works using native competition.

  For asset health work on our compressor fleet, we will test to ensure our proposed investments meet your current and future network capability needs. As we move forward, our asset decisions will need to be assessed using this approach.

  To deliver the network capability you need and to maintain asset health across our network, we are forecasting a need to maintain a similar level of cost as proposed for RIIO-2 to at least 2030.
- **Timely delivery of emissions legislation compliance by 2030 (£51m pa)**. We have 28 compressor units that are subject to the Medium Combustion Plant Directive (MCPD) and we need to make decisions now on the solutions. Based on the network capability you have currently indicated that you need, we are proposing limiting new compressor installations to two in RIIO-2 and a further five in RIIO-3. For a further 21 compressor units we are exploring decommissioning and derogation solutions and will test this with you during the summer, before finalising our plans.
- **Protecting the transmission network from rising cyber and physical security threats (£123m pa).** We are working with the Department for Business, Energy & Industrial Strategy (BEIS), Ofgem in their joint role as competent authority, and with the Health and Safety Executive (HSE) to assess our existing cyber protection capability and confirm the further works that will be required to protect against these threats.

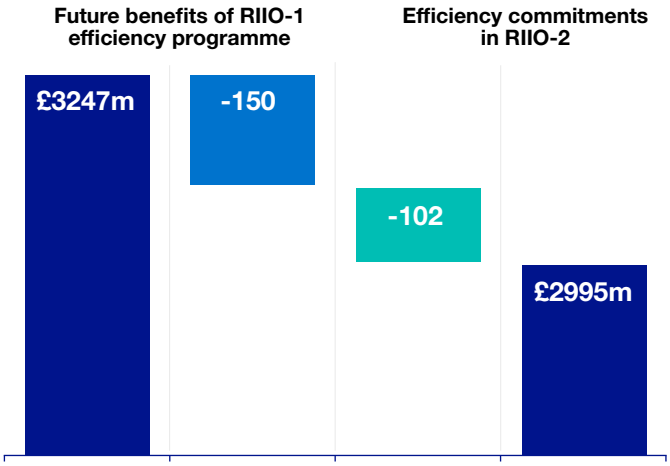
Being more efficient to deliver value for money

To deliver our proposals as cost-effectively as possible we have challenged ourselves to drive efficiencies across our activities. We have done this by:

- building in the future benefits of our stretching UK efficiency programme, **saving £150m** over the full RIIO-2 period
- making an ambitious commitment to further **reduce our operating costs by £22m**. This represents a further 5.6% improvement in our operating productivity by the end of RIIO-2, nearly three times the government's forecast of UK productivity growth. The outcome of our total operational cost efficiencies will mean our RIIO-2 costs are 13% lower by the end of the RIIO-2 period than today's level
- building in the benefits of our past successful engineering and asset management innovations to include a 4% efficiency on our direct capital investments, **saving £80m.**

What drives our costs? continued

Figure 5.1
Five year total efficiency benefits



In addition to the efficiency improvements and commitments we have applied, we have challenged ourselves to focus on the most effective and efficient activities that will deliver the network capability needs of our stakeholders. We have proposed a plan on future compressors over RIIO-2 and RIIO-3 that will result in the remaining 21 compressors being decommissioned or derogated at a cost that's significantly lower than replacing these units. This has the potential to **save consumers over £300m in RIIO-2 and £263m in RIIO-3.**

Overall, we are reducing the costs of delivering your priorities in RIIO-2 by **£552m**.

We are conscious that undertaking our activities effectively has a more far-reaching impact on consumer bills than the cost of our activities alone. By facilitating the effective functioning of the gas market we have a positive impact on the wholesale energy cost for consumers. This impact was supported by a recent study by EY. This concluded that even with perfect foresight and not taking account of an unexpected short-term shock, failure to maintain the existing capability of the NTS could have significant impacts on GB consumers, adding up to £877m per annum to electricity wholesale prices by 2035.

Financial framework

We have developed our business plan to deliver on our stakeholders' priorities and provide value for money. Part of this is ensuring that our draft plan balances the needs of investors with the needs of consumers today and into the future. Getting an appropriate financial framework which is transparent, robust and reflects the risks and long-term nature of the investments is vital in ensuring networks are able to fund future infrastructure efficiently and sustainably. Within our plan, we propose an appropriate base return due to shareholders (called the "cost of equity") which rewards them for the risk that they take in investing in a transmission business:

- we recognise that there are economic reasons why the cost of equity should be lower in the RIIO-2 period than it was in RIIO-1 but not to the extent Ofgem has indicated in their RIIO-2 Sector Specific Methodology document published in May.
- our plan assumes a base return of 5.5% which is consistent with our response to Ofgem's December 2018 RIIO-2 framework consultation, as this level of return better reflects the risks of running a transmission business and gives a more sustainable long-term risk/reward balance.
- the financial package we propose incentivises networks to innovate so we can deliver stakeholders' needs in the uncertain whole energy system transition.

We consider Ofgem's proposals for return are incorrect because they involve errors in the approach, arbitrary adjustments and the selective use of available evidence. Our assumption of 5.5% better reflects the risk of running an gas transmission business and provides a sustainable long-term risk/return balance. The base return we propose enables and encourages us to innovate to meet the huge challenges required to deliver the clean energy system of the future.

Use of an appropriate return is important to the resilience of the energy sector as a whole, but nowhere is it more pronounced than in transmission, where the uncertainty and complexity of investment required, and the scale and pace of market disruption is markedly higher than in other sectors. We have also seen growth in the cyber threat to our assets and the risk of political intervention in our operations over the last few years. These are risks which as a network we are best placed to manage because our customers and consumers do not have the ability to mitigate.

7. Our impact on energy bills

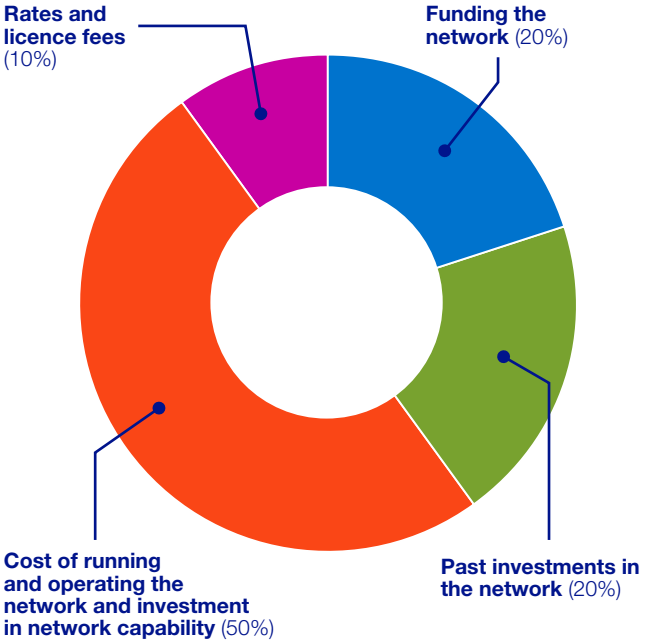
Our plan keeps our portion of a domestic end consumer's energy bill at or below £10 per year before inflation.

Whilst the increased expenditure required to deliver our RIIO-2 proposals brings an additional ~70p to the domestic end consumer bill, we can finance and make all the investments in our draft plan without increasing our part of the bill by:

- accepting a lower return from day one of the next price control period
- embedding savings in our underlying operating costs to reduce them by 13% from 2018 to 2026
- including 4% efficiency in our direct capital investments.

We will check our plan and its costs with domestic consumers through acceptability testing.

How our £10 per year portion of the domestic bill breaks down



Funding the network: upfront spend comes with an associated cost of raising funds, this is similar to the interest paid on a loan.

Past investments in the network: the cost of past investments in the gas networks is spread so consumers pay over the life of the assets. This portion relates to cost in prior regulatory periods.

Cost of running and operating the network and investment in network capability: the cost of work to deliver network capability within the current regulatory period is spread so consumers pay over the life of the assets. This also covers the day-to-day costs of running and operating a safe and reliable network.

Rates and licence fees: the obligatory charges that we have to pay in order to operate.

Ofgem has not finalised the financial model which will calculate revenue for RIIO-2 but using the figures set out in this plan, we estimate that our underlying revenue in RIIO-2 will be broadly flat compared to the average level in RIIO-1. There will be annual fluctuations from the underlying trend due to regulatory framework items such as uncertainty mechanisms and past investment adjustments. We are proposing changes to the framework, which will reduce these fluctuations, so for this draft plan we have focused on explaining the underlying revenue trends. The final framework will impact on the actual bill consumers and our customers incur. We are working with our customers and industrial and commercial consumers so they can understand the potential implications of the plan on them and we will provide further information once Ofgem has finalised the financial model to calculate revenues for RIIO-2.

Balancing costs between current and future consumers

Given the need for investment in RIIO-2 and beyond, and the changing future energy landscape in relation to gas usage as we decarbonise Great Britain's energy system, it is important we, and our regulator Ofgem, take account of the balance of cost that current and future consumers will pay. There are two areas of our plan which reflect our initial views in these areas for RIIO-2:

- Ofgem proposes a move to a new Consumer Prices Index (CPIH) metric for indexing our revenues, which will increase bills for today's consumers but lead to lower costs to consumers in the future. Whilst we are supportive of this change it should be neutral to consumers and investors and not be used as a tool to reduce the cost of equity for the transmission business, which should reflect the risks and long-term nature of the investments.
- To manage and recognise the uncertainty driven by the future transition to a net zero carbon economy we have proposed, and will consult further on, accelerated regulatory depreciation during RIIO-2. This is aimed at matching revenue with the usage of our assets and managing the potential risk to future consumers given the uncertainty linked to the energy transition.

8. Summary and next steps

We are confident our business plan is underpinned by solid foundations. We have embraced the new enhanced engagement arrangements introduced for RIIO-2 to thoroughly challenge and review our business plan. Already, this has brought significant improvements to the draft plan and we will continue to listen and act on the challenges as we build further versions. We have used techniques such as external benchmarking, engineering justification reports and cost-benefit-analysis (CBA) to make sure our plans are robust and we have built in efficiencies and benefits from innovation realised in RIIO-1. We have modelled key financial assumptions, including accelerated depreciation and asset lives and we are confident that our plan is deliverable across RIIO-2 and RIIO-3.

Next steps

This is our draft plan and builds on what we have heard from our February 2019 consultation on 'shaping the gas transmission system of the future'.

- During the summer we want to talk to you again to make sure this plan delivers the network capability you need now and into the future. This process might change the draft plan content, the total cost and the impact on consumer and customer bills.
- We will be reflecting on Ofgem's RIIO-2 decision document published in May 2019 and will set out more detail on incentives and other mechanisms Ofgem has proposed in our October draft plan.
- We will engage with you on the potential implications of the government's commitment to Net Zero by 2050 and talk to you about the potential role and activities that we should include, either in our plan or by ensuring the regulatory mechanisms around whole energy systems allow us to propose solutions for your long-term needs.
- We have identified that the proposed project at our Bacton terminal may meet the criteria of competition as defined by Ofgem in their May 2019 decision document. In addition, it is possible that the solution to reinforce the network in south Wales will meet the competition criteria if the customer progresses with this scheme. We will discuss these with Ofgem to decide how they should be taken forward.
- Once Ofgem has finalised the financial model to calculate revenues for RIIO-2, we will provide further information to help industrial and commercial consumers understand the potential implications of the plan on them.
- We will carry out nationally representative quantitative domestic consumer research to test whether our proposals hit the mark.
- We will continue the dialogue with you on our plan and will take comments on board for our next draft plan in October, alongside comments from our independent stakeholder user group and the RIIO-2 Challenge Group.

We welcome your continued input and feedback throughout 2019 to ensure this plan delivers for you now and into the future.

9. Our plan for assuring our final business plan

The board of National Grid Gas has been fully involved in developing this draft plan. For our final business plan in December we are planning for our board, including our sufficiently independent directors, to provide formal assurances on the quality of our plan. Board members of our parent company, National Grid plc, have also been involved in developing this draft plan. This page describes the assurance processes that we will follow for our final business plan in December.

Our plan uses accurate, high-quality information

We have in place a programme to make sure that our board members have the information and confidence they need to assure our final business plan.

We have a strong control and assurance culture built on the tough rules that apply to us such as the London Stockmarket listing rules, the UK's corporate governance code and the USA's Sarbanes–Oxley requirements for publicly-listed companies. Our RIIO-2 assurance plan builds on these strong existing assurance systems.

We have performed a full risk assessment of our RIIO-2 business plan and designed an assurance plan using the following three lines of assurance:

- business unit management
- internal independent team
- external or internal audit

We have engaged an external expert consultancy to independently review and advise us on our risk assessment and planned assurance approach and we will complete our assurance work for our final business plan in December.

The statements we will ask our Board to make on the final business plan

We are working towards providing our Board with the confidence to make statements in relation to the following areas:

- the board's ownership of the overall long-term strategy that underpins the plan.
- the quality of the underlying information.
- the quality of our cost forecasts, including how they are value for money.
- meeting our statutory and licence obligations.

Our National Grid gas transmission board members

Nicola Shaw
Chair

Phil Sheppard
Director Gas Transmission

Chris Bennett
Director Regulation

Alan Foster
Chief Financial Officer

Fintan Slye
Director System Operator

Dr Cathryn Ross
Sufficiently independent director

Dr Clive Elphick
Sufficiently independent director

Alexandra Lewis
Treasurer

10. How our draft plan maps to Ofgem's business plan guidance

We have built our draft business plan around your key stakeholder priorities. Our regulator, Ofgem, will be assessing our final business plan against guidance it issued on 3 June 2019. We will reflect this guidance in our October draft plan, but in the meantime the table below shows how this draft plan maps to Ofgem's guidance.

No.	Ofgem assessment criteria	Location of our evidence
1	Track record	Each of our stakeholder priority chapters includes a summary of our current performance. Please also see our RIIO-2 challenge group response and our annual RPP reports.
2	Business plan commitment	Chapter 9 – how we will assure our final business plan.
3	Giving consumers a stronger voice	Chapter 20 – creating a stakeholder-led plan. Annexes on independent stakeholder user group set up, stakeholder strategy and engagement report. Each of our stakeholder priority chapters explains what our stakeholders have told us and any relevant engagement logs.
4	Meet the needs of consumers and network users	Each of our stakeholder priority chapters explains our proposals for network users and consumer benefits. Chapter 26 – I want all the information I need to run my business, and to understand what you do and why Chapter 27 – I want to connect to the transmission system
5	Maintain a safe and resilient network	Chapter 21 – I want the gas transmission system to be safe. Chapter 22 – I want to take gas on and off the transmission system where and when I want Chapter 23 – I want you to protect the transmission system from cyber and external threats.
6	Deliver an environmentally sustainable network	Chapter 24 – I want you to care about the environment and communities. Chapter 25 – I want you to facilitate the whole energy system of the future – innovating to meet the challenges ahead.
7	Enabling whole system solutions	Chapter 25 – I want you to facilitate the whole system of the future – innovating to meet the challenges ahead.
8	Managing uncertainty	Each of our stakeholder priority chapters includes how we manage risk and uncertainty. Annex on uncertainty mechanisms.
9	Innovation	Chapter 25 – I want you to facilitate the whole system of the future – innovating to meet the challenges ahead.
10	Competition	Chapter 28 – our plan is efficient and affordable, providing value for money
11	A consistent view of the future	Part 2 – context
12	Cost information	Chapter 30 – our plan is financeable. Business plan data templates. Investment decision pack, which includes our engineering justification reports and cost benefit analysis.
13	Financial information	Chapter 30 – our plan is financeable.

How to navigate our draft plan

Our draft business plan matters to people with a variety of different interests, including consumers. We have written our draft business plan with our customers and industry stakeholders in mind and it will be reviewed by our independent stakeholder user group and the RIIO-2 challenge group.

Part 1: Executive summary

This is a high-level outline of how we built our plan, what it delivers and the benefits it will deliver to consumers.

Part 2: Context

We describe the context and how this affects our plan.

Part 3: Approach to our RIIO-2 business plan

The principles we have built our plan on and how we will deliver the plan.

How to navigate our draft plan

Part 4: Our draft plan is built on stakeholder priorities

How we have built our plan and the detail of our proposals.

How we have used our engagement approach to build a truly stakeholder-led plan.

We show how we deliver your priorities through our proposals by following our 'Golden Thread' structure:

- What is this stakeholder priority about?
- Our activities and current performance
- What are our stakeholders telling us?
- Our proposals for RIIO-2 and how they will benefit consumers
- How will we deliver?
- Risk and uncertainty
- Our proposed costs for RIIO-2
- Next steps

We have linked our stakeholder priorities to Ofgem's proposed consumer focused outcomes as follows:

Maintain a safe and resilient network

Deliver an environmentally sustainable network

Meets the needs of consumers and network users

Part 5: How we deliver our stakeholders' priorities

In this section we describe how our plan is supported, because we are committed to providing robust justification that evidences our planned investment. This evidence is referenced within the main document, and full details are included in the appendices.

How to navigate our plan

Annexes

Annexes – our draft business plan is supported by the following annexes:

- Independent stakeholder user group set-up report
- Stakeholder strategy
- Network capability reports
- National Grid UK cyber security strategy
- Compressor emissions compliance strategy
- Environmental action plan
- Ethical procurement action plan
- Environmental and supply chain sustainability benchmarking
- NG environment BMS
- Environmental management system
- Innovation strategy
- Sustainable workforce strategy
- IT investment plan
- Output delivery incentives, price control deliverables and uncertainty mechanisms
- Finance
- Real price effects and future efficiency
- Willingness to Pay
- EY report
- Golden threads

Our stakeholder priority chapters are also supported by:

- Engagement logs – explaining the stakeholder and consumer engagement we have carried out for each of our stakeholder priorities
- Cost-benefit-analysis and engineering justification reports – these reports explain in detail the need for and the benefits of the investment we are proposing in each area.

Part 2
Context

Despite significant and rapid change in the energy sector, we and our stakeholders believe that gas will continue playing a significant role in all Future Energy Scenarios[6] during the transition to decarbonise the GB energy system by 2050. And while gas is needed, consumers will require a gas transmission system that is safe, reliable, resilient, clean and affordable.

In building our plan we have used scenarios and forecasts to understand the drivers for investment. The Future Energy Scenarios (FES) publication sets out a view of plausible futures for the energy transition. This, with stakeholder views gathered by network companies, was the starting point for the cross-sector work to develop a "consistent view of the future"[7] upon which our plan is based.

Because no decisions have been made yet about which pathway the transition will take, we have engaged extensively with stakeholders so we can understand your priorities to inform our business plan.

We set out:

- the **changing energy landscape,** particularly how gas is supplied, the changing requirements of consumers and customers, and our priorities for reducing emissions
- the **challenges to the network** emerging from these changes, in conjunction with the state of our ageing assets

[6] http://fes.nationalgrid.com/fes-document/
[7] http://www.energynetworks.org/news/publications/reports/

11. The changing energy landscape

Future changes in the energy sector towards a low-carbon future will have significant implications for our business. There are three key areas where we expect change:

- the long-term role of gas in the transition towards a low-carbon future;
- how gas is sourced, transported and used in GB;
- legislative changes relevant to energy networks.

Long-term role of gas

In the transition to a low-carbon future, no-one yet knows the pathway GB will take to decarbonise energy to provide clean heat, nor how long it will take to achieve. So there is a wide range of different projections for the rate of change in how gas will be used, where and how gas will enter and exit the network, and what types of gas will flow.

Nonetheless, informed by our stakeholder engagement, we understand that:

- there is a long-term need for the gas transmission network in delivering the energy transition. Under all Future Energy Scenarios gas, in varying forms, will be used until at least 2045
- preserving capability and flexibility in the transmission network keeps options open and reduces the long-term uncertainty risk at minimal cost, while also ensuring the GB energy supply is secure now and in the future
- the role of gas is expected to change with decarbonisation, decentralisation and digitisation.

On **decarbonisation**, setting a 2050 net zero carbon emissions target is the right ambition and there must be a clear policy framework to make it a reality. The next decade towards 2030 is vital and the decisions we take today will pave the way to a new energy era. Emissions from heat delivered by natural gas are the single biggest contributor to UK emissions at 37%[8]. As per the Committee on Climate Change (CCC) report, we need to see much greater progress in making areas like heat and transport cleaner, with both government and industry stepping up action. Gas can support a fair transition to low-carbon power, heat, industry and transport and play a key role in meeting the GB environmental targets. The current average unit rate of gas per kWh is 10p lower than electricity[9].

Gas supports decarbonisation in:

- Generation: Gas generation through combined cycle gas turbines (CCGTs) provides a reliable and flexible way to support intermittent electricity renewables and is a viable alternative to coal. Currently, on average, 40% of the UK's electricity supply is generated using gas.
- Heat: Around 80% of UK homes are heated by gas. Gas can help decarbonise heat at lowest cost and disruption to consumers (especially those who are vulnerable), whether that's natural gas or biogases such as biomethane and/or hydrogen.
- Transport: Commercial vehicles, especially heavy goods vehicles, could use biogases, natural gas or hydrogen to achieve air quality improvements when compared to diesel. Doing so would complement the uptake in domestic electric vehicles, and it could reduce the need for upgrades in network infrastructure by making effective use of the existing gas and electricity networks.
- Industry: The network provides options for hydrogen and carbon capture usage and storage, as well as a way to employ other renewable sources of gas for industry to use to help decarbonise.

On **decentralisation**, consumer behaviour is changing, and more consumers are making choices about where they want their energy from. Inevitably, this is creating a more decentralised energy route and generation is becoming more embedded within distribution networks. Suppliers of alternative sources of gas, such as biomethane, are looking at whether to connect to a distribution or transmission network. This will mean that a more holistic, coordinated approach to energy planning and operation will be required going forwards. Whole system solutions will become more the 'norm'. We, as the gas transmission system operator (TSO), are in a unique position to help drive debate and collaborative action across the energy sector.

Digitisation is making the world more connected. There are constant advances in digital and other technology, which can bring both benefits and challenges to consumers and networks. If we are to respond to change effectively, we must invest and improve our digital systems during RIIO-2. This investment will bring benefits to consumers; using technology more will mean we can reduce costs and improve our services to customers.

[8] BEIS - Clean Growth - Transforming Heating https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/766109/decarbonising-heating.pdf
[9] https://www.ukpower.co.uk/home_energy/tariffs-per-unit-kwh

The changing energy landscape continued

How gas is sourced, transported and used

We've experienced dramatic changes in the pattern of gas supply in Great Britain over the past 15 years. From being self-sufficient in 2000, GB is now dependent on imported gas for around half its needs. Additionally, growing renewable generation will lead to gas-fired generation being needed increasingly often to support intermittent electricity.

As these trends develop, this leads to significant uncertainty in the future in three areas.

- The **volume and type of gas** expected to flow through the transmission network.
- **Where, when and how gas will be injected into** the transmission network.
- **Where, when and how gas will be taken off** the transmission network.

The effects of this underlying uncertainty have been observed over the past 15 years. For example, while the aggregate volume of gas consumed over a year has gradually declined, we have seen peak volumes of gas (at a single point of time) remaining broadly constant.

Taken together, this affects the location of *where* gas is sourced and consumed, as well as the timings of *when* gas is sourced and consumed. These changes are already creating new operability challenges – for example, shippers are increasingly changing where and when to flow gas on and off the network – and we expect these challenges to grow in the years ahead. We are doing extensive work to understand whether our network can withstand the changing use of gas and, if it can't, what the consequences might be. Our preliminary analysis, including our recent study by EY (annex A11.01), shows the capability of our network has significant impacts on GB wholesale energy costs: it facilitates diversity in supply sources, and it enables gas-fired generation to mitigate the effects of more intermittent renewable electricity generation.

Legislative changes

Energy has always been, and will continue to be, vital to GB's economic and social interests. Towards the low-carbon future, several pieces of legislation have been introduced with regards to emissions as well as cyber and physical security.

On **air quality emissions**, legislation has been introduced to encourage a reduction in NOx and CO^2 to a safe level. This tightening emissions legislation affects our fleet of gas compressors and our response to this legislation forms part of our business plan for RIIO-2, as it has done during RIIO-1. We discuss this in more detail in the chapter 'I want you to care for the environment and communities.'

On **cyber and physical security legislation**, our network is a critical part of the energy industry and is specified as critical national infrastructure (CNI) by the government and wider stakeholders. We therefore have to make a range of investments in physical and cyber security to comply with the legislation that is applicable to our network. Our approach on physical security is in line with the information and guidance published by the Centre for the Protection of National Infrastructure (CPNI). The Security of Network and Information Systems (NIS) regulations came into effect in the UK on 10 May 2018. They aim to minimise the risk of cyber-attack and the resulting impact on UK CNI and the economy.

During RIIO-2, we will meet the needs of government and wider stakeholders on both cyber and physical security. You'll find more information about how we plan to do this in the chapter 'I want you to protect the system from cyber and external threats.'

12. Challenges for the existing network

The age and use of our critical infrastructure mean **our assets now require greater care**, increased monitoring, refurbishment and replacement to maintain a safe and reliable transmission system. For example, 70% of our site assets will be more than 40 years old at the end of RIIO-1 and we are observing more condition-related issues across these sites.
We must address these to ensure we can deliver the services you require in the most efficient and affordable way.

The decisions we make now will have long-term implications, so we need to ensure our investment proposals are supported by robust cost-benefit-analysis against a range of credible future energy scenarios, so we make informed choices for consumers today and in the future.

Part 3
Approach to our RIIO-2 business plan

This chapter sets out our approach to our business plan and how we will balance the factors and trade-offs we've highlighted to guide the investments required.

We explain in this chapter:

- The **core principles** underpinning our planning. These help us test that we are only spending on areas that deliver real consumer value, and that we spend the money at the right time.
- Our work on defining **network capability**.
- The **implications for our draft RIIO-2 business plan** given the external context and stakeholder views, and the factors we need to balance when making investment choices.
- How our **areas of investment** deliver Ofgem's output categories, stakeholder priorities and the challenging external context.
- Our commitment to maximise **efficiency and affordability** for consumers, and our plans to continue innovating to improve efficiency.

13. Core principles for our business planning

For each area of our plan, we have applied three core principles to ensure that our plan is optimal.

Our three core principles are:

- to ensure that each investment decision is made in the **interests of consumers** by investing only where and when needed .
- **stakeholder engagement,** which will continue throughout our business planning, to account for any evolving requirements and ensure the timings of investments are optimal. See the 'creating a stakeholder-led plan' chapter for more detail.
- **cost efficiency,** minimising the impact on consumer bills for current and future consumers. We expand on this in the chapter 'I want you to be efficient and affordable'.

These core principles inform the cost-benefit-analysis[10] ('CBA') for each investment to explore whether it is required and, if it is, when costs should be incurred to maximise consumer value.

[10] These CBAs inform our engineering justification reports for our business plan. For the compressor investments, the CBA approach is contained in the Compressor Emissions Compliance Strategy.

14. Network capability

Defining the capability of the network

The capability of the network can be measured by its ability to accommodate levels of gas flows onto and off the network. The capability at any entry or exit point that can be delivered in any day will differ depending on the specific situation on the day. This will include the local and national balance between supply and demand, the existing level of gas in the network, the profiles of gas coming on and off the network and the assets available at the time.

The existing network has been designed to meet peak demand requirements by moving the necessary quantity of gas around the network. This is in line with our licence obligation to have a network that meets the peak demand experienced in an exceptional winter, calculated as occurring once in every twenty years.

It's important that we minimise the costs to consumers, considering the impact on current and future consumers bills. Reducing network capability could:

- limit the ability of directly connected customers to operate their businesses as efficiently as possible
- limit access to the cheapest supply of gas, increasing wholesale gas prices
- reduce operational and maintenance costs.

Excess network capability could:

- result in unnecessary operating and maintenance costs
- create the risk of asset stranding increasing costs for consumers.

Our July draft business plan is designed to deliver the level of network capability we believe stakeholders require. Striking a balance on the costs of current and future consumers is covered in more detail in chapter 15.

Understanding stakeholder requirements

Since October 2017, we have undertaken a series of engagements to understand stakeholder requirements on the network now, and into the future. We have used a variety of communication channels from webinars and workshops to bilateral meetings and newsletter publications. This engagement has covered a cross section of our stakeholder universe. We have created a segmentation model to better understand our stakeholder specific requirements and ensure that we have achieved a representative contribution.

Our engagement to date has captured consumer representatives, traditional industry customers and a range of interest groups, research and development organisations. Topics have ranged from how we shape the future of the network, to how we manage the environmental impacts of operating the network, and consumer listening. Gas Future Operability Planning[11] (GFOP) has played an important role in this stakeholder engagement.

Calculating the capability of the network

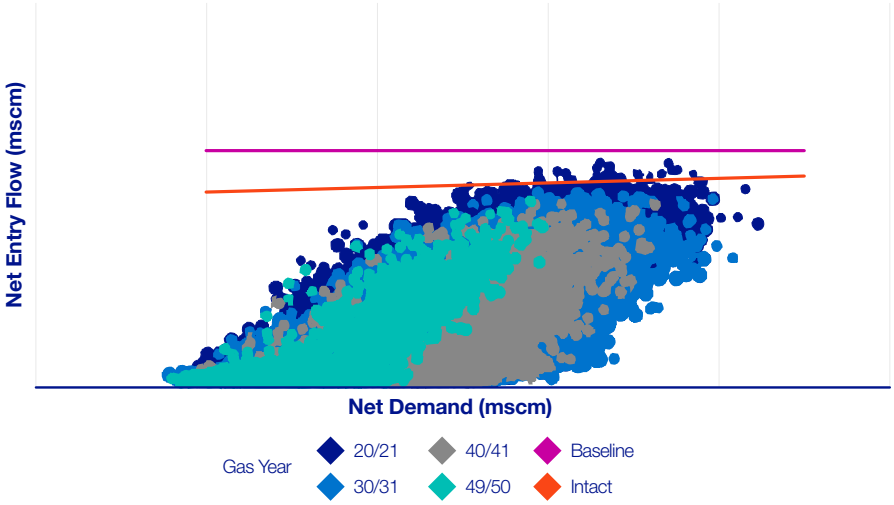
We use a range of existing analysis tools to calculate network capability. We compare the physical capability with a wide range of potential future flows using the Future Energy Scenarios (FES) analysis. By quantifying the requirements of our customers and comparing them with the ability of the network to meet them, we can identify areas where there is a potential mismatch between capability and requirements. We then explore options on the network to meet these requirements.

Table 14.1
Analysis undertaken to establish the capability of the network

	The July draft business plan takes account of or measures:	We intend to engage further on how we describe or measure:
Entry and exit flows	✓	✓
Pressure levels and ranges	✓	✓
Exceptional winter obligations	✓	✓
Long term supply and demand changes	✓	✓
Flow profiling	✓	✓
Asset data	✓	✓
Capacity baselines	✓	✓
Commercial arrangements	✓	✓
Boundary transfers	✓	✓
Environmental obligations	✓	✓
Customer driven changes to flows		✓

[11] https://www.nationalgridgas.com/insight-and-innovation/gas-future-operability-planning-gfop

Figure 14.2
An example of the metrics we have developed, showing supply and demand scenarios versus network capability from 2020-2050



Notes:
The purple line shows the capacity baseline for the entry point

The orange line shows the level of network capability with an intact network (i.e. all assets available)

The blue dots show different supply/demand combinations and required levels of net entry flow for four different gas years. This shows how requirements may change over time.

As a result of the analysis we have undertaken for our business plan we have developed some proposed metrics that show different levels of network capability, compared to supply and demand scenarios in four different years. An example of the metrics we have developed is shown above.

Future stakeholder engagement on network capability and capacity baselines

Between our July and our October draft submissions, we will be undertaking a series of stakeholder engagements on the topic of network capability and capacity baselines.

Our `capacity baselines' are the levels of capacity that we must make available at each of the network entry and exit points on any given gas day. We're obligated to make this available for sale. If we are unable to meet customers intended gas flows, where they hold firm capacity rights, we are required to provide compensation.

Our planned stakeholder engagement is intended to seek views on the appropriate level of network capability and capacity baselines for the RIIO-2 business plan. Our July business plan proposals may therefore change as a result of this engagement. Looking forward to our October draft submission, we will use this feedback to support our analysis. This will be a key input in defining our business plan proposal. Stakeholder feedback will also be used to support the development of the three reports[12] relating to network capability, that we are required to submit alongside the business plan. The draft versions of these reports can be found in annex A14.01.

To ensure our stakeholders see the value in supporting our engagement we have committed to sharing feedback that highlights how their inputs were considered in our options assessments.

Impact of network capability on our draft business plan

In our July draft business plan, our asset proposals are based on delivering the level of the network capability stakeholders need. In annex A14.01 we show metrics that represent how the physical capability of the network meets those needs. The work we need to do to manage those assets, can be broken down into the following categories:

- asset health
- environmental impact
- cyber resilience

The combination of ageing assets and new environmental legislation means we must make some important decisions in our RIIO-2 business plan, that will have long term implications on the level of network capability. This involves decisions around maintaining or reducing capability.

[12] An initial network capability report, a network capability target report and a baseline obligated capacities report.

15. Implications for our investments in RIIO-2

We need to support the move to a net zero carbon energy system by 2050, at the same time as delivering against our consumer and stakeholder priorities.

Robust and well-justified investments are needed to create the flexibility in network capability. This flexibility will be essential in meeting the future energy needs of consumers whilst enabling us to deliver your priorities. We must develop our business plans, clearly and in collaboration with you, our stakeholders, to ensure that the optimal investments are made at the right scale, the right place and the right time. This is also intended to avoid any overspend, as well as any under-investment that may jeopardise the use of gas by current and future consumers.

In doing so, we recognise that trade-offs exist, and that we need to get the balance right. For example, between:

- costs borne by **current vs future consumers** (for example, choosing not to invest now may lower the bills of current consumers but may impact the bills of future consumers by increasing the cost and/or risk incurred in the future).
- investing in **assets** to deliver gas to customers whenever and wherever they want vs **utilising commercial constraint management** tools when economic to do so. Our plans are based in part on the current regime continuing in its current form but if this were to change then the balance of some of our decisions may change.
- maintaining assets to **manage uncertainty** through providing optionality vs the risk of **asset stranding.**

The investments we propose to make in light of these trade-offs are discussed in our stakeholder priority chapters supported by separate engineering justification reports. This overall investment strategy is summarised in the table below.

Strategy	What this means…
Respond to immediate and future uncertain needs with 'no regret' investment	Do the things we need to do to keep the network safe and protected (e.g. investment in cyber security, which has a relatively short asset life). Maintain the health of our assets to facilitate an efficient gas market, reducing consumer energy costs and keeping the public safe.
Maintain options for future use of the network	Maintaining the pipeline network to keep options open. The uncertainty, environmental impact and cost means there is rarely a strong economic rationale for decommissioning pipelines.
Optimise approach to long-term network capability decline	Accommodating reduced future network capability by choosing not to replace like-for-like all compressors that will breach the emission limits from 2030 onwards, although it may limit future flexibility.

We set out our approach to the RIIO-2 business plan in more detail in the next chapter.

16. Areas of investments in line with Ofgem's output categories

Our stakeholder priorities influence everything we do. They have shaped our entire planning process and we have structured this plan to address each of these eight stakeholder priorities in turn. Ofgem has set out three areas of outputs for us to deliver. These are:

- maintain a safe and resilient network.
- deliver an environmentally sustainable network.
- meet the needs of consumers and network users.

These complement the stakeholder priorities. For example, addressing the priority "I want you to care for communities and the environment" will require outputs in all three of Ofgem's categories. Ultimately, these overlaps arise as most decisions to maintain network safety and resilience, and deliver an environmentally sustainable network, must be driven by the needs of consumers and customers. In this context, we assess each investment from a consumer value perspective. The following table shows the potential overlaps with investment areas, and the primary investment area where the stakeholder priority is discussed and costs have been allocated:

No.		Maintain a safe and resilient network	Deliver an environmentally sustainable network	Meet the needs of consumers and network users
1	I want the gas system to be safe			
2	I want to take gas on and off the transmission system where and when I want			
3	I want you to protect the transmission system from cyber and external threats			
4	I want you to care for the environment and communities			
5	I want you to facilitate the whole energy system of the future – innovating to meet the challenges ahead			
6	I want all the information I need to run my business, and to understand what you do and why			
7	I want to connect to the transmission system			
8	I want you to be efficient and affordable			

primary area where stakeholder priority is discussed

overlap area where stakeholder priority is discussed

17. How we will deliver our outputs efficiently

Efficient planning and delivery of investments helps to keep consumer bills down. Our draft plan includes details of how we will deliver efficiently, and how we'll continue to look for ways to increase efficiency and reduce consumer bills through:

- outputs and incentives
- efficient financing
- uncertainty and risk

Through our RIIO-2 price control process, we also intend to set out clear **outputs and incentives** upfront, so that we will be incentivised to outperform on our targets as well as to be held accountable to do so. These outputs are a mix of licence obligations, price control deliverables (funded through our "baseline" revenues), and output delivery incentives in areas where we should set ambitions to outperform to share successes with consumers. We are currently working on our bespoke outputs with the stakeholder user group. We discuss this further in **'Summary of our outputs and incentives'**.

To deliver the investments required to achieve the stakeholder priorities, we have set out our plans to **finance our investments as efficiently as possible**. This involves developing a proposed financial package that seeks to fund our investments at the lowest rate possible for an efficient, financeable company (i.e. one that can maintain an investment-grade credit rating). Recognising that some financial elements are outside of our control, this includes several mechanisms to ensure that any additional benefits or cost to us will be shared with consumers. We discuss this further in **'Our plan is financeable'**.

There will inevitably be some **uncertainty** about our activities and the associated costs because of the duration of the price control and the fast-changing energy landscape. This uncertainty will be shared by our customers and it could affect consumer bills so we are working with Ofgem on ways to manage it. We have proposed a series of uncertainty mechanisms to adjust the amount we earn for each year in the price control. We cover these plans in **'Summary of our outputs and incentives'**.

18. How our draft plan aligns with Citizens Advice's five principles

Citizens Advice is the official representative for energy consumers in Great Britain and it has designed five principles that we must meet for RIIO-2 to really deliver for consumers. This chart summarises how our draft plan maps to the five principles.

No.	Citizens Advice principle	How our draft plan aligns with the principle
1	Profits are lower than the previous price control, to more accurately reflect the relative low risk for investors in this sector.	We are proposing a lower base return in the RIIO-2 period lowering profits from RIIO-1. Our proposals reflect the risks associated with our business.
2	The value of any unspent funding for infrastructure projects is returned to consumers promptly and in full.	We are proposing many measurable outputs in our draft business plan. If we don't deliver an output and there's no good reason, we will return the money to consumers.
3	Industry business plans and regulatory decisions are directly informed by consumer (including future consumer) feedback and research.	We have built our draft business plan around our stakeholders' eight priorities and our consumers' three priorities to make sure it reflects them. We will involve our stakeholders, including consumer representatives, in annual updates so it continues to meet consumer need.
4	Companies are required to publish complete information on their performance, financial structures, gearing and ownership.	We report a lot of information on our performance to financial markets and our regulator. In future we will clearly show the link between what we deliver for consumers and our financial rewards. Our independent stakeholder user group will challenge us on the quality of our annual reports.
5	Innovation funding and incentives support consumers in the transition to a low-carbon future, particularly those consumers in vulnerable circumstances.	We will focus on innovation in a number of areas to reduce carbon emissions. We are also focusing our innovation on reducing costs for consumers in the medium term, such as applying new digital technologies to our network.

Part 4

Our draft plan is built on stakeholder priorities

19. We are still working on our draft plan

This document is the first draft of our business plan. We are due to submit our final business plan to our regulator, Ofgem, on 9 December 2019 and we will continue to work on it. We are still engaging with our stakeholders on particular topics and we will listen to your feedback on this draft. It takes time for us to write our plan and therefore we had a cut-off date for new information we could consider. This means we have not yet taken full account of important information such as Ofgem's RIIO-2 methodology decision, Ofgem's business plan guidance and the Climate Change Committee's Net Zero report. Below we provide more details on the main areas we are still working on. We might need to take account of other developments before December as well.

Stakeholder engagement - we are continuing engagement on a number of topics including how our proposals deliver the network capability our stakeholders need, and our consumer engagement programme, including acceptability testing and research on domestic consumers' views on the trade-offs in our plan. We will provide further information to help industrial and commercial consumers understand the potential implication of the plan on them.

I want to take gas on and off the network and I want to connect - we have identified that the proposed project at our Bacton terminal may meet the criteria of competition as defined by Ofgem in their May 2019 decision document. In addition, it is possible that the solution to reinforce the network in south Wales will meet the competition criteria if the customer progresses with this scheme. We will discuss these with Ofgem to decide how they should be taken forward.

I want you to care for the environment and communities - we have not fully reflected on the implications the government's commitment to Net-Zero by 2050 yet. This could affect our environmental commitments, but also our expenditure and outputs for the transition to the energy system of the future.

Our plan is efficient and affordable, providing value for money - we are still reviewing the benchmarking and efficiency evidence we have collected. The results and the implications for our plan could change. The forecasts for real price effects (RPEs) may change.

Our plan is financeable - we will continue to engage with investors as the RIIO package is developed further. We will continue to update our risk analysis and modelling. We deepen our assessment of financeability as new information becomes available, including from Ofgem. We will analyse consumer bill effects in more depth as new information becomes available, including from Ofgem.

Output delivery incentives - Ofgem's methodology decision provided clarity on its approach to common and bespoke output delivery incentives (ODIs). We are continuing to develop our bespoke ODIs with our stakeholders and the independent stakeholder user group.

Information Technology (IT) - we will continue our benchmarking activities and review our IT Investment plan against the draft proposals in the Energy Data Taskforce Report on delivering a Modern, Digitalised Energy System.

20. Creating a stakeholder-led business plan

We have listened to you, our stakeholders

Over the last two years we have carried out our most extensive listening exercise ever to create this stakeholder-led business plan. In that time, we've engaged more than 100 times, with 500+ individuals. We have also listened to domestic and major energy consumers extensively, surveying more than 3,000 household bill payers and 1,000 major energy users. We championed enhanced engagement and we're proud to be the first network company to set up an independent stakeholder user group. We have provided more information about our emerging ideas for our business plan to you than ever before, including a consultation in February 2019 when we played back what we had heard from you. Thank you for shaping our thinking, challenging our ideas and helping to develop our business plan.

We've built this draft business plan around what our stakeholders have said and your priorities as below:

Figure 20.1 consumer and stakeholder priorities

In each chapter, you'll find out what we have heard and how we have built our business plan with stakeholders.

We're talking directly with consumers

Alongside our local major project consultations, we are talking extensively and directly to consumers. Domestic, industrial and commercial business consumers' views are important to us, particularly those of bill payers. Even though we have no direct relationship with domestic consumers, we know that our plan must deliver an energy system that meets their needs today and in the future. So, we are now talking directly to households and businesses about what they want and what they are willing to pay for our services.

You expect your views to make a genuine difference to our business plan. We are committed to making sure they do. This chapter demonstrates how we've taken those views on board.

Creating a stakeholder-led business plan

We manage the network on your behalf and we recognise more than ever the importance of bringing your voices into our decision-making processes to give our decisions legitimacy. Our stakeholders include: customers who pay us for our products and services, consumers including domestic, business

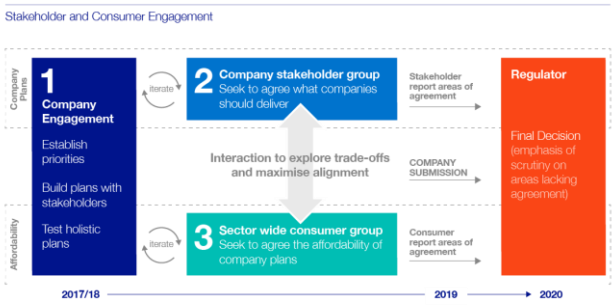
and industrial users of gas, government and non-government organisations, regulators, consumer groups, interest groups, consultancies and academics.

In a time of such unprecedented change, we must all work together to make sure our future business plans meet the needs of all stakeholders and have flexibility to adapt to whichever future plays out. This business plan is intended to deliver our services efficiently and effectively while being flexible enough to adapt to the constantly changing environment.

Our approach

Through coordinated, structured and inclusive stakeholder engagement we have shaped a credible, legitimate business plan. We are also making sure that our plans and decisions are being challenged as we go – we explain later in this chapter how our independent stakeholder user group challenges us to ensure that our engagement is broad and that we take insights on board.

Figure 20.2 RIIO-2 stakeholder engagement



Championing enhanced engagement

We have championed a robust, constructive engagement from the start. We identified key learning from our RIIO-1 stakeholder engagement approach, working closely with Ofgem, Citizens Advice and others (such as PwC) with price control experience across sectors, for support in shaping the process that all networks will be following.

We looked at best practice from other industries that use a stakeholder-led approach. For example, we spoke with Heathrow Airport and with several of the UK water companies because their regulator, Ofwat, has set out similar requirements for their latest price control review process.

Together with National Grid Electricity Transmission (NGET) we were the first network to establish our independent stakeholder user group and begin the challenge-and-review process with them.

We want to be as inclusive and open as possible

Since 2016, we have been following the AA1000 Stakeholder Engagement Standard[13], which sets out principles and detailed steps for how all types of organisations should go about engaging with their stakeholders. It's an internationally-recognised, best practice approach, and we have combined its principles with what we learnt from others to develop our approach for RIIO-2. In each stage we have five steps: plan, prepare, implement, review and improve. We mapped our stakeholders based on their interest in the topic and the impact our work has on them in that area. During our engagements, we asked them to gauge their own level of interest in a topic to further validate our approach.

Finally, we evolved our engagement to make it as effective as possible, based on three factors:

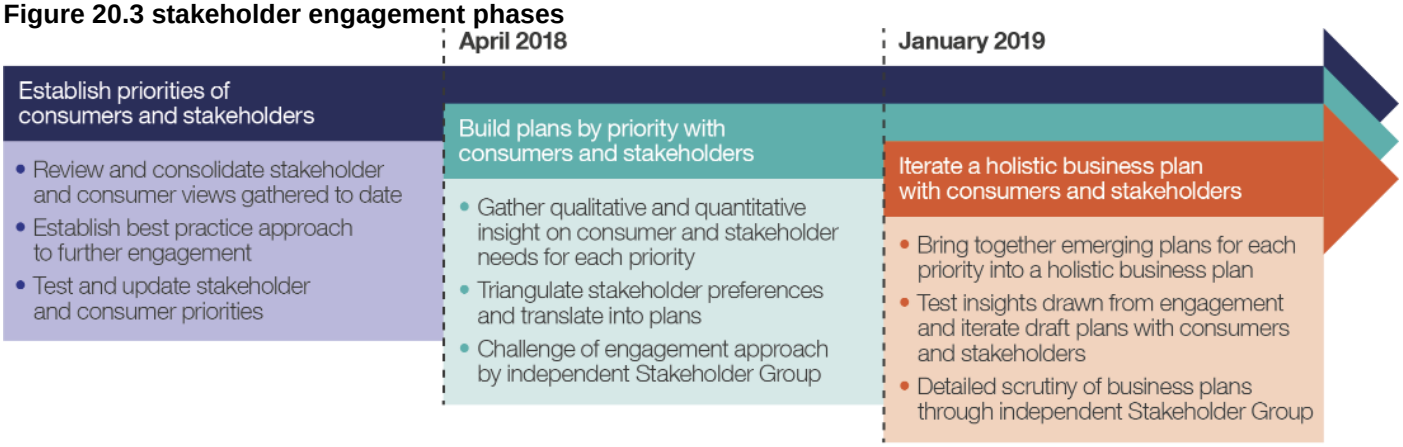
- how stakeholders tell us they want to engage
- what we're talking to them about
- the type of insight we're seeking.

How we have built our plan

Our engagement was divided into three overlapping phases that built on each other. At first, we started broad to make sure we were not missing any important points. Then we got into more detail on areas stakeholders are most interested in so that, by the end of the process, we will have a plan that reflects what our stakeholders want from us. It's a way of working that allows us to show the clear link between what stakeholders have told us and what's in our plans.

[13] https://www.accountability.org/wp-content/uploads/2016/10/AA1000SES_2015.pdf

Figure 20.3 stakeholder engagement phases



Phase 1: establish the priorities of consumers and stakeholders

We used insights from business-as-usual (BAU) activities to target engagement for RIIO-2 from several channels. These include ongoing conversations during our day-to-day interactions, specific meetings, workshops, webinars and online consultations. Over time, we've built up a picture of your eight priorities and we encapsulated this feedback into three consumer priority statements. During 2018 we checked with stakeholders that we had reflected their priorities accurately and did some further work to refine them. Find out more in our Listen Report[14].

Phase 2: build plans by priority with consumers and stakeholders

In the second phase, we worked with stakeholders to develop options and identify preferred solutions. We're using insights from different sources, including primary channels where we speak directly to our stakeholders through targeted RIIO-2 activities or via our everyday business engagement. We are also including secondary sources and desk research so our plan can benefit from insights that have already been published elsewhere.

Our independent stakeholder user group performs an important role challenging us to make our stakeholder engagement as effective as possible, and we worked with economics consultancy Frontier Economics to review our engagement material from a behavioural economic approach. We want to make sure that our business plan accurately reflects what you tell us.

Some of the best insight came from events with stakeholders we have never spoken to before, at the British Ceramic Confederation we asked, 'How can gas transmission help enable and support your business?'. We also held panel debates on the future of the gas transmission system and environmental and strategic 'Future needs of the gas transmission system' workshops. Following feedback from stakeholders we reduced the number of polls used during events, ran more webinars and worked with the third-party specialists to make sure we focused on the issues that matter to stakeholders.

Giving stakeholders options

One important change in the way we've engaged is the development and discussion of options. In the past, we've been accused of sharing plans only when we had already decided the outcome, and not genuinely consulting with those affected. So instead, we have developed themes such as 'reliability', proposed costed options around these and shared them with our stakeholders. We build our plans depending on what you prioritise.

Sometimes, options aren't available (where we are bound by legislation, for example), and in these cases we've explained our approach and why we need to do what we do. Where there is a choice, we've also provided details of costs (including the impact on consumer bills) to allow stakeholders to make a more informed decision. This is much more detail than we've shared before.

We're talking directly with household and business consumers

We've also developed a programme of consumer engagement, working with consumer representatives (e.g. Citizens Advice) to overcome the difficulties of engaging with consumers who we have no direct relationship with. We will keep improving how we do this to make sure we speak to a representative

[14] https://www.nationalgridgas.com/sites/gas/files/documents/RIIO%20T2%20Listen%20Report.pdf

sample of the population (including the vulnerable and fuel poor) and ensure we only talk to them about things they can genuinely influence. We'll also look at quantitative, qualitative and secondary research and review findings with trending data and external sources, using experts where needed. We'll review and build on this as we progress.

Already, we have surveyed more than 3,000 household bill payers across the country to understand their priorities and willingness to pay. Once we've embedded the learnings into our business plan, we will finish our consumer programme for RIIO-2 with acceptability testing.

Phase 3: iterate a holistic business plan with consumers and stakeholders

Throughout our RIIO-2 engagement process, we need to make sure the latest version of our plans clearly reflects what stakeholders have told us. The AA1000 standard that we follow includes steps to make sure we have accurately captured what we have heard, check this with stakeholders, and then act on it in the right way. Once again, Frontier Economics is working with us on engagement and providing us with their independent conclusions about key topics that we discussed in our business plan. For example, for asset health we provided all the engagement collateral and engagement output, so they could draw out outcomes and conclusions. They evaluated whether our stakeholder representation was robust, analysed stakeholder responses to various options based on different stakeholder groups and assessed the validity of the engagement. We also asked them to look at other third-party sources for more insights into the possible conclusions for the business plan.

As well as playing back the outputs from individual engagement activities, we have also shared our latest ideas at various points in the process, most notably in our February 2019 stakeholder playback consultation. We pulled together everything we'd heard on all eight of our stakeholder priorities into one document, setting out what our direction of travel was based on stakeholders' views. Then we consulted on this, to make sure we were on the right lines. As far as we are aware this is the first time an energy network company has consulted on its direction of travel for the whole of its business plan based on stakeholder feedback.

Our website attracted over 3,300-page views. Most of the 47 gas and electricity transmission respondents said our consultation was relevant to them and nearly all respondents said the consultation was clearly written. Industry stakeholders said that the key requirement for the gas transmission system of the future is to be flexible to adapt for new gas entry points, differing gas compositions and different types of decarbonised gas on the system. The majority of respondents to the playback consultation felt that they were impacted a lot or a great deal by what National Grid does. We have incorporated feedback from this consultation into our draft plan in the relevant priority chapters. Now, there's a further opportunity for stakeholders to comment, as we publish our draft plan. Throughout this whole process, we aim to explain at each stage what we have changed, what we haven't changed - and why - as a result of stakeholder feedback.

Stakeholder feedback has directly informed these areas:

- 'I want to take gas on and off the transmission system when and where I want' – asset health investment plans are based on the option to 'maintain service risk levels stable' i.e. as per RIIO-1. This proposal represented your view that there should be no reduction in the levels of service we provide across all key risk categories.
- 'I want to take gas on and off the transmission system when and where I want' – at Bacton, our chosen option to meet your requirements is to redevelop the terminal, sized to our understanding of future requirements but allowing for potential future changes. We tested the output of our targeted engagement during a webinar and 67% of you supported our proposal.

Planned future engagement:

- Asset Health webinar – July
- Theddlethorpe demolition – July
- St Fergus emissions – July
- Consumer acceptability testing – July
- Network capability – ongoing

Independent scrutiny of our engagement and business plans

The independent stakeholder user group has been meeting regularly since July 2018. The group, chaired by Trisha McAuley OBE, is made up of senior representatives from consumer, environmental and public interest groups, as well as large energy users, large-scale and small-scale customers, and distribution networks.

They have been challenging and reviewing how we engage with stakeholders in developing our business plan. For example, are we properly representing the priorities of all our stakeholders? Are we making sure

that stakeholders have the right opportunities for their views to be heard and are we being innovative? In doing this, the group is assessing us against their own engagement principles.

They have been scrutinising our business plan, assessing the outputs we're committing to deliver, our costs and incentives and how we plan to deal with uncertainty in RIIO-2. They will check that these reflect what our stakeholders have told us. They will report to Ofgem on areas of our business plan they agree with, as well as any areas they are concerned about. For more information on the set-up of the independent stakeholder user group and the governance arrangements it has in place, please see annex A20.01.

The independent stakeholder user group has challenged us

The stakeholder user group has so far raised over 100 challenges to us and we identified five key themes that cut across the topics discussed: stakeholder engagement strategy, consumer outcomes, topic context, collaboration and benchmarking, and stakeholder segmentation.

Following the group's feedback so far:

- we've extended our phase two engagement phase to make sure we have enough information to explain fully the options we're presenting

- we have expanded our consumer engagement programme to meet their expectations. They have challenged us to think about different ways of engaging consumers as well, particularly when it comes to getting into detail on topics that impact them, but that they may not be very familiar with. Consumer experts on the user group have given us specific challenges in this area, we worked with third parties who specialise in this type of work to develop a plan for research and engagement. This included using cultural research and looking at consumer trends to understand the needs of future consumers as well as current ones.

- we also commissioned specialist third-party organisations to assess our approach and tell us where we needed to do things differently to reach the targets the group has set for our engagement process.

We used 'engagement logs' to provide information to the stakeholder user group. We created these documents to provide a systematic record of our engagement as we went along. They gave the user group and the third-party specialists the details of our engagement in one place and allowed them to carry out a thorough assessment of our approach. We have submitted these engagement logs alongside our plan to offer detail for each priority on stakeholder mapping, segmentation and the chosen channels of engagement. We also used one-page summaries of each stakeholder priority, our 'golden threads,' they illustrate how our stakeholder engagement has influenced our proposals and consumer benefits, these can be found in annex A20.03.

Our future commitments

The engagement process for our RIIO-2 draft business plan has led us to produce a draft plan that is our most stakeholder, customer and consumer-focused to date. We want the benefits of this approach to feed into business-as-usual throughout the RIIO-2 period, influencing how we report our performance and how we adapt our business plan as circumstances change. You can read more on our RIIO-2 stakeholder strategy in annex A20.02.

We will commit to continuing our direct consumer research in the RIIO-2 period, carrying out consumer listening sessions as well as more formal research studies at regular intervals to help us continually reflect consumer needs. We'll supplement this through analysing consumer trends data and other secondary sources of research.

We believe it is possible to establish clear and appropriate commitments for stakeholder engagement during RIIO-2 by seeking input from the existing user group. We also believe the enduring use of the user group will allow the commitments to be reviewed during the RIIO-2 period, making sure they remain up to date and relevant based on changing stakeholder requirements, evolving best practice etc.

In our 'I want all the information I need to run my business, and to understand what you do and why' chapter, we provide details of our proposed approach for an ongoing, annual process for updating our business plan that reflects the needs of our stakeholders. We are already putting in place processes and resources to make sure this happens.

We will also to continue to learn from best practice as we develop our programme and our RIIO-2 commitments. We will develop our thinking on any bespoke stakeholder engagement outputs and on the tools, we will use to monitor performance and delivery.

21. I want the gas system to be safe

What is this stakeholder priority about?

This priority is about what we do to keep the public, our employees and other people who work on or around our assets safe from the hazards inherent in our business. Failure to supply gas and major uncontrolled release of gas from the high-pressure network, are both potential threats to life and property.

At National Grid, safety is paramount. We continue to pursue our goal of zero harm to the public, our employees, and other people who work on or around our assets from the safety risks associated with our activities. In addition, we have obligations to comply with relevant health and safety legislation, monitored and enforced by the Health and Safety Executive (HSE).

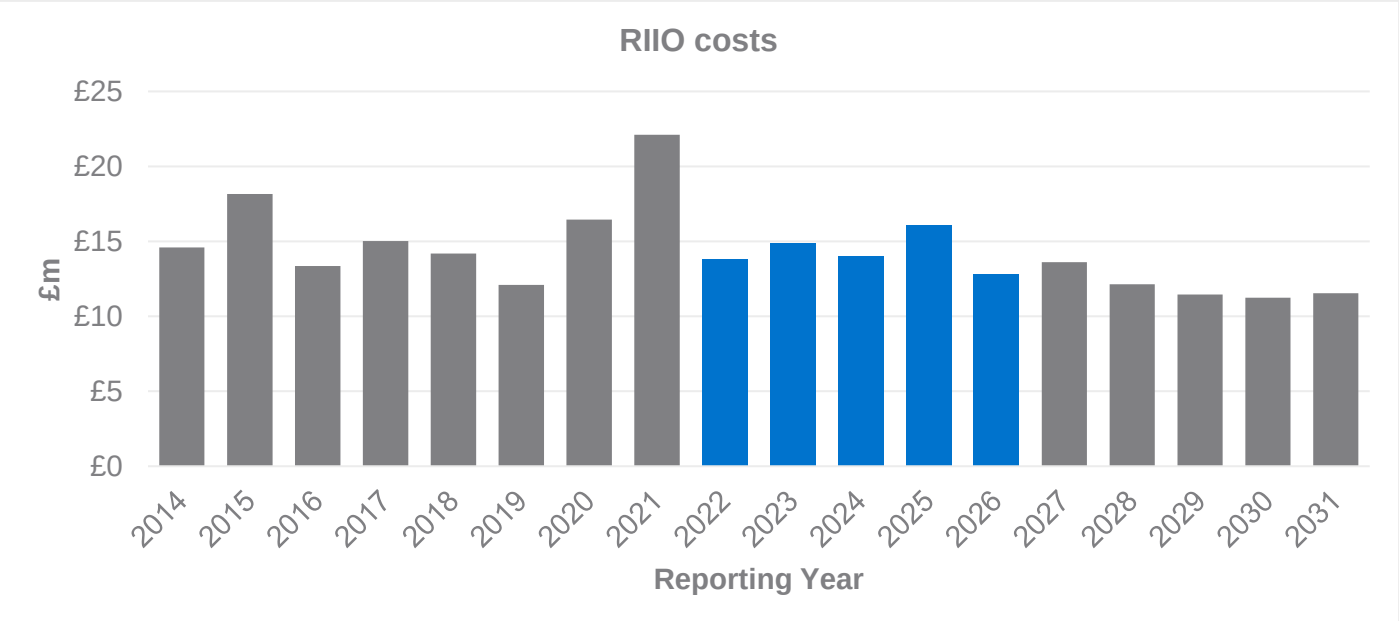
What have you told us?

You have consistently said that safety is a priority as you are aware of the risks to life and disruption to gas supplies associated with our operations and you appreciate the crucial role of the gas transmission system.

During RIIO-2 we will: maintain our world-class level of safety whilst continuing to pursue our goal of zero harm. We will comply with legislation through routine and preventive safety activities to protect the public, our assets and people. Our RIIO-2 plan for safety continues the best practices we implemented in RIIO-1 for compliance with mature legislation. We will spend £14.3m per year on the routine and preventive safety activities described in this priority. This compares to £15.8m per year during RIIO-1.

Please note that our approach to safety is reflected across the whole of our business plan. For each priority with a safety element we've included these costs in the relevant section of the business plan. For example, there are elements of our asset health and cyber resilience programmes that also bring important safety benefits. Our safety culture underpins how we undertake all work.

Figure 21.1 RIIO-1 and RIIO-2 spend profile 'I want the gas system to be safe'



1. What is this stakeholder priority about?

We understand the vital importance of safety. Failure to supply gas (especially to vulnerable consumers), and any major uncontrolled release of gas from the high-pressure network, are both potential threats to life. Consumers who use the gas that we transport, and society generally, expect us to maintain the highest safety standards.

This priority is about our routine and non-routine activities to protect the public, our employees, people who work on or around our assets and the environment from the safety risks associated with the network. Alongside our asset and process-related safety compliance activities, we have included our work on occupational safety, wellbeing and health and driving the right safety culture throughout our organisation.

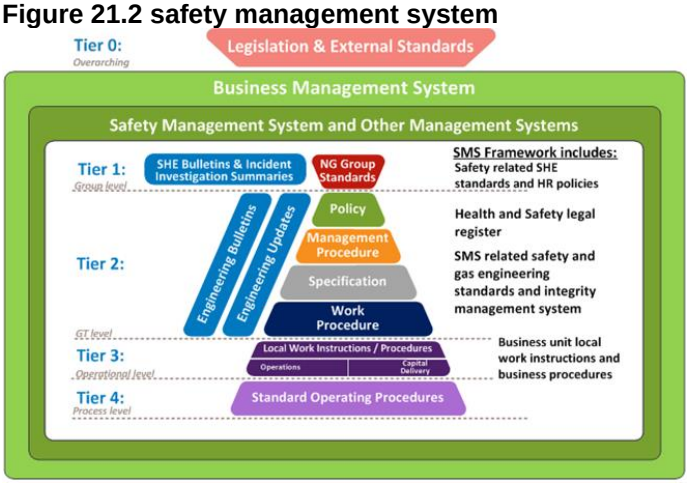
As a gas transporter, and in our role as Network Emergency Co-ordinator (NEC), we must comply with written 'safety cases' accepted by the Health and Safety Executive (HSE). These set out how we manage the safety of the gas network in line with the Gas Safety (Management) Regulations, and how we manage our top tier control of major accident hazards (COMAH) sites, St Fergus and Bacton.

Key safety legislation for our business is predominantly based on 'goal setting' principles. This means we must manage risks down to a level as low as reasonably practical (ALARP). We cannot stand still. The safety standards expected of us are continually increasing as new technologies come on line and best practice evolves. At the same time, population growth is bringing more frequent encroachment on our pipelines and at other potentially hazardous facilities.

2. Our activities and current performance

We have a mature safety management system (SMS), organised to deliver our statutory and regulatory duties. We use it to ensure that we have taken all necessary steps (as far as is reasonably practical) to comply with all relevant safety legislation – primarily the Health and Safety at Work Act and its associated codes of practice and guidance. The SMS is a framework that allows us to consistently identify and control health and safety risks, reduce potential for accidents and incidents, and continually improve performance. The SMS is organised as shown in figure 21.2 below.

Figure 21.2 safety management system



Our key activities associated with the safety priority are summarised in table 21.3 below. Safety considerations underpin everything we do in both office and operational environments, but here we have highlighted just those activities and teams for which safety is the primary relevance.

Table 21.3 summary of safety activities for business planning

Activity	What does this involve?
Strategy, assurance and NEC role	Setting standards and implementing management systems for: • process safety, • occupational safety, wellbeing and health • assurance including audit and benchmarking. Reviewing and updating safety cases. Fulfilling the Network Emergency Co-ordinator role including co-ordination of cross-industry emergency exercises.
Protecting our assets	Regular aerial surveillance of all pipeline routes to highlight any risks to pipeline integrity e.g. from farming or construction activity. Regular line walking of all pipeline routes to identify issues not visible from the air e.g. depth of burial and damaged pipeline marker posts. Talking to land owners and local authorities to raise awareness of the safety issues of working near our assets. Providing a 24/7 emergency response to make safe and repair any pipeline damage including through the use of specialist equipment and strategic spares.
Safety compliance	Compliance with key legislation including the Pressure Systems Safety Regulations and the Pipeline Safety Regulations, for example

Activity	What does this involve?
	through regular pipeline inline inspections and pressure systems testing. Explosive atmospheres management and life-cycle management of safety systems.
Operational property	Maintenance of operational land and buildings. Refurbishment and/or replacement of control/administration buildings to protect the assets inside and provide appropriate welfare arrangements for employees e.g. toilets, mess rooms, flooring, roofing, heating and air conditioning.

Track record and learning in RIIO-1

Our safety performance is reported in our annual regulatory reporting packs[15]. We have met our key target of compliance with all relevant Health and Safety Executive (HSE) legislation. Notable performance across the RIIO-1 period includes:

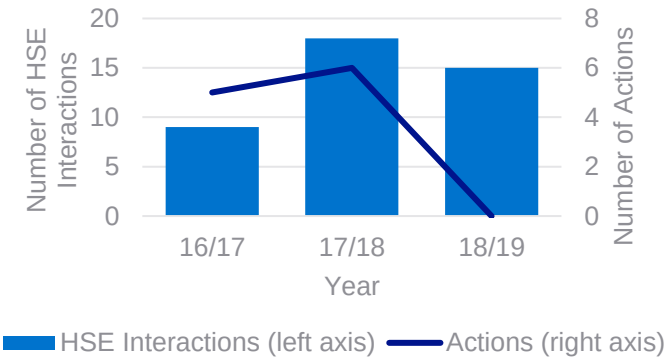
HSE requirements

From a safety perspective, we are regulated by the HSE. To provide assurance that we are complying with key safety legislation and ensure that risks to people from our activities are ALARP, we:

- operate permissioning activities relating to COMAH, Gas Safety (Management) Regulations, Pipeline Safety Regulations and Pressure Systems Safety Regulations
- carry out targeted inspections and investigations
- raise awareness of current safety related issues/trends through planned liaison meetings.

During the RIIO-1 period we have developed a proactive working relationship with the HSE. Over the last two years there has been an increased focus by the HSE testing our compliance to legislation and safety cases (accepted by the HSE). Previously, the HSE has identified potential control weaknesses requiring clarification or action. However, last year no actions were issued illustrating the improved maturity and value of the three lines of defence assurance model in ensuring we meet our licence condition. We continue to work closely with the HSE. Figure 21.4 below shows the number of HSE interactions over the last three years along with the number of actions raised. Also, during the RIIO-1 period we had an inspection for the NEC, which resulted in no actions and 7 recommendations.

Figure 21.4 number of HSE interactions and associated actions



Processes

As mentioned earlier, we have a mature safety management system to manage these safety risks, which we have strengthened throughout RIIO-1 including our overall assurance processes implementing three lines of defence in line with good practice.

We also asked independent experts DNVGL to benchmark our process safety management performance using its International Sustainability Rating System. Our performance was rated in the upper quartile within a comparator group of more than 200 worldwide oil and gas sites. This objective assessment has helped us to be clear on what it means to be 'industry leading'. It has given us a better picture of our strengths and weaknesses and sharpened our focus on areas to improve in the future to manage the inherent risks of our high hazard assets.

Safety innovation

We are committed to drive efficiencies in the activities we undertake and also seek innovative ways to continually improve our safety performance. Through RIIO-1 we have undertaken number of our Network Innovation Allowance (NIA) projects focused on specific safety improvements. We track and report[16] the value for our customers from such innovations.

[15] Annual RRP Reporting Packs: https://www.nationalgridgas.com/about-us/business-planning-riio/how-were-performing

[16] https://www.nationalgrid.com/sites/default/files/documents/National%20Grid%20Gas%20Transmission%20NIA%20Annual%20Summary%202017-18.pdf

Table 21.5 safety innovation projects[17]

Case Study	Benefits	Value
Impact protection slabs	Use of polyethylene (PE) instead of concrete slabs to protect pipelines. Cheaper, safer and quicker to install.	£483k saving to date in purchase and installation of PE slabs.
Vent stack design	Development of 'above ground installation (AGI) safe' software package allows better quantitative risk assessments, resulting in more efficient designs.	£84k saving at Peterborough compressor station.
Safety in PIG trap closures	Failure modes analysed, and new training package developed and implemented.	£10k per year based on avoided failures.

During RIIO-2, we will seek to develop our tools and capabilities in areas such as network emergency simulation, consequences of bio gases and hydrogen blends. There will also be opportunities for collaboration and sharing of best practice (both with GDNs and other gas transporters worldwide), continuing to participate in these groups is vitally important to ensure we learn lessons from all safety incidents. More information on our innovation proposals for RIIO-2 can be found in annex A25.03.

Across our US and UK business we share best practice on safety measures, led by our Chief Engineer. This allows us to apply further insight and best practice to our activities.

Keeping our employees safe

We regret that, over the RIIO-1 period up to 31 March 2019, our operations incurred one employee and 17 contractor lost time injuries (LTIs); such injuries occur against a backdrop of more than 25 million hours worked. Our combined injury frequency rate over the RIIO-1 period up to 31 March 2019 was 0.07. This is good performance within the UK Energy Industry Safety Leaders Group range of 0.04 to 0.25.

3. What are our stakeholders telling us?

We have asked for your views on safety through various channels including workshop events, webinars and direct engagement with the Health and Safety Executive (HSE). You consistently say that safety is a priority. Most of our safety-related activities are driven by compliance with legislation and application of established best practices and so our level of future work is not open to direct influence by customer or consumer preferences.

At our 'shaping the future' engagement events in Autumn 2017, we wanted to find out what is important to you about safety. Feedback included:

"Safety first. Ageing assets have known issues. We should provide assurance we will continue to be safe in future, not just now."

"A major accident has the potential for injury to be caused. Domestic customers should not face any supply security risk."

"Safety delivers now, but increasing attention needed as assets age."

Our conclusion from this is that safety should be a top priority and you expect us to be as safe as possible in all our activities. It will be important during RIIO-2 that we address the issues of our ageing assets, ensuring they are safe now and into the future.

We also participate in industry wide groups in the UK and across Europe. In the UK for example we are part of the UK Onshore Pipeline Operators' Association (UKOPA), where we participate to share knowledge and promote best practice across the industry. UKOPA helps to develop a comprehensive and consistent view of strategic issues that relate to the safe operation and maintenance of onshore pipelines.

We also undertake regular engagement with the other terminal operators at St Fergus and Bacton. These meetings cover topics from operations to safety, including any lessons learnt. We also attend regular HSE forums that allows for best practices to be shared.

4. Our proposals for RIIO-2 and how they will benefit consumers

In our proposals for RIIO-2, we will continue to pursue our goal of zero harm. We will protect the public, our employees and the environment from the safety risks of our transmission system and comply with all

[17] https://www.nationalgridgas.com/insight-and-innovation/transmission-innovation/delivering-value-innovation

legislation that applies. We are committed to continual process improvement.

The gas transmission SMS framework structure is based on the Plan, Do, Check, Act (PDCA) model, which is an iterative process and drives continuous improvement. This will be a key process that will help us maintain our world-class level of safety whilst continuing to pursue our goal of zero harm. We will continue to embed the benefits of safety innovations into business as usual and look for further ways to improve.

Our safety priority maps to Ofgem's output category, 'maintain a safe and resilient network'.

How do our RIIO-2 proposals benefit consumers?

Our attention to safety delivers benefits for industrial and domestic consumers:

Consumer priorities	How does our plan support this?
"I want to use energy as and when I want"	Our commitment to safety-related inspections, maintenance and asset replacement avoids unplanned downtime of network elements, which could disrupt continuity of gas supply. This also affects industry and electricity supply.
"I want you to facilitate delivery of a sustainable energy system"	Our focus on zero-harm ambition through managing down the likelihood of low frequency, high impact incidents protects society from potential disruption and damage to public health, business, transport and the natural environment that could be associated with gas transmission failure events.

5. How will we deliver?

The specific activities we will undertake gives us confidence we have the right propositions in place to pursue our zero harm goal.

Activity	What
Strategy and Assurance-People	Gas transmission teams to carry out our strategy and assurance roles. Central teams who provide support on our corporate health and safety commitments.
Emergency Preparedness	24/7 standby cover, emergency planning and training. Activities associated with our NEC role.
Protecting our Assets	Helicopter and line walking surveys, compliance with safety legislation. Maintain an emergency response and repair service for our pipework systems across Great Britain.

People – developing the skills and behaviours that support safety

We define and maintain safety and technical competencies (STCs) for our operational workforce, and the requirements of each competency and relevant authorisation level. This then informs the nature and frequency of training to maintain a competent, resilient workforce.

Over the last year we have implemented a specialist competence management system (Cognisco) to provide a detailed, comprehensive view of capability and competence across our operational workforce. We reviewed core competencies for each role and discipline and mapped the workforce to those competencies. The results give us both a clear view of current effectiveness and a projected view of training demand to maintain the appropriate levels of expertise and experience.

During RIIO-2, we will exploit this management information further, to manage training schedules more efficiently and support a more flexible, agile workforce. We must also recognise that new requirements and regulatory demands may emerge, bringing additional costs and training challenges.

Our future safety performance is underpinned by the culture of our organisation and the behaviours of our people. We're aiming for a proactive safety culture. We have various targeted campaigns to support staff and managers as they develop positive safety behaviour. We will monitor our progress along the safety culture ladder via annual surveys among our people.

Our costs for strategy and assurance reflect an appropriate allocation to the gas transmission business of the costs of our Safety, Health and Sustainability team which provides efficiencies in scale by supporting our UK gas and electricity businesses. Also included are the direct costs of our dedicated safety and integrity assurance team, which provides:

- independent, risk-based second line assurance for gas transmission, as part of the three lines of defence model to ensure continued safe and compliant operations
- insightful support and guidance to mitigate key safety, environmental and business risks and to drive continual improvements and efficiencies in gas transmission.

Emergency preparedness

The costs include the direct time of individuals, mostly in our Gas System Operator (GSO) Emergency Incident and Framework team, for emergency planning and the independent Network Emergency Co-ordinator responsibilities. This includes provision of incident response training for our own staff and relevant gas distribution network staff, updating the NEC safety case, and co-ordination of both internal and industry-wide emergency exercises across gas market participants including the Department for Business, Energy & Industrial Strategy (BEIS) and the HSE. Further information about how we manage network gas supply emergencies can be found here[18].

Drivers of our emergency preparedness activity in RIIO-2 include:

- the increased operational challenges posed by more diverse supply/demand patterns
- potential changes to the network gas supply emergency framework associated with trends in decentralisation and decarbonisation
- development and adoption of new tools and systems
- the need for emergency planning co-ordination with other gas transmission operators across Europe.

Our planning assumes we maintain the same levels of 24/7 emergency standby across our business and it will require designated gas transmission staff to be trained and on call to respond to asset-related emergency events.

Protecting our assets

Accidental damage to pipelines by third parties is the number one cause of pipeline rupture in Europe. There are well-established industry practices[19] accepted by the HSE to guard against accidental interference, we must have in place the emergency response capability to make safe and repair any suspected or actual damage. Our RIIO-2 plan is based on continued application of these good practices.

We carry out regular visual checks on our entire 7,600 km network. The current best practice and most efficient method is via helicopter patrols, which we undertake fortnightly. We also undertake line-walking to check depth of burial and look for issues that would not be seen from the air. Our policy says that the interval between subsequent line walks should either be every four years or determined by a risk-based approach.

We actively explore alternative methods and new technologies to see if there are advantages in performance, cost or efficiency. For example, we trialled drones to see if they could offer any advantages over line-walking or traditional aerial surveillance. The technology is promising but there are limitations in relation to permitted use, privacy and data protection.

We are obliged to maintain an emergency response and repair service for our pipework systems across Great Britain. We share efficiency with other gas pipeline operators by accessing the same centralised emergency materials and equipment (CEME) scheme operated by the Pipelines Maintenance Centre. There is no other national provider of this niche specialist capability.

6. Risk and uncertainty

We see it as a fundamental part of our business-as-usual responsibility to manage the safety of our operations. We carry the risks, including reputational and financial, of any failure events or lapse in safety performance that could happen under our stewardship.

7. Our proposed costs for RIIO-2

Overall for RIIO-2 we expect expenditure to remain at a similar level to RIIO-1. This is based on assumptions of compliance with the same mature legislation, good practice for compliance remaining in place, a similar workload, stable outsourced costs and the embedding of RIIO-1 efficiencies.

We will spend £14.3m per year on the routine and preventive safety activities described in this chapter. This compares to £15.8m per year during RIIO-1.

The ‘operational properties’ costs account for our improvements to our buildings on our operational sites, ensuring they are fit for purpose to enable our employees and contractors to undertake their work in a safe environment. These are capex costs.

Our costs associated with ‘accidental threats’ are related to our activities protecting our assets, including our regular visual checks of our pipelines such as helicopter patrols.

[18] https://www.nationalgridgas.com/safety-and-emergencies/network-gas-supply-emergencies-ngse

[19] Institution of Gas Engineers and Managers IGEM/TD1 Standard for steel pipelines and associated installations for high pressure gas transmission

Our costs associated with 'corporate health and safety' covers our support staff, who provide support and guidance in relation to our corporate health and safety responsibilities.

Our cost associated to the cost line 'other' covers our teams and activities in relation to our strategy and assurance role. This includes both our gas transmission assurance and integrity teams and our costs associated with our emergency preparedness activities.

Table 21.6 summary safety costs – activity split

Activity spend (£m in 18/19 prices)	2022	2023	2024	2025	2026	Total RIIO-2	Annualised RIIO-2	Annualised RIIO-1
Operational properties	4.2	4.7	3.9	4.6	3.6	21.0	4.2	3.6
Accidental threats	5.8	6.1	5.5	6.0	5.8	29.2	5.8	5.8
Corporate health and safety	0.6	0.6	0.6	0.6	0.6	3.1	0.6	1.1
Other	3.2	3.4	3.9	4.9	2.8	18.2	3.6	5.2
Grand total	**13.8**	**14.8**	**14.0**	**16.1**	**12.8**	**71.5**	**14.3**	**15.8**

Business plan data templates

Our business plan is accompanied by a set of spreadsheet business plan data templates (BPDT) in a format required by Ofgem. The following table shows how our safety activity costs feed into the BPDTs.

Table 21.7 summary of safety costs – BPDT split

RRP Category (£m in 18/19 prices)	2022	2023	2024	2025	2026	Total RIIO-2	Annualised RIIO-2	Annualised RIIO-1
Closely associated indirects	1.9	1.9	1.9	1.9	1.9	9.4	1.9	2.2
Direct costs	8.7	9.0	8.5	10.8	8.7	45.8	9.2	10.1
Load-related	0.2	0.2	0.5	0.2	0.0	1.2	0.2	2.0
Non-operational capex	2.9	3.6	2.9	3.0	2.1	14.7	2.9	1.5
SO Capex	0.1	0.1	0.1	0.1	0.1	0.5	0.1	0.1
Grand total	**13.8**	**14.8**	**14.0**	**16.1**	**12.8**	**71.5**	**14.3**	**15.8**

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

What is this stakeholder priority about?

A network and commercial framework that allows customers to take gas on and off the transmission system where and when they want, has many benefits for our customers and consumers of gas. We make it possible for a diverse range of supplies to come onto the network and this allows the cheapest sources of gas to reach the market, lowering energy costs for consumers and improving the security of supply. As a joint transmission owner (TO) and system operator (SO), our activities under this priority include maintaining and operating our physical network, and the day-to-day processes that support the market. We must avoid the serious consequences of a potential asset failure, such as an uncontrolled release of gas, fire, explosion or failing to deliver gas to consumers.

What have you told us?

For consumers of gas, reliable supplies are essential, whether it's for heating, electricity generation or for operation of industrial processes. Consumers of large amounts of gas have told us that continuity of gas supplies is essential to avoid detrimental impacts on their business processes, finances and global reputations. For some industrial consumers' loss of gas supply would cause irreparable damage to facilities, potential closure and/or loss of employment.

Stakeholder feedback confirms that our customers want to be able to alter the location, volume and profile of their gas flows in response to prevailing market conditions.

What will we deliver?

We will deliver world class levels of reliability. In RIIO-2, we will need to take action to address the growing number to defects occurring as our assets age. If we don't intervene our assets would move towards an unmanageable position and get significantly worse in RIIO-2 without intervention. We will address these issues by continuing to invest in a programme that will enhance resilience, stabilise risks on our network over a 10-year period and focussing on efficient asset management and system operation. This will ensure we maintain service levels for our customers.

We have embedded the innovations developed through RIIO-1 into our plans and will continue to innovate utilising our world class asset management capability.

We have set a challenging 4% cost efficiency on our direct capital investment plan that we will set out to deliver in RIIO-2.

We will invest in the developing capabilities for our people and systems, to allow us to plan, maintain and operate our network and markets in the most cost-efficient way.

We will cover five topics in detail:
Asset health, asset management, network resilience, environmental resilience, and gas system operation.

These commitments result in the following priority outputs. Outputs are summarised in more detail in chapter 29.

Table 22.1 outputs summary 'I want to take gas on and off the transmission system where and when I want'

Output type	Output	Business plan proposal
Licence obligation	Maintain a 1 in 20 demand capability	To ensure NGGT efficiently manages the network to be able to meet a 1 in 20 peak demand severe weather event.
Price control deliverable	Network Asset Risk Metrics target	Relative target to measure delivery of our asset health investments with justified over and under delivery.
Price control deliverable	Bacton terminal site redevelopment	Delivery of Bacton terminal site redevelopment.
Price control deliverable	Kings Lynn subsidence	Address subsidence at Kings Lynn compressor site.
Output delivery incentive	Residual balancing	Retain scheme. Incentive set with appropriate rewards and penalties to meet the needs of consumers, recognising the impact of a changing energy landscape. Propose options to amend linepack component of scheme to better drive the right behaviour during seasonal transitions between winter and summer. Metrics to be agreed with Ofgem.
Output delivery incentive	Maintenance (use of days and changes schemes)	Retain existing schemes and expand to cover the wider range of maintenance activities supported by stakeholder feedback. Incentive set with appropriate rewards and penalties to meet the needs of consumers, recognising that the volume of planned maintenance is likely to be significantly higher in RIIO-2. Metrics to be agreed with Ofgem.
Output delivery incentive	Entry and exit capacity constraint management	Retain scheme. Incentive set with appropriate rewards and penalties to meet the needs of consumers, recognising the impact of a changing energy landscape. Propose options to amend linepack component of scheme to better drive the right behaviour during seasonal transitions between winter and summer. Metrics to be agreed with Ofgem
Output delivery incentive	Potential new incentive on linepack management	Develop and consult on options and consider interactions with existing incentives (e.g. residual balancing and constraint management).

Our proposed costs for RIIO-2

Figure 22.2 RIIO-1 and RIIO-2 spend profile 'I want to take gas on and off the transmission system where and when I want'

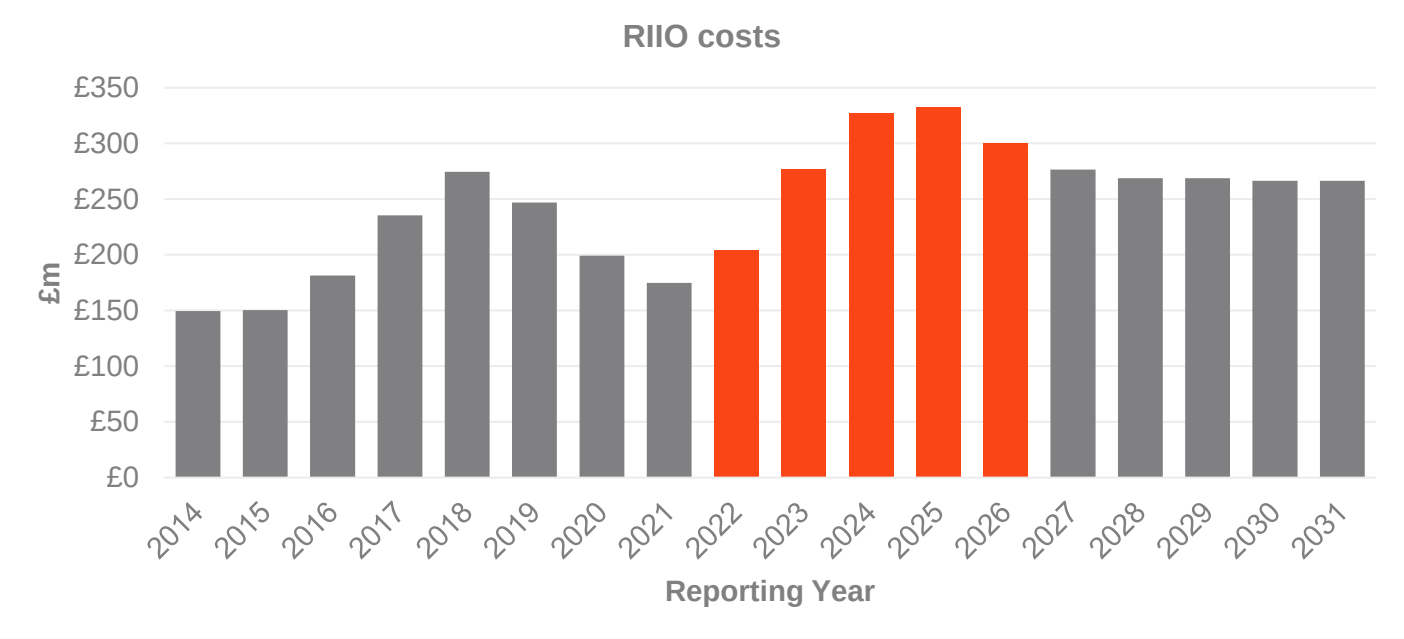


Table 22.3 activity spend 'I want to take gas on and off the transmission system where and when I want'

(£m in 18/19 prices)	2022	2023	2024	2025	2026	Total RIIO-2	Annualised RIIO-2	Annualised RIIO-1
Asset health (general + GRAID)[20]	80.8	110.5	169.6	171.4	170.4	702.7	140.5	88.1
Asset health (Specific large projects)[21]	14.9	52.1	44.6	51.4	23.2	186.1	37.2	22.7
Asset management	67.0	68.2	70.4	63.2	63.8	332.7	66.5	59.9
Network resilience	0.0	1.0	0.0	2.7	2.7	6.5	1.3	0.0
Environmental resilience	0.8	0.7	0.8	1.0	0.8	4.2	0.8	0.5
Gas System Operation	40.5	44.6	41.5	42.9	39.2	208.7	41.7	30.4
Total	**203.9**	**277.2**	**326.8**	**332.6**	**300.2**	**1440.8**	**288.2**	**201.5**

Business plan data templates

Our business plan is accompanied by a set of spreadsheet business plan data templates (BPDT) in a format required by Ofgem. The following table shows how the costs for these activities feed into the BPDTs.

Table 22.4 business plan data for 'I want to take gas on and off the transmission system where and when I want'

RRP Category (£m in 18/19 prices)	2022	2023	2024	2025	2026	Total RIIO-2	Annualised RIIO-2	Annualised RIIO-1
Closely associated indirects	36.0	36.4	36.9	36.6	37.1	182.9	36.6	24.8
Direct costs	47.3	47.6	47.6	47.0	46.3	235.8	47.2	41.7
Load related	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4[22]
Non load related	92.5	160.5	211.1	222.4	193.3	879.7	175.9	109.4
Non-operational capex	13.7	14.7	16.4	10.4	11.0	66.3	13.3	10.3
SO capex	14.3	18.0	14.8	16.3	12.6	76.0	15.2	12.5
Total non-controllable costs	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5
Grand total	**203.9**	**277.2**	**326.8**	**332.6**	**300.2**	**1440.8**	**288.2**	**201.5**

How our proposals benefit consumers

Consumer priority	How does our plan support this?
"I want to use energy as and when I want"	Our plan supports security of GB gas supply because: • facilitating a diverse range of supplies onto the network helps in delivering security of supply • high reliability also protects against losses of gas supply, which can significantly affect the operations of industrial consumers as we prioritise the protection of supplies to domestic consumers • consumers of large amounts of gas have told us that continuity of gas supply is essential to avoid detrimental impacts on their business processes, finances and global reputations. For some consumers, loss of gas supply would cause irreparable damage to facilities, potential closure and/or potential loss of employment at their affected facilities.
"I want you to facilitate delivery of a sustainable energy system"	Our plan supports a sustainable lower carbon future because: • we recognise there is a range of views over the long-term role of gas and the need for the gas transmission system. Until the exact pathway for gas is more certain we believe that it is in consumers' interests, where it makes financial sense, to maintain existing assets and keep future energy options open. This could include using the network to transport other gases, such as biogases, hydrogen or carbon dioxide.

[20] Excludes asset health costs for the existing Bacton terminal.
[21] For RIIO-2, this includes Kings Lynn subsidence and Bacton terminal (asset health on the existing terminal plus construction of a new terminal) and £1m for project closure of Feeder 9 project.
[22] There is a minor inconsistency in this figure which will be resolved for October business plan. This has arisen as a result of mapping business plan data templates to our key stakeholder priorities, whilst also maintaining alignment with our 2019 Regulatory Reporting Pack (RRP).

Consumer priority	How does our plan support this?
"I want an affordable energy bill"	Our plan supports an affordable energy bill because: • a high level of network reliability keeps energy bills low for domestic and industrial consumers by enabling access to the lowest cost gas supplies • if connected parties can't operate efficiently because of restrictions on the network, their increased costs will ultimately be passed on to end consumers and some of these businesses could close and relocate outside of GB leading to potential closure and/or loss of employment. • we are the joint transmission owner (TO) and system operator (SO). By maintaining the most efficient network and linking with new or existing commercial framework/tools we can create additional value for stakeholders and consumers. Our RIIO-2 plan is designed to deliver an efficient and reliable network, supported by the right commercial frameworks with the right capabilities to meet the needs of current and future customers.

1. What is this stakeholder priority about?

This priority is about providing a network and commercial framework that allows customers to take gas on and off the transmission system where and when they want. It includes the costs of maintaining and operating our physical network and the day-to-day processes that facilitate the market.

You have told us you value being able to flow gas without restriction. You want to be able to alter the location, volume and profile of your gas flow in response to prevailing market conditions. Unrestricted access to the network allows customers to source gas from the lowest cost supplies, ensuring wholesale gas costs are kept as low as possible for all consumers. For those who take gas off the transmission network, unrestricted access allows you to operate your own business processes safely and efficiently, unhindered by the operation of the gas transmission network. If connected parties can't operate efficiently because of restrictions on the gas transmission network, the increased costs will ultimately be passed on to end consumers; or businesses could opt to close and relocate outside of Great Britain.

These principles[23] underpin our thinking on this topic:

- A belief that there is a long-term future for gas and the network until at least 2045. This belief is based on the timescales necessary to decarbonise heat and also on the limitations of alternative energy sources for industry. It factors in limited alternatives to gas-fuelled power stations for large-scale flexible generation.
- We recognise there's a range of views over the long-term role of gas and the need for the network. Until the exact pathway for gas is more certain we believe it is in consumers' interests, where it makes financial sense, to maintain existing assets and keep future energy options open. Early decommissioning of assets could close off certain future energy options and/or result in higher costs to consumers if assets have to be replaced (e.g. to facilitate carbon capture usage and storage).
- A high level of network reliability helps to keep energy bills low for domestic and industrial consumers, enabling the lowest cost gas supplies to enter the GB. High reliability also protects against losses of gas supply, which can have a significant impact on your operations as we prioritise protecting supplies to domestic consumers.
- We are both the owner and operator of the gas transmission network. By maintaining the most efficient network and using new or existing commercial framework/tools we can create additional value for you and for consumers.

2. Our activities and current performance

During RIIO-1 we have maintained reliability and facilitated the delivery of 99.99%[24] of gas requirements in 2018/19, allowing consumers to use gas as and when they want. Customers have been able to change the volumes, profiles and locations of their gas flows, often at short notice. We have achieved this despite periods of cold weather, such as the 1 March 2018 'Beast from the East' and periods of local flooding in 2013.

[23] Part 2 of this plan provides further information on the long-term future for gas and keeping options open, including external publications that support these views.
[24] One power station experienced flow restrictions for a three day period

3. What are our stakeholders telling us?

You're telling us that this is an important topic. We've done lots of work to understand your views already, listening and learning via several well-established channels, including:

- Future Energy Scenarios[25] have engaged 650 stakeholders to develop a credible range of energy scenarios out to 2050. We are already using the findings in our planning.

- Future of Gas[26]project. You're telling us that gas will play a critical role for many decades to come and that you see an opportunity for a greener future by using hydrogen and biogases along with natural gas.

- Gas Future Operability Planning[27]This helps us to tackle operability challenges caused by variable supply and demand patterns. You challenge our assumptions about future uncertainties, share with us what you want from the network and work with us to understand the operational risks posed to the wider energy system.

- Operational Forums,[28] which discuss recent operational performance, deep dive any significant operational events and provide an opportunity to flag upcoming issues or changes. This allows us to look at opportunities to address these.

We also continue to engage stakeholders at industry events and conferences. Recent examples including the Utility Week Live - Future of Gas session, the Network magazine - Future of Heat plenary session and the reception of the all-Party Parliamentary Group on Hydrogen.

At stakeholder events in 2018[29] we asked gas producers, gas shippers, gas storage operators and large industrial consumers about the problems they would face if they couldn't take gas on and off the network as needed. They talked about:

- impact on their ability to carry out day-to-day business
- impact on their commercial or financial position, especially for industrial consumers competing for business in international markets
- knock-on issues in areas such as reputation, long-term business viability and jobs
- safety impacts, particularly if there is little notice of any disruption to the ability to take gas on and off the network.

Here is some of the specific feedback we received:

"50% of our business comes from oil and gas so the impacts physically and commercially are both really important" [redacted]

"There would be a high impact on finances. We would be unable to generate electricity, unable to meet stakeholder requirements and not be able to meet trader demands" [redacted]

"~£10m to replace furnace if gas supplies are interrupted and can't shut down in a controlled way over several days" [redacted]

"To power stations there will be a high operational and financial impact and it could potentially break the plant" [redacted]

For more information on our engagement on this subject, please see Annex A22.01

Learning from RIIO-1

We have built in a number of innovation benefits achieved in RIIO-1 to our asset health plan. These are detailed in our innovation annex A25.03.

Our new ways of working from RIIO-1 include a new 'campaign' approach; grouping together asset replacements that require specific network outages and delivery capabilities across particular geographies. These groups are developed and contracted as a package to drive an increase in efficiency and delivery of a larger volume of work with minimum customer impact.

Undertaking this programme in the early years of RIIO-1 resulted in a reduced expenditure profile over the first few years. For instance, through these innovative and low cost options in 2017/18 we revised

[25] http://fes.nationalgrid.com/fes-document/
[26] http://futureofgas.uk/
[27] https://www.nationalgridgas.com/insight-and-innovation/gas-future-operability-planning-gfop
[28] https://www.nationalgridgas.com/data-and-operations/operational-forum

[29] During July 2018, we held four regional events in St Fergus, London, Chester and Bacton which were attended by over 50 stakeholders from a wide range of organisations to discuss requirements for the future needs of the gas transmission network.

our overall forecast downwards, a reduction of £12m on our 2016/17 RRP submission.

We will continue to use native competition to deliver our asset health work to leverage cost benefits for customers.
We are using our asset data to inform our programmes of work and will use this to focus on delivering improved reliability at lowest cost.

Across our US and UK business we share best practice, led by our Chief Engineer. This allows us to apply further insight and best practice to our activities.

4. Our proposals for RIIO-2 and how they will benefit consumers

Our key proposals under the five areas covered in this chapter are:

Asset health plan including specific projects at Bacton terminal and Kings Lynn

Our RIIO-2 asset health plan maintains the current levels of network risk (measured as the level of monetised risk), providing customers with similar levels of reliability and availability.

We need to invest more in RIIO-2 to maintain the levels of reliability and safety. As we are managing an ageing network with many assets at the end of their design life more condition related issues are being observed. We must avoid the serious consequences of a potential asset failure, such as an uncontrolled release of gas, fire, explosion or impacts from failing to deliver gas to consumers.

We have developed our RIIO-2 asset health plan using the new digital capabilities[30] we developed during RIIO-1. Our RIIO-1 innovation[31] is also included in our plans, driving efficiency and safety.

There are two locations where we have identified that the most economic course of action requires a more fundamental intervention:

- Bacton gas terminal, where we are proposing to fully redevelop the terminal
- Kings Lynn, where we are rebuilding part of the compressor site due to subsidence.

Asset management

Our RIIO-2 business plan shows a commitment to provide the reliable and flexible network that our stakeholders have told us they value. This requires a further step up of work from RIIO-1 and will require additional project support headcount within our central and operational teams. Understanding asset condition is key to ensure safe and efficient asset management. We plan to build on asset management tools and techniques we have developed in RIIO-1 to enhance our capability.

Network resilience

We have assessed the existing network to identify areas with lower resilience, i.e. those where planned or unplanned maintenance activities are more likely to disrupt customers' gas flows. We are proposing to make relatively small investments in two locations to increase the level of resilience for customers. At [redacted] to reduce ~2m consumers reliance on a single pipeline and at Tirley to prevent routine maintenance reducing capability at the Milford Haven LNG terminal.

Environmental resilience

Climate change introduces different risks to the network (for example, in response to flooding or river bed erosion). For RIIO-2 we are proposing a risk-based approach to achieve better understanding of the risks faced as a result of these challenges.

Gas system operation

We will continue to drive the efficient operation of the network, working with our customers to understand their needs and striving to deliver those needs with the assets and commercial tools available to us.

To meet customer needs while allowing more access to the network, we must invest in developing capabilities for our people and systems. This will allow us to drive the best performance from our assets and ensure appropriate market solutions are in place.

Following a series of cross-sector workshops, Ofgem has set a series of outputs and incentives to enable monitoring of how the business plan is being delivered. This priority 'I want to take gas on and off the transmission system where and when I want' maps to two of Ofgem's output categories - 'maintain a safe and resilient network' and 'meet the needs of consumers and network users'.

[30] For example, the new decision support tools developed in response to the NARM methodologies used for asset health

[31] See the RIIO-1 section of the Innovation Strategy Annex A25.03 for more detail

5. How will we deliver?

We will continue to explore process efficiencies in our role as integrated transmission system operator. For example, we are improving the prioritisation of our asset health work by collecting more detailed asset condition data and enhancing the tools that support decision-making.

We will also continue to explore how innovative technologies and approaches can support us in our commitment to meet your needs, and those of consumers, efficiently. This includes how we provide more access to assets to allow more asset health work while minimising the impact on you, driving our existing assets harder and developing new commercial tools to provide the right services.

And, in the longer term, it may be possible to repurpose assets to support decarbonisation, for example through a move to low-carbon gases (including hydrogen). As part of this work, we're considering future-proofing the asset investment in our RIIO-2 asset investment programme where possible and cost effective, for example to manage different gas qualities or mixes. There's more information on this in chapter 25.

6. Risk and uncertainty

There is a risk that an unexpected issue causes additional asset health risk impacting our ability to meet the requirements of stakeholders. This could be as a result of climate change (e.g. a landslip caused by significant rainfall, requiring a pipeline diversion), discovery of a type fault on an asset that is used across the network[32] or as a result of issues identified from the environmental surveys we plan to undertake.

These are unexpected occurrences that may require a mitigation activity during the RIIO-2 period. Our approach to managing this situation would be to consider risk trading across assets types, as permitted under the asset health methodology. One of the tools developed as part of the network asset risk metrics (NARMs) methodology[33] is the 'Service Risk Framework' to categorise the main risk areas, helping to assign a monetised value to each. The Service Risk Framework describes the expected performance measures for our assets, from our perspective and that of our external stakeholders.

7. Next steps

We will:

- build the outcomes from the stakeholder engagement including on network capability into the next iteration of our business plan. We will use the new framework to demonstrate the link between customer requirements and the levels of network capability you need
- work with you to confirm our **asset health** proposals are aligned to your needs
- engage with our supply chain to understand the best ways to contract for, and plan delivery of, the increased RIIO-2 workload
- work on benchmarking our **asset health** unit costs to make sure they are efficient
- work further with Ofgem and stakeholders on the redevelopment of the Bacton terminal, specifically around the role of competition and whether an uncertainty mechanism is appropriate.

In the next pages we cover each of the following sub-topics in detail;

- asset health (including Bacton terminal redevelopment and Kings Lynn subsidence)
- asset management
- network resilience
- environmental resilience
- gas system operation.

[32] For example, on a particular type of valve

[33] http://www.talkingnetworkstx.com/network-output-measures.aspx - NARMs previously known as NOM methodology.

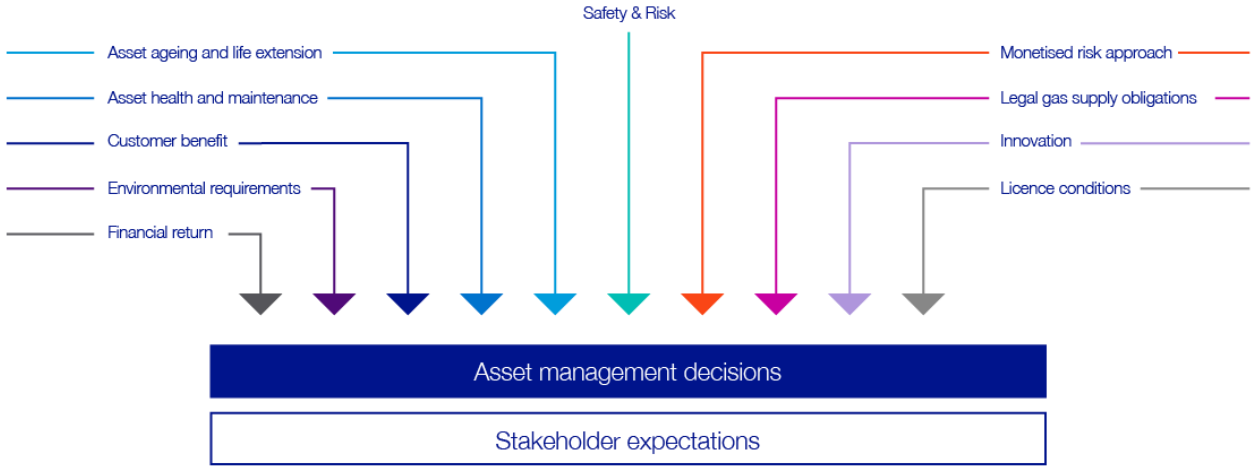
Asset health

1. What is this sub-topic about?

Our asset health plan sets out how we will manage, maintain and invest in our existing asset infrastructure to deliver the services you require. Our asset health proposals are underpinned by the need to maintain the necessary safety and reliability of our network, playing an important future role in support of the energy transition.

This chapter includes our asset management strategy and approach to RIIO-1 before setting out our RIIO-2 engagement and RIIO-2 proposals

Figure 22.5 factors affecting asset management decisions



2. Our activities and current performance

Asset management strategy

Our assets can have adverse impacts on our stakeholders and the environment if they aren't managed correctly, such as an asset failure leading to increased risk to life and property and/or cause significant customer disruption. Many of our asset decisions are complex. As we aim for world-class asset management, we make our asset decisions within a framework that is balanced, auditable and justifiable, and is designed to overcome challenges through innovation. We have a defined set of criteria to help us make our asset decisions and these reflect the different expectations of our stakeholders. As the sole licensed gas transporter, we also have duties and obligations under the Gas Act and through our Gas Transporter Licence. These factors all draw together to underpin our asset management decisions

We also have a company-level strategic framework and a set of gas transmission ambitions, which together shape our asset management objectives:

- ***Safety and compliance:*** actively promote positive safety and compliance behaviours and enhance our risk management by strengthening our controls and demonstrating compliance with our obligations.
- ***Asset management capability:*** balance cost, risk and performance to deliver a safe and reliable network by growing our capability in asset management.
- ***Drive efficiency and effectiveness:*** realise our promises to customers and stakeholders by planning and delivering our outputs efficiently, safely, on time, to budget and at the right quality.
- ***Data:*** collect and manage the quality of our data to make timely and well-informed asset management decisions.
- ***High performing teams:*** set ourselves up for success by taking accountability for delivering results, adapting well to change, taking an external perspective and continuously improving
- ***Future of Gas Transmission:*** enable the energy system of the future by delivering the gas transmission network and services that our current and future customers and stakeholders value.

To optimise our actions and potential investments in asset health, we consider four key risk factors: safety, reliability, environmental and risk of disruption to the transport sector. Through these metrics and

legislative requirements, we manage risks on the network as efficiently as possible.

An ageing network

The network evolved over time into its current role at the heart of UK energy supply. Construction of the National Transmission System (NTS) dates back to the early 1960s with a high-pressure methane pipeline from Canvey Island to Leeds. Conversion to North Sea gas then led significant network expansion throughout the 1970s, creating a network for transporting gas from the offshore UK Continental Shelf facilities to the UK's major towns and cities. A second phase of expansion occurred in the 1990s with the 'dash for gas'; a sharp increase in the number of large industrial and power station connections onto the network. The last significant network growth connected the liquefied natural gas (LNG) terminals at Milford Haven to the network in 2009.

Today, our network delivers three times as much energy as the electricity network. This extensive use and the great age of the critical infrastructure mean our assets now require greater care, increased monitoring, refurbishment and replacement to maintain a safe, reliable transmission system. A significant proportion of the assets are reaching, or have reached, the end of their design life see figure 22.6 below. This resulted in a change of focus in our asset management approach in RIIO-1, considering both the risk and consequence of any asset proposed investment. For RIIO-2, the future uncertainty of the energy system transition is an additional important consideration in our proposals.

Figure 22.6 NTS sites age profile (commissioning date for all above ground assets) excluding pipelines

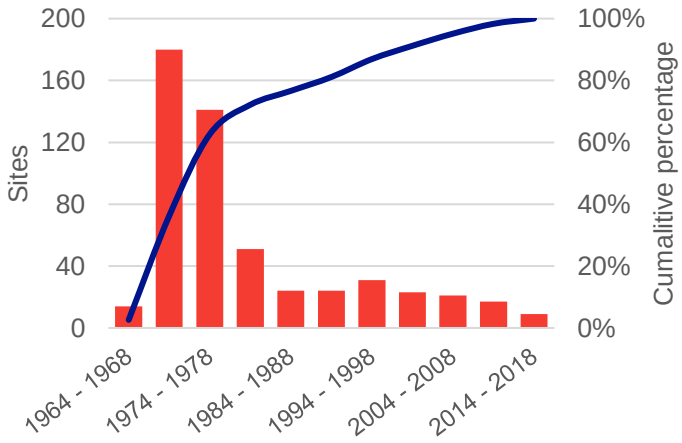
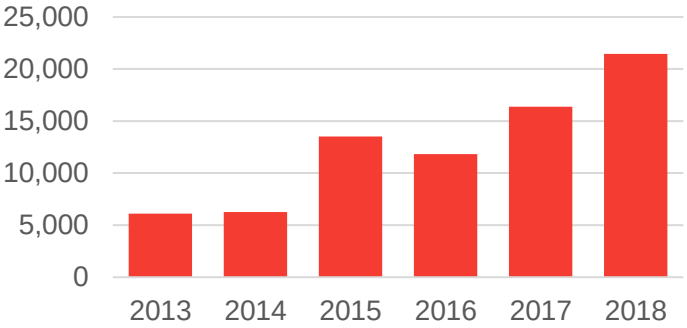


Figure 22.7 annual volume of asset defects recorded by field engineers



This change in focus led us to capture more granularity on our asset defects and capture these in central systems rather than at site locations. This has led to the recording of increased defects on the network as shown in figure 22.7. Based on this work, and using our modelling capability to forecast the rate of defects and impacts on service, we are moving towards an unmanageable position should we progress through RIIO-2 without significant intervention.

During RIIO-1 we continue to manage the situation of ageing assets and higher volumes of defects, including investing in excess of our RIIO-1 allowances on asset health by £100m to maintain the safety and reliability of our network. Our field engineers operate an operational risk assessment process to manage these issues and put in place mitigation measures whilst the appropriate corrective intervention is identified.

Our approach to managing the assets

Our definition of asset management aligns to the international standard for asset management (ISO 55000:2014) and is:
"The coordinated capability to make lifecycle cost, risk and performance decisions and thereby create value for an organisation from its assets".

Our approach to asset management applies to all assets that comprise the network in England, Scotland and Wales and it also covers all National Grid employees and contractors who work on them. Our key asset management obligations are:

- to develop and maintain a safe and efficient, coordinated and economic system of gas transmission, which supports competition in the supply of gas
- to have regard for the effect of our activities on the environment.

These obligations ensure we take a holistic view of our asset health works to supports the network capabilities you want from us. This section expands on the wide range of inputs including tools, methodologies and data, that underpin our asset management approach.

Our asset management maturity is underpinned by our routine maintenance activities, which proactively identify asset health issues. The information we collect enables us to prioritise investment decisions. We have set out our asset management approach in our Strategic Asset Management Plan (SAMP), describing our overall management strategy for the network's assets and how our practices, policies and procedures together form an integrated asset management system.

As a first step we determine what's needed in the future and these requirements influence whether we maintain, replace or decommission assets. We use a wide range of information to assess condition, likelihood of failure and the potential consequences to help us make these decisions. Over the RIIO-1 period, working with Ofgem and other industry stakeholders, we developed an approach to risk termed the network asset risk metric (NARMs)[34] methodology. Translating supply, safety or environmental risks into a financial cost standardises how we quantify different issues and we can then compare their significance through an approach called monetising risk. Based on the principles of monetised risk, we can forecast cost, risk and service performance of the assets in the long-term, leading to better decisions and more efficient spending.

One of the tools developed as part of the NARMs methodology is the 'Service Risk Framework' to categorise the main risk areas, helping to assign a monetised value to each. The Service Risk Framework describes the expected performance measures for our assets, from our perspective and that of our external stakeholders. For each service risk measure, such as safety or environment, we have defined a measure for potential severity, based either on a measurable value that can be costed separately (such as emission of pollutant gases to air) or on the actual cost of remedying any damage.

We consulted extensively on our NARMs methodology, which was developed with Ofgem oversight. Through our engagement we received the following written feedback from our stakeholders;

"This methodology should help to ensure that a better balance is struck in the future. Compared with the previous methodology, the new methodology facilitates improved transparency in reporting investment benefits as well as their jjustifications" [redacted]

"We understand that "risk monetisation can be used to identify the most cost beneficial interventions." And that the measurement of monetised risk can be used to show what value investment can give, but we do not see how this information is used to demonstrate the best outcome has been achieved. We understand that targets should be agreed with Ofgem and the onus is on Ofgem to monitor this" [redacted]

"In the consultation, aspects of the methodology and its application have been identified that require further work ahead of the RIIO-GT2 price control. We recommend efforts are focussed on ensuring the methodology is wholly fit-for-purpose for developing the business plan for and undertaking network investment during the RIIO-GT2 price control." [redacted]

To address [redacted] concerns, we have been fully engaged in Ofgem's industry working groups to agree the methodology and mechanism that will be applied to the RIIO-2 plan. Our approach is consistent with Ofgem requirements and aligns with stakeholder needs.

We have also developed an asset investment optimisation tool, called the decision support tool (DST) to compare different investment options. The output from the DST is a total cost and the resultant service level risk, in terms of safety, reliability, environmental, societal and financial risk. The modelling process calculates the monetised risk for each pipeline section or piece of equipment. Deterioration assumptions are then applied. This future profile is essential to justify investments as our assets generally have a long life. This is particularly important in the context of the future network requirements within the energy transition. The DST model is used in conjunction with 'hard-coded' investments driven by government policy and legislation or where an off-line justification needs to be carried out by subject matter experts (SMEs).

Using these tools, we have developed plans based on service, risk and cost, which has identified an

[34] http://www.talkingnetworkstx.com/network-output-measures.aspx - NARMs previously known as NOM methodology.

increasing level of work to maintain service as we move into RIIO-2. With increasing asset health issues, this has required us to look for ways to efficiently deliver work and access the network while minimising customer disruption. This work included areas of the network that had never had previous significant intrusive maintenance. We introduced a 'campaign' approach; grouping together asset replacements that require specific network outages and delivery capabilities across particular locations. They are contracted together to improve efficiency and deliver a larger volume of work during a single system outage.

While we have deep expertise and experience we sometimes need to call on specific capability or expertise. Sourcing additional asset management expertise from external providers and specialists is overseen and managed through National Grid's procurement processes. We operate a series of procurement frameworks to drive efficient selection of a supplier in a competitive environment that ensures value for money.

We are audited against the certified international standard ISO55000:2014. This standard focuses on ensuring a continuous improvement in our asset management activities.

As part of this continuous review we compare ourselves against other asset-intensive organisations, including those outside the utility sector, and identify areas to improve on. We have increased our investment in innovation, both to give us confidence in assessing the condition of our assets and to drive more efficient work procedures. Through projects such as GRAID[35], a robot that assesses the health of pipelines on sites where internal inspection has not previously been possible. Or shallow dig, a new technique to enable repairs to corroded valve pipework, we are ensuring a safer and more reliable supply of gas to GB consumers. We look for opportunities to improve our systems and procedures and how we manage our assets. The process of continual improvement is underpinned by our performance management approach, improving the way we think and work in meeting our asset management objectives.

Enhanced knowledge of asset condition and risk, continual improvement and innovation and our approach to deliverability come together to underpin our RIIO-2 asset health plan.

RIIO-1 performance

In our RIIO-1 business plan we signalled the need for increasing expenditure to address the condition of our assets, forecasting £719m. Ofgem concluded that a lower level of investment was needed with more efficient delivery and we were granted an allowance of £593m.

We are forecasting to spend in excess of our RIIO-1 allowances on asset health by £100m to maintain the safety and reliability of our network. This includes investing over £40m at our Bacton terminal (for which we did not secure any separate regulatory allowances in RIIO-1).

We have used native competition for all our asset health investments in RIIO-1 ensuring lowest competitive price for our customers.

The RIIO-1 price control introduced the Network Output Measure (NOM) methodology to assess whether we are delivering the asset health outputs. We have had a strong focus on delivering work across the network that will manage the level of risk at the lowest cost. We are on target to deliver the absolute level of network risk agreed as part of the RIIO-1 price control and maintain the service risk level our customers expect.

Our asset management approach for RIIO-2

We have maintained the high levels of safety and reliability on our network that you expect from us throughout RIIO-1 achieving 99.99% reliability. In our plan, we take a holistic view of our asset health requirements to deliver a service that supports the network capabilities you require. Our RIIO-2 plan will achieve a programme that stabilises risk over a 10 year period across our asset base. This will ensure we maintain service levels for our customers.

In our asset health plan for RIIO-2, we started by determining the future requirements to underpin decisions about maintaining, replacing or decommissioning assets. This includes network analysis used to assess the sensitivity of alternative supply and demand scenarios against the FES '1 in 20' peak demand.

Then, we used all known information about our assets in terms of condition, probability of failure and the potential consequences to understand what impact we may have on the level of risk on the network and the level of risk in the future without investment. These inputs allow us to translate

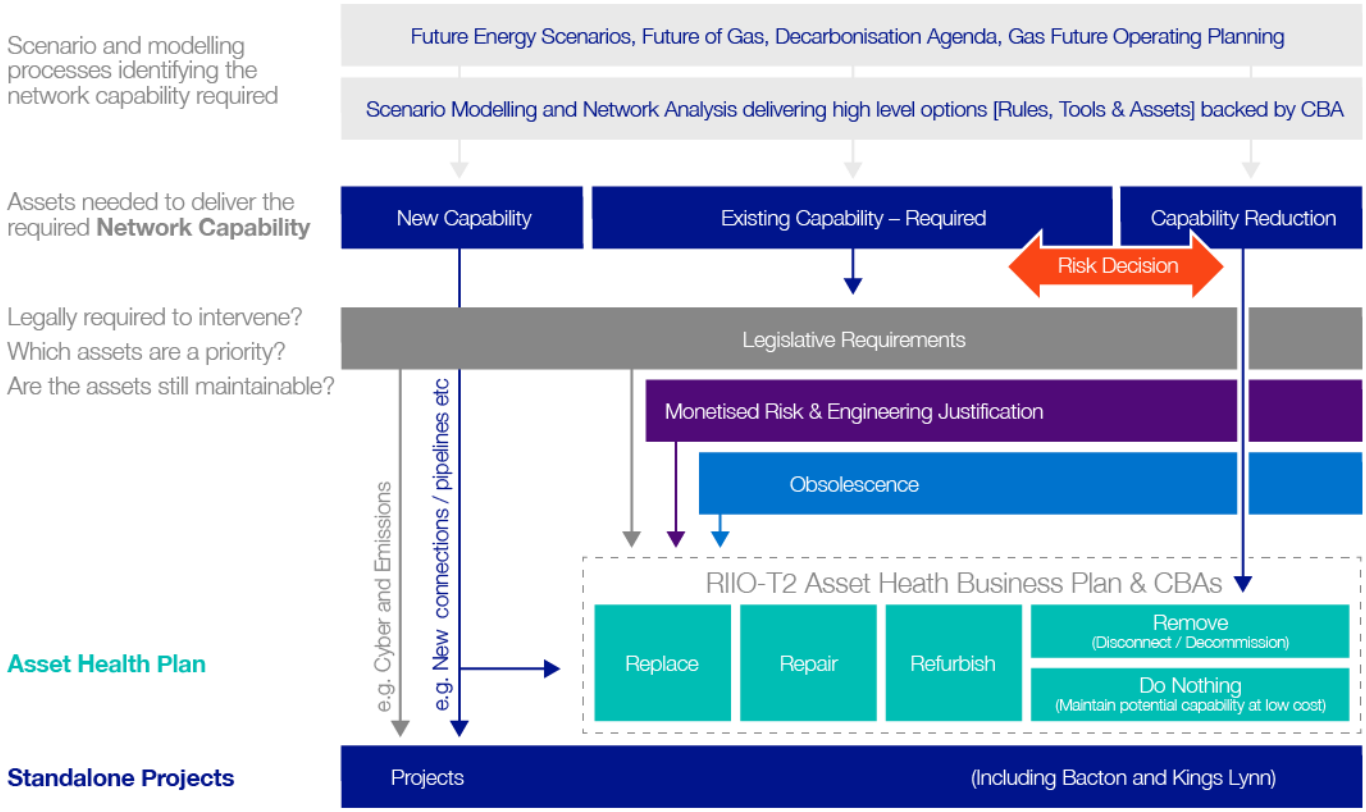
[35] GRAID – gas robotic agile inspection device

service, risk and cost into a plan that delivers for our customers.

These asset health activities are, then, a fundamental element in defining our overall network capability.

The diagram below shows how the information feeds our approach to planning, defining levels of services and risk analysis to give that overall capability picture.

Figure 22.8 approach to giving overall capability view



3. What are our stakeholders telling us?

Stakeholders representing almost all sectors have been very clear that network reliability, and therefore asset health, is a critical area. Reliability and resilience are absolute fundamentals for consumers and they expect power and heat to be there whenever, wherever and however they need it, now and in the future.

In bringing all our engagement together we have been able to turn the material into meaningful and actionable insight. The key conclusions are as follows:

- we should not allow any decline in health and safety service risk levels.
- according to the stakeholders polled on the asset health costed options, there is very little support for constraining our plan purely on cost, such as the same level as RIIO-1. Stakeholders do not want to see an increase in risk, and they are willing to pay more to achieve this.
- overall, there is very slightly more support for increasing the reliability by 10% compared to keeping risk the same as RIIO-1. However, the responses vary according to which stakeholder groups we focus on. Stakeholders that pay bills slightly prefer to keep risk the same as RIIO-1.
- there is strong support from stakeholders to pursue the future-proofing option and to strengthen our focus on options around improving efficiency.
- stakeholders overall also want to us to pursue the option to reduce cost to consumers, although some were unsure about this.

It is also important that we gather consumer views to shape the asset health plan. Working collaboratively with the electricity transmission networks, we have surveyed domestic and business consumers about

their willingness to pay[36] to reduce the risk of an interruption at household level. The output from this work concluded that domestic consumers place a very high value on reliability and value improving reliability by 10% at a cost of £0.50 per annum. Similarly, non-domestic consumers value reliability to a similar extent as domestic consumers. This allows us to have a complete picture of what our stakeholders and consumers value and we have taken these views into account in building our plan.

In response to stakeholder feedback, we have used the following primary principles to develop our RIIO-2 asset health investment plans:

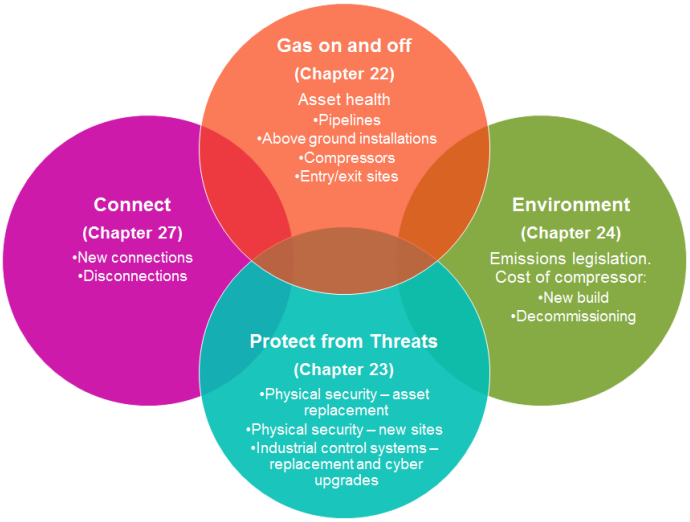
- continue to meet our legislative and policy requirements
- maintain service levels as a continuation of our RIIO-1 approach that represents our customer and stakeholder views
- no reduction in the levels of service we provide across all key risk categories until 2030.
- seek cost beneficial ways to deliver improvements, such as our approach to our Bacton terminal and subsidence at part of the Kings Lynn compressor site
- consideration of future-proofing assets, for example repurposing for hydrogen transportation[37] or as part of a carbon capture usage and storage system.

We will be talking to stakeholders this summer to test that we're still on the right track and we'll reflect any changes in our business plans in October and December 2019.

4. Our proposals for RIIO-2

In developing our asset health proposal, we needed to take into account of other primary drivers for works on the assets. We have made a conscious decision to separate out our activities into their separate primary cost drivers. Each driver does require work on our physical gas transportation assets. The diagram below and description explains our current proposal for separating our plan and associated assumptions. This avoids any ambiguity in our plan and increases transparency of the need to undertake works.

Figure 22.9 potential overlaps between cost drivers



We propose that works in the following categories are funded in separable mechanisms including:

- customer-driven connections, diversions and disconnections
- asset upgrades to comply with the NIS Directive (cyber security)
- physical security asset replacement or new build investments.
- asset replacements, upgrades or decommissioning to comply with emissions legislation e.g. Medium Combustion Plant Directive.
- asset health works covered under NARMs.

We have set out our proposals for each area in the associated chapter and justified this through additional justification reports and cost-benefit-analysis.

If our proposals are not accepted against our proposed categories, but associated asset health works are still needed, the assets identified would have to revert into the asset health category. If this happens, we'd account for the monetised service risk benefits and would incorporate the works and outputs into a revised NARMs plan and targets.

Impact of network capability engagement

Building on the work to date, we will be further refining our plan against the network capability needs of our stakeholders for the October 2019 submission. Should this lead to changes in requirements we will update each impacted area of our plan.

[36] Willingness to pay is discussed in chapter 28

[37] More information on our hydrogen activities can be found in chapter 25 on whole energy systems.

Asset Health plan for RIIO-2

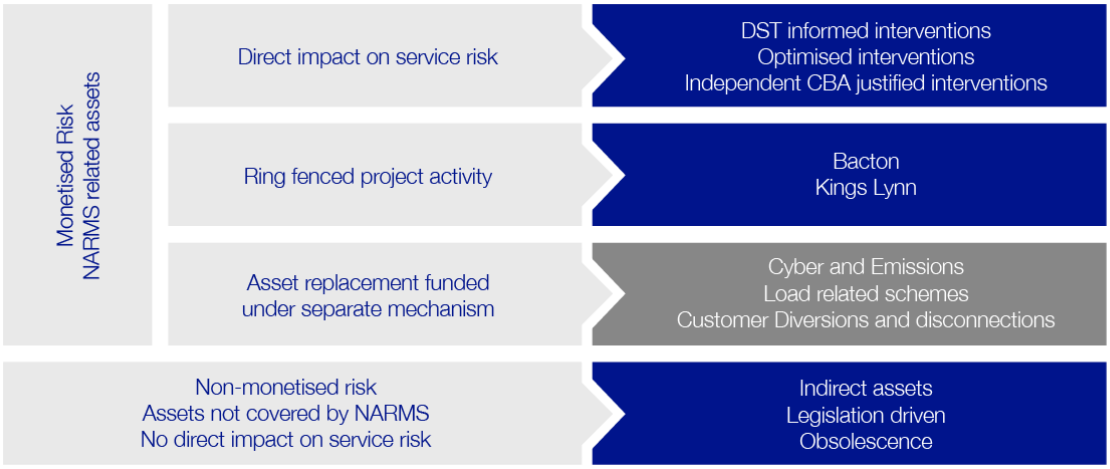
Our asset health plan invests £888m in the period 2021-2026 and sets out to deliver the desired level of service required by you, our stakeholders. Our plan is underpinned by the approach described above: we'll assess robust data and information including observed asset condition information and input from our subject matter experts, then justify our proposals through the NARMs methodology and cost benefit analysis.

We have used Ofgem's asset health plan structure as summarised in figure 22.10. Our asset health plan is structured into three of the four categories.

1. **direct impact on service risk** for assets that can be justified using monetised risk
2. **ring fenced project activity** delivering two projects through defined Price Control Deliverables - i.e. Bacton and Kings Lynn, where site redevelopment is the most economical approach to managing the risk
3. **non-monetised risk** delivering works to ensure compliance with legislative and wider oil and gas industry standards and addressing our assets (e.g. civil and electrical) that support or contribute to the safe operation of the system.

Investments in a fourth category, ('asset health funded under a separate mechanism') are covered in separate chapters.

Figure 22.10 asset health plan structure



Across these three areas, we have 10 investment themes to encompass our full asset health plan and each is supported by a separate engineering justification report and cost-benefit-analysis.

This results in the following price control deliverables which are summarised in the table below and set out in more detail annex A29.01.

Table 22.11 outputs relating to asset health

PCD name	Business plan proposal - what the PCD measures	Related UM	Supporting info
3. **NARMs (PCD/ODI)**	Relative target to measure delivery of our asset health investments with justified over and under delivery.	-	8 x Justification report & CBA (Annex's A22.08 – A22.23)
6. **Kings Lynn subsidence**	Address subsidence at Kings Lynn compressor site	-	1 x Justification report & CBA (Annex 22.04 & A22.05)
7. **Bacton terminal site redevelopment**	Delivery of Bacton terminal site redevelopment	-	1 x Justification report & CBA (Annex A22.02 & A22.03)

Monetised risk and non-monetised risk investments

Learning from RIIO-1, we have built a plan that takes a strategic and proactive and evidenced approach to managing our assets that will ensure we achieve a programme that stabilises risk over a 10-year period across our asset base, i.e. maintains network risk. We cover **eight** of the investment themes below highlighting, in summary, the scope, cost and proposals of each. Our Bacton and Kings Lynn projects are discussed separately.

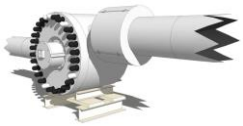
Investment theme / subtheme	Example assets	Description	RIIO-2 (£m)
Cab infrastructure - **Cab enclosures** - **Air Intake** - **Ventilation** - **Exhaust** - **Fire Suppression**	 *1970s gas-driven compressor cab building*	Cab infrastructure includes the systems that support the compressors, including buildings, fire suppression, exhausts, ventilation and air intake. There are specific policies that support the need for investment for buildings, fire suppression and ventilation whilst investment in exhausts is driven by emissions legislation. Legislation: PM84 (BSISO21 78)	37.1

Our Proposal – engineering justification report A22.08

Cab infrastructure is a secondary asset but fundamental to ensure safe operation of the compressor train and compliance with environmental and safety legislation.

We propose a rolling campaign that brings our cabs into compliance over a 10-year period that allows the primary compressor train to remain operational. This programme aligns with our need to refurbish and replace the majority of the fire suppression systems to manage potential emergencies within the cab enclosures.

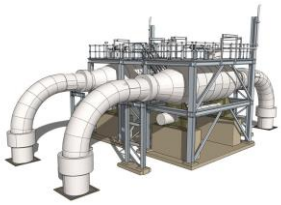
Our cab infrastructure plan is the least whole life cost in order to maintain availability and reliability for customers.

Investment theme / Subtheme	Example assets	Description	RIIO-2 (£m)
Compressor train - **Gas Generators, Starter Motors and Power Turbine** - **Electric Drives** - **Compressor** - **Vent Systems**	 *Compressor with cutaway suction and discharge pipework*  *Avon-type gas generator*	Ensuring gas compression can be applied at different points on the network to move gas from entry points at the right pressure to the network exit points. Compressors cover the vent systems, fuel tanks, starter motors, compressors, gas generators and power turbine. Most of these assets are covered in the monetised risk area of the plan, however some policy investment is required around vent systems. This investment is driven by Pressure Systems Safety Regulations (PSSR) and PM84.	104.7

Our Proposal – engineering justification report A22.10

Our asset strategy is to ensure a good consistent level of unit availability and reliability for the fleet. To maintain these assets we follow the original equipment manufacturers recommendations and our policy is consistent across all European compressor operators.

Our plan is the minimum interventions required and least whole life cost in order to maintain availability and reliability for customers.

Investment theme	Example assets	Description	RIIO-2 (£m)
Plant and equipment - **Above ground pipe and coating, Cathodic Protection and Cladding** - **Filters, Scrubbers, Strainers and Preheaters** - **Pressure Reduction, Flow Control and Slamshut Valves**	 *Scrubber – to remove liquid, dust and debris from gas flow*  *Cathodic protection transformer rectifier*	Range of assets on compressor sites and other above ground installations to enable the efficient and safe operation of the network. Includes; pipework on our sites which is coated as a primary means of corrosion prevention and protected by Cathodic Protection as a secondary means where it is underground; pipe cladding to mitigate noise and thermally insulate the pipework; filters, scrubbers and strainers to remove particulates and liquids from the gas flow; preheaters to prevent condensate after pressure reduction points that meeting customer requirements; and slamshut valves	138.0

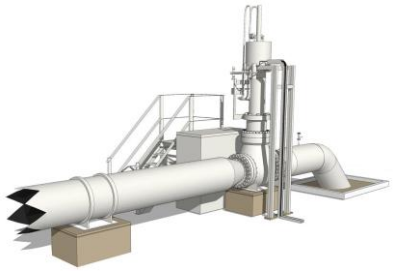
Our Proposal – engineering justification report A22.12

The pipework and all plant and equipment are subject to the Pipeline Safety Regulations (PSR) and Pressure Systems Safety Regulations (PSSR). Assets need to be designed, constructed and operated so that the risks are as low as reasonably practicable.

For pipework, that has intrusive site and cladding inspections, a rolling long-term programme is required. Our strategy is to propose a 15 year repaint or partial paint strategy driven by our robust corrosion inspection programme and corrosion records. This will allow us to re-life existing coating and undertake remediation of significant defects.

For key plant items we have undertaken a full risk and requirement assessment. We will undertake a risk-based intervention programme based on this specific asset information, which includes asset removal where appropriate.

Our plant and equipment plan is the least whole life cost in order to maintain availability and reliability for customers and is cost beneficial over a 36 year period.

Investment theme	Example assets	Description	RIIO-2 (£m)
Valves - **Locally Actuated Valves** - **Remote Isolation Valves** - **Process Valves** - **Non-Return Valves**	 *Cutaway section of pipework with valve and actuator*	Limits gas loss in emergencies, manages flow direction, facilitates maintenance and enables safe and effective start-up and shutdown of different parts of the network.	61.9

Our proposal – engineering justification report A22.14

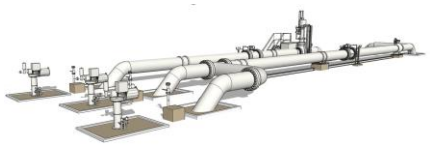
We are proposing investments on 8% of the population of valves over the RIIO-2 period. The ability to isolate effectively through our valve population is primarily a safety driver and allows us to undertake network outages.

This programme will reduce the consequences of the deteriorating asset condition, and address issues such as;

- isolations becoming increasingly complex, time consuming and expensive due to internal leakage across isolation valves.
- isolations requiring increasing lengths of the network to be vented with an increased environmental impact.

- the passing of gas from vent and sealant lines and stem extensions to atmosphere, which presents a safety hazard as well as the obvious environmental impact.
- increased outage time when failures do occur with potential customer constraints due to obsolete assets and unavailability of spares.

Our valve plan is the least whole life cost in order to maintain availability and reliability for customers and is cost beneficial over a 36 year period.

Investment theme / Subtheme	Example assets	Description	RIIO-2 (£m)
Pipelines - **Pipeline, Coating and CP System** - **PIG Traps** - **Nitrogen Sleeves** - **Water Course Crossings** - **Depth of Cover**	 *Pipelines connecting to site assets*	The pipelines category covers pipe bridges, river crossings, marker posts, pig traps, impact protection and cathodic protection.	135.3

Our proposal – engineering justification report A22.16

This varied collection of assets has a range of drivers for investment, with the main drivers for investment stemming from PSR and PSSR. These drive activities from inspections, to repair, to decommissioning and replacement.

Our pipeline plan is built on robust data that has been gathered over many years. Our programme is driven by primary legislation and managed through an accepted methodology agreed with the HSE.

Significant pipe replacement or coating reapplication to address defects would be too expensive for customers. The most cost-efficient solution is a regime of internal and ground-based surveys combined with investment in cathodic protection and the associated investigation and remedial works.

One important area of investment for RIIO-2 and beyond is to ensure our cathodic protection system continues to protect our pipelines from corrosion where the primary coating has failed.

A 10-year view has been taken, covering the RIIO-2 and RIIO-3 regulatory periods to ensure a balanced, lifecycle approach to managing our pipeline integrity. Our pipeline plan is the least whole life cost in order to maintain availability and reliability for customers and is cost beneficial over a 10 year period.

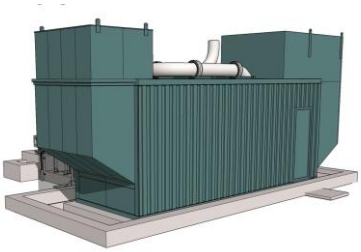
Investment theme / Subtheme	Example assets	Description	RIIO-2 (£m)
Structural integrity - **Pipe Supports, Pits and Ducting** - **Security, Fencing, Buildings and Access** - **Tanks, Bunds, Sewage Treatment and Drainage**	 *Valve pit*  *Steel storage tank (CMT lube oil)*	Structural integrity covers many assets that support our network, such as security, drainage, access, buildings and enclosures, ducting, and pipe supports and pits.	97.6

Our proposal – engineering justification report A22.18

These assets support our pipelines and sites to ensure they are safely operated, protected and limit impact of our assets on the environment. As such their continued provision of a basic required level of performance is necessary, with the most critical elements such as buildings, concrete foundations and pipe supports being essential. In some cases, these support compliance with the Pressure Systems Safety Regulations (PSSR) and the Pipeline Safety Regulations (PSR) as well as some environmental obligations.

For site security, we have a duty of care to ensure both the public and employees are protected and therefore we need to ensure our sites are safe and secure.

Our approach is based on best practice management of civils assets. Our proposal is the least whole life cost approach to the management of these assets.

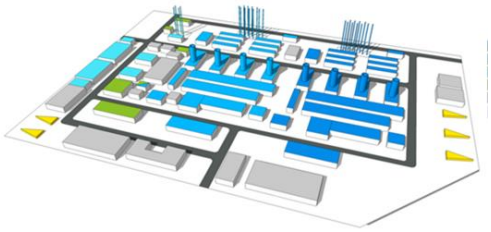
Investment theme / Subtheme	Example assets	Description	RIIO-2 (£m)
Electrical - **Standby Power Supplies** - **Site Electrical Systems**	 *Diesel-powered standby generator*	Electrical covers all electrical assets that support our network – standby generators, safe shutdown and the electrical variable speed drive. All our electrical equipment and associated systems must be designed, maintained and operated in a safe manner in accordance with the Electricity at Work Regulations. In addition to these standard requirements, the electrical equipment on a gas site is captured by Dangerous Substances and Explosive Atmospheres Regulations (DSEAR). The sites are zoned into hazardous areas and we must make sure that any electrical equipment is compliant with the requirements of the relevant equipment protection systems for each zone, designed and installed correctly and maintained in good condition.	31.2

Our proposal – engineering justification report A22.20

The Electrical Infrastructure provides power to enable the safe and effective operation of sites across the network. Most assets within the gas transmission system rely on an electrical supply to fulfil their function or are protected by equipment that requires an electrical supply. If these assets deteriorate too far and fail against Electricity at Work Regulations or DSEAR then the primary asset will be shutdown.

A proactive and phased intervention programme is proposed to avoid unmanageable levels of defects, together with the associated adverse impacts on the safety, operation and availability of the network and any potential legislative non-compliance.

Our proposed proactive programme is the least whole life cost in order to maintain availability and reliability for customers and is cost beneficial over a 22 year period for site electricals and 33 years for standby power.

Investment theme / Subtheme	Example assets	Description	RIIO-2 (£m)
St Fergus	 *Illustration of our St Fergus site*	The National Grid St Fergus gas terminal handles anything between 25 and 50% of the UK's gas supplies. The St Fergus terminal takes gas from three sub-terminals operated by our customers and exports it to 5 feeder pipelines into the rest of the network. The site can be split into three basic areas – compression, mixing and manifolds (including all process pipework). The site has been in continuous operation for over 40 years and is now moving beyond the design life of most of the critical assets.	63.1

Our proposal – engineering justification report A22.22
The terminal site comprises a large quantity of coated pipework 17km of which is buried and protected by cathodic protection systems, over 1,200 valves above 4" in diameter plus additional valves below that size, and 7 gas generator and 2 electric drive compressors are each protected by compressor cab infrastructure. All of this equipment needs electrical infrastructure and structural assets to operate in a safe and reliable manner.

This site includes works described in all of the other 7 investment themes and subthemes and our approach to each is consistently applied at our St Fergus site. The individual investments are detailed and evidenced within the engineering justification reports.

Our proposal to manage the assets at St Fergus is the least whole life cost approach and is cost beneficial over a 45 year period.

Using the NARMs methodology, we have determined the deterioration profiles with associated consequences and probabilities of failure for each of the eight categories. To maintain the service risk across our network we have:

Optimised interventions – determined the mix of asset interventions to deliver the most economical solutions. This includes some legislation-driven interventions to deliver a condition benefit and an improvement to service risk. These have also been reviewed by our subject matter experts to ensure they are consistent with their views.

Justified interventions using independent cost-benefit-analysis – our asset subject matter experts have identified asset interventions that are cost beneficial. Where investments are supported by the CBA, investment constraints have been input to the decision support tool[38] and contribute to our service risk target of maintaining the levels of service risk.

Non-monetised risk – assets not covered by NARMs- Asset investments within this category are driven by legislative requirements, management of indirect assets and obsolescence. We have covered these elements within each engineering justification report and explained the drivers for these investments, which can be linked to any of the following areas;

Compliance with legislative and industry standards
These are mandated asset interventions across certain asset themes that don't directly deliver a condition benefit and so don't directly improve service risk levels. There are a number of legislative and oil and gas industry standards that we must deliver against, that are transposed into the policies our safety case is dependent on. We have identified these separately in our plan with the associated workloads and are committed to delivering on these commitments over RIIO-2.

Civils assets supporting our safe operation
We have a range of electrical and civil assets (e.g. security fences, and pipe supports) that currently do not directly impact service risk as they are not integral to the transportation of gas. These assets are, however, essential to the safe operation of the network and would have a detrimental effect on the protection of the network and the environment if these were not managed and addressed. Examples include the site security fencing, road access and pipe and other asset supports, which degrade over time.

Our approach is to take a condition-based approach that is based on best practice management. Our programme is a least whole life cost approach to the management of these assets and will ensure current and future customers can benefit from our network until at least 2045.

Obsolescence
The reliability of our assets deteriorates with age and duty. Access to spares and expertise to carry out repairs becomes increasingly limited as equipment becomes obsolete. This is particularly a problem with electrical equipment which has a much shorter asset support life than some of the mechanical assets. We manage relationships with original equipment manufacturers (OEM) so that we're aware of component lifecycles and we have advance warning of imminent obsolescence. This helps us decide whether to obtain additional spares before products are withdrawn, so we can defer replacement. These investments are not solely limited to old assets or condition-based issues; sometimes original equipment manufacturers can no longer support and or provide maintenance spares. Obsolescence interventions are not currently modelled in the NARMs methodology.

Defined price control deliverable projects

We have proposed projects at Bacton and Kings Lynn with separate funding and specific price control deliverables (PCDs). These projects will deliver service risk benefits and our analysis shows that these will contribute to an improvement in reliability for customers. The justification for these projects is covered under separate sections of this chapter.

5. How will we deliver?

The planned increase in work on the network has required us to think very differently about how we manage our asset health works whilst ensuring we can deliver the service our customers need throughout the year. It is important that the RIIO-2 incentive arrangements on maintenance, capacity constraints and customer satisfaction are aligned to minimise the impact our work can have on our customers.

The application of innovation projects developed in RIIO-1, such as GRAID and shallow dig as discussed

[38] An example of this is Compressor Train - Intervention frequency on these assets is determined and completed in accordance with OEM recommendations (considered industry best practice). The independent CBA supports the SME proposed investment and will therefore be fixed to the corresponding value supported by the CBA.

earlier and other projects, such as composite pipe supports and 3D Modelling (BIM), will be critical to successful and efficient delivery of our programmes of work. We will also continue to develop our campaign approach alongside our procurement contract strategy to drive successful and efficient delivery of work.

We have developed our asset health plan over a 10-year period to accommodate network outages in RIIO-2 and RIIO-3. However, we have tested that the works can be managed through network outages required by this plan while minimising constraints and costs for our customers. Bringing workload forward or deferring into RIIO-3 is likely to have an effect on the capability of the network during that period.

The building blocks of our outage plan are:

- pipeline inspection outages – we have defined when we need to internally inspect our pipelines (between five and 15 years). Remediation outages are scheduled following inspection. Our plan is designed to deliver as many works as required during a single outage for pipeline inspections or remediations, to avoid any more down-time.

- interaction with other programmes (cyber and emissions legislation-driven works) – to manage external threats and reduce the emissions at our compressor sites we have prioritised the associated outages over the 10-year period. Deadlines for these programmes mean we need to ensure we meet the compliance date. These activities have then been scheduled alongside our asset health plans.

- non-routine maintenance – over time, we'll need to carry out non-routine maintenance that requires outages. We can't plan for this, but our plan provides flexibility to schedule additional outages.

6. Risk and uncertainty

The most significant risk is an unexpected asset failure or need to isolate due to unacceptable safety risk that affects our ability to meet the requirements of stakeholders. This could be as a result of climate change (e.g. a landslip caused by significant rainfall, requiring a pipeline diversion) or the discovery of a type fault on a type of asset (e.g. a particular valve or pipeline section) that is used across the network. As these are unexpected and unforecastable costs requiring a mitigation activity that can't be deferred and can cost millions of pounds to manage and rectify.

As we implement project GRAID, we will get more accurate information on the condition of the below ground pipework on our sites. This could identify further work on our assets which needs to be accommodated in our plans.

Whilst undertaking our proposed asset health works, we are likely to find additional issues due to the costs and practicalities associated with fully inspecting some of our assets in advance of works. Some of these new issues will be best dealt with while we're working on site, but we'll be able to defer others until a later date. We need the ability to trade risk across our asset categories, so we can deliver the best outcome for consumers.

Given these potential risks described above, we are proposing that the RIIO-1 mechanisms for justified over- and under-delivery of NARMs outputs are retained for RIIO-2, which is consistent with Ofgem's Sector Specific Methodology Decision in May 2019.

Given the growing workload and our limited ability to access some parts of the network without impacting gas supplies, we are having to think differently about how we deliver our plans. This includes careful consideration of any work deferrals as this would probably affect future year outage plans and could impact gas supplies to customers.

7. Our proposed costs for RIIO-2

Table 22.12 asset health spend

(£m in 18/19 prices)	2022	2023	2024	2025	2026	Total RIIO-2	Annualised RIIO-2	Annualised RIIO-1
Cab infrastructure	4.1	5.8	9.1	9.1	9.1	37.1	7.4	
Compressor train	11.6	16.3	25.6	25.6	25.6	104.7	20.9	
Plant and equipment	15.3	21.5	33.7	33.7	33.7	138.0	27.6	
Valve	6.9	9.6	15.1	15.1	15.1	61.9	12.4	
Pipelines	15.0	21.0	33.1	33.1	33.1	135.3	27.1	

Structural integrity	10.8	15.2	23.9	23.9	23.9	97.6	19.5	
Electrical	3.5	4.9	7.6	7.6	7.6	31.2	6.2	
St Fergus	7.0	9.8	15.4	15.4	15.4	63.1	12.6	
OPEX	3.1	3.1	3.1	3.1	3.1	15.5	3.1	
GRAID	3.4	3.4	3.0	4.8	3.8	18.3	3.7	
Total[39]	**80.8**	**110.5**	**169.6**	**171.4**	**170.4**	**702.7**	**140.5**	**88.1**[40]

8. Next steps

We are engaging over the summer on network capability and to ensure our business plan proposals meets the needs of stakeholders. Changes to our proposals may require us to revisit areas of our plan due to the interactions between compressor investments to meet environmental legislation, asset health, cyber and physical security investments.

We are still talking to consumers, introducing an interactive online tool that allows them to experiment with changing the levels of service they receive and to see the resulting impact on their bill.

We are planning to work with stakeholders over the summer 2019 to test whether our interpretation of our previous stakeholder engagement together with the new asset health framework still reflects their views. We will respond to any changes in our business plan in October 2019.

We have also initiated work with some European gas transmission companies on a study to compare unit costs for some categories of asset health work. This is the first time this has been tried and it is a technically complex piece of work, requiring the alignment of both cost and asset structures across the companies. We are hoping that this work will inform our December business plan submission.

Bacton

1. What is this sub-topic about?

We propose to replace the terminal at Bacton, Norfolk as the most efficient way of meeting future customer requirements[41]. Doing so will create a site with appropriate capabilities and it avoids the need for a more expensive asset health programme. Such a programme would take many years to complete because it's not possible to take the required outages without significant customer disruption. The payback period for a new terminal over an asset health approach is 12 years from 2021 (2033).

We have considered whether a programme of asset health during RIIO-2, would allow deferral of the decision on Bacton until RIIO-3. However, there are a number of issues with the existing site that need to be addressed in RIIO-2 and can't be deferred until RIIO-3. These issues include:

- obsolescence of the fire and gas system; the distributed control system and the gas quality system,
- issues with corrosion and non-sealing valves, and
- increased costs associated with operating and maintaining redundant assets.

The cost benefit analysis has confirmed that the redeveloped terminal is a cheaper option than adopting a long-term asset health programme.
We are seeing parties connected to our Bacton terminal, experiencing similar issues with their own assets and needing to investment in them, [redacted]

2. Our activities and current performance

Bacton terminal is a key site for the network. It delivers supplies from the southern North Sea, from interconnector pipelines from the Netherlands and Belgium. Bacton is also a key demand on the network, delivering exports to Europe, to the Great Yarmouth power station and to a gas distribution network offtake. Over the last two years we have seen days where the terminal delivered 39% of GB gas supplies and other days where it met 30% of GB gas demand.

Bacton is the only terminal on the network that switches from being net supply to net demand and plays an important role in connecting the GB gas market to the European gas market. The terminal is one of two top tier control of major accidents and hazards (COMAH) sites on the network.

[39] Total excludes RIIO-2 asset health on the existing Bacton terminal. See table 22.13 for these costs
[40] RIIO-1 costs not categorised in the same way as for RIIO-2, therefore no equivalent breakdown is available
[41] Future Energy Scenarios indicates Bacton will still play a significant role beyond 2040.

The terminal also allows pressure and flow control of the various pipelines connected to it, which delivers safe pressures and security of supply for customers and consumers in the South East (including London).

The terminal was commissioned in 1968. Many of the assets have been operational since then and they are over design life (30 years). It is acceptable to extend life (dependent on asset condition) but we are now seeing an increased rate of deterioration and greater intervention will be needed. Many asset health issues will need attention during RIIO-2.

The high importance of Bacton to the security of supply in the South East, and our obligations to parties connected to the site, both limit the ability to take outages. During RIIO-1, completion of the asset health works at Bacton would have been delivered more efficiently through extended terminal or sub-terminal outages but, given the criticality of the site, we scheduled work around sub-terminal outages and completed it in a less efficient, piecemeal fashion. During RIIO-2, we will need to align disruptive works around customer outages.

3. What are our stakeholders telling us?

We've engaged extensively with you about options for the Bacton site, through site-specific workshops, webinars and one-to-ones. You have validated the critical importance of the site both locally and nationally, now and into the future. The key points you shared are these:

- you have long-term strategies for southern North Sea gas and interconnectors that go beyond 2040; correspondingly, our investment at Bacton needs to consider the long term
- the stability and absolute level of gas pressure at Bacton are important for maximising recovery of southern North Sea gas, reducing offshore compression requirements, facilitating interconnector flows (import and export) and for Great Yarmouth power station connected to the site
- you need minimal disruption
    - for some parties, it is possible to agree and align an outage for up to two weeks each year, but more than this having significant financial impact
    - [redacted] GDN offtake is a single feed, and hence outages can't be accommodated without disruption to GDN-connected consumers.
- you're interested in development of blending and pressure services. Given the level of interest in blending, this is an area we are exploring during RIIO-1.

A summary of our engagement can be found in annex A22.02

4. Our proposals for RIIO-2

Our chosen option to meet your requirements is to redevelop the terminal at Bacton, sized to our understanding of future requirements but allowing for potential future changes (e.g. connection of storage or compression if required and the facilitation of decarbonisation). As we have no recent experience of terminal design and construction, we have engaged specialist external consultancy support [redacted]. Our costs have been developed with their help and they have also developed a preliminary design, construction strategy and timeline to prove deliverability during RIIO-2.

Our proposal to replace the terminal includes consideration of FES forecasts, stakeholder views on Bacton having a long-term future and the current issues at the site. As such the ongoing work on network capability will not influence our decision to replace the terminal, rather than adopting an asset health approach. We propose that this investment is delivered through a specific price control deliverable, which can be found in chapter 29.

Once the redeveloped terminal is operational, the existing terminal will be decommissioned.

We tested the option during a webinar with Bacton stakeholders and 67% of responses supported our proposal (33% were unsure). Stakeholders also told us:

Investment is required for the long-term reliability and safe operation of the terminal, therefore something fit for purpose is preferable [redacted]

Excellent opportunity to get ready for future flow scenarios [redacted]

The best option and future proof [redacted]

New terminal will ensure capacity and efficiency to support longer-term plans for customers. Not clear to me though if some tweaks to existing would also do the same at lower cost. [redacted]

5. How will we deliver?

Redeveloping the terminal offline allows efficient construction. We will reduce construction risk by building a modularised solution offline and offsite, avoiding the need for extended periods of outage. Connection of the redeveloped terminal would require short outages (two weeks at most) but these could be staggered and aligned with customers' own outages. The terminal can be designed to meet customers' future needs efficiently, including the efficient recovery of gas reserves and operation of interconnectors.

This option also reduces the requirement for site personnel to work close to live gas assets during construction.

This project meets the criteria for competition, we will discuss this with Ofgem ahead of our October draft business plan.

6. Risk and uncertainty

We have commissioned a study that confirms the feasibility of the option to redevelop the Bacton terminal but there are also risks: extensive construction, commissioning difficulties, technologies that are new to National Grid. However, the risk is on a short timescale and can be managed more easily by companies used to operating in this arena.

Given the uncertainty around costs and risks, we are considering whether an uncertainty mechanism around the Bacton terminal costs would be appropriate.

Longer term, this redevelopment reduces the hydrocarbon inventory and improves site safety systems.

If the option of a redeveloped terminal is not taken forward, the fall-back would be the more expensive asset health option. There is not a viable do-nothing option.

7. Our proposed costs for RIIO-2

You can find the full range of options considered, and their relative costs, in the Bacton engineering justification report annex A22.02 and CBA in annex A22.03.

Construction of the redeveloped terminal will increase costs during RIIO-2 compared to the alternative of maintaining the existing terminal, but it delivers considerable savings when these costs are considered out to 2047[42].

During the RIIO-2 period, minimal asset health works will still be required on the existing terminal to ensure it remains operational while the new terminal is constructed; they will cost significantly less than those we'd need to undertake if we opted to retain the existing terminal for a longer period. Redeveloping the terminal would also reduce the amount of gas at the Bacton site, moving from a top tier COMAH site to a lower tier COMAH site, reducing costs for consumers.

In this part of the business plan, we've included the costs of building the new terminal and the least regrets costs of asset health on the existing terminal. Other related costs associated with Bacton and included in the justification report are not included in table 22.13. The opex costs form part of the asset management costs in this chapter and the costs of decommissioning the existing Bacton terminal are captured in the chapter 'I want to care for the environment and communities.'

Table 22.13 costs at Bacton for construction of the new terminal and asset health on the existing terminal

(£m in 18/19 prices)	2022	2023	2024	2025	2026	Total RIIO-2	Annualised RIIO-2	Annualised RIIO-1
Bacton - new terminal	6.8	42.6	35.7	42.1	15.5	142.7	28.5	0.0
Bacton – asset health on existing terminal	0.5	2.8	2.3	2.7	1.2	9.5	1.9	------[43]
Bacton- total	**7.4**	**45.4**	**38.0**	**44.8**	**16.6**	**152.1**	**30.4**	**0.0**

[42] 25 years from the start of RIIO-2, the period used for our CBAs

[43] The RIIO-1 asset health costs relating to Bacton are contained within the RIIO-1 annualised average figure in Table 22.12

Kings Lynn subsidence

1. What is this sub-topic about?

This part of our asset health plan proposes rebuilding part of the Kings Lynn compressor site. This investment is needed because of ground movement (subsidence) that has put unacceptable stress on valves and associated pipework at the site, 'do nothing' is not an acceptable option.

2. Our activities and current performance

Kings Lynn is an important site providing compression and connecting three pipelines (feeders 2, 4 and 27). The combination of compressors and pipelines is important in meeting customers' entry and exit capacity at the Bacton terminal.

Recently, the bi-directional area at Kings Lynn compressor has been suffering from a large amount of ground movement. During RIIO-1, we've carried out work to find out the extent of this. Excavations have found that the ground is of poor quality and is not supporting the pipework. We also found that drainage was poor, and water wasn't being removed in a timely manner. During the excavation works we found concrete attached to some of the small pipework and placing extra stress on it; this has since been removed.

Throughout 2017 and 2018 [redacted] carried out stress surveys on the pipework and found that some of the pipework has a stress level of over three times the acceptable limit. One of the most concerning parts of the report shows that the subsidence and pipe movement between 2017 and 2018 continued to worsen and this is likely to continue if we don't intervene.

3. What are our stakeholders telling us?

Without intervention there are safety risks (uncontrolled release of gas at the site), and wider risks to meeting customer requirements at Bacton (both for entry and exit) and security of supply. As this is an issue with an existing site we have not specifically engaged with stakeholders about it. However, maintaining the capability of the site is necessary to provide the entry and exit capabilities that stakeholders need at the Bacton terminal.

4. Our proposals for RIIO-2

We plan to construct a new bi-directional area within the boundaries of the existing Kings Lynn compressor site, and we propose that this investment is delivered through a specific price control deliverable, which can be found in Chapter 29.

The options considered, and their relative costs, are available for review in the Kings Lynn subsidence engineering justification report annex A22.04 and CBA annex A22.05. Ahead of our October business plan we will continue to develop the options for addressing the Kings Lynn site to ensure the chosen solution represents the best outcome for customers and consumers.

Table 22.14 cost for Kings Lynn Subsidence

(£m in 18/19 prices)	2022	2023	2024	2025	2026	Total RIIO-2	Annualised RIIO-2	Annualised RIIO-1
Kings Lynn	6.6	6.6	6.6	6.6	6.6	33.0	6.6	0.0

Asset management

1. What is this sub-topic about?

Provision of a safe and reliable network that is protected from third party threats is reliant on having the right levels of resource, supported by the right processes, systems, tools and equipment. These can be summarised and grouped as:

- **People –** cost associated with the resources to develop our asset management strategies, delivery of maintenance activities, reactive maintenance/repairs, response[44] and operation of the St Fergus and Bacton terminals. This also includes the operational training required to equip these resources with the right capabilities and competence for these activities.
- **IT systems** – costs associated with running and improving the IT systems used to support the management of network assets.

[44] Including to compressor trips/breakdowns, site alarms, aerial sightings of third party interference, third party requests (emergency, minor work requests and planned works) and contractual obligations in Network Exit Agreements.

- **Asset support costs** – costs associated with running and maintaining the network assets. This includes having the right tools, equipment, consumables and strategic spares to maintain the network, provision of commercial vehicles for the operational field force and utility bills for our operational sites.

2. Our activities and proposals for RIIO-2

Customers have told us about the value of having unrestricted access to the network, and the impacts on them of any disruption to their ability to use the network.

Our proposal for RIIO-2, is to ensure we have the right level of human resource, trained with the right capabilities, supported by the tools, vehicles, spares and IT systems, to efficiently deliver customers' requirements. The specific activities and their associated costs are driven by maintenance schedules, asset condition, use and customer demand. We participate in European benchmarking activities and other industry groups to ensure adoption of best practice and cost efficiency.

Asset management has not been a topic where there have been specific options to explore with external stakeholders.

People

Our ability to deliver the service our customers expect depends on the availability of suitably skilled resources. During the last 10 years there has been high demand for critical engineering skill sets and a consequent reduction in suitable candidates from traditional routes across the utilities and oil and gas industries. This risk is particularly relevant to changes in the North Sea, impacting Scotland and the East of England. With up to four-year training requirements for many of our staff, we have had to respond by investing in skills development, education to grow the workforce of the future and recruitment, training and retention to give the business continuity of skills.

Our resourcing business model to deliver this has flexed over time, moving to a combination of pro-active, 'grow your own' approaches supplemented by experienced external hires with contractor support where cost-effective. Primarily, we seek to hire talented and experienced people across all our core business areas using our in-house recruitment team and direct-sourcing capability. This provides the most cost-efficient delivery of new talent into the organisation.

Some of our core roles have a scarce talent pool and are recognised on the shortage occupation list in the UK; where required, we make use of the General Work Visa (Tier 2) to support recruitment activity in these areas. We supplement this with support from agency partners, particularly when looking for niche skills such as cyber or legal experts. In addition, we are continually looking to grow our own talent in core science, technology, engineering and maths (STEM) areas through our annual apprenticeship and graduate programmes. Finally, in some areas it is prudent to supplement our permanent workforce with contingent labour to maintain flexibility in delivering peaks of work such as for major capital projects; to deliver this we use dedicated managed service providers.

Early in RIIO-1, we undertook a major restructuring programme[45] and in 2018/19 we again reviewed our organisation and costs to create:

- clear accountabilities especially between commercial, strategic, engineering and delivery activities
- specialisation and focus to drive efficiency
- simplification of team interfaces to provide clarity on responsibilities to drive efficiency
- an outcome-led organisation including customer and service outcomes.

The benefits to drive opex efficiencies in our operating model will start to be realised ahead of the RIIO-2 period.

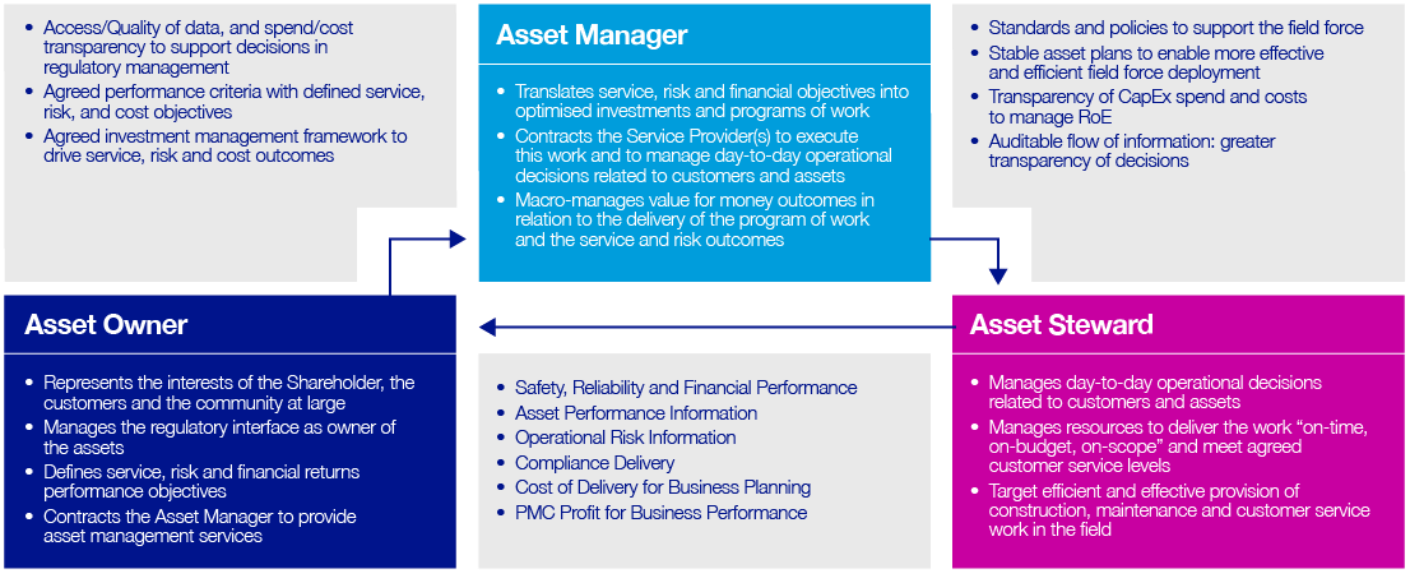
This recent restructure followed asset management best practice and has created three functions: asset owner, asset management[46] and asset steward. These functions work together to set and deliver our business objectives as shown in figure 22.15 below.
Our asset owner teams are accountable for setting the strategic direction of the transmission owner and managing overall business performance against our customers' and shareholder expectations. They provide independent, risk-based, second-line assurance, as part of the three lines of defence, to ensure continued, safe and compliant operations.
Our asset manager teams provide a centre of engineering expertise to create and implement asset

[45] The total efficiencies resulting from these programmes can be found in chapter 28.
[46] For the purposes of our data tables, the asset owner and asset manager resources are combined together since they tend to be more centrally based roles, whereas asset steward resources tend to be more geographically based.

management strategies and plans that deliver the level of service, risk appetite and performance targets set by the strategy & performance team, while being compliant with safety and legislative requirements.

Our asset steward teams perform maintenance, repair and operation activities for the network and for external customers. The teams are geographically spread and operate and maintain two upper tier COMAH terminal sites. They also maintain the compressor stations, above ground installations and high-pressure pipelines. Our asset steward team also includes[47] our specialist Pipeline Maintenance Centre (PMC)[48] depots providing support across the gas industry. They also deliver emergency and reliability response on a 24/7/365 basis across the network, both for our assets and for external customers.

Figure 22.15 asset management roles



There are several drivers that will increase our headcount in RIIO-2 so we can deliver our levels of service and investment plans.

Workforce attrition, including retirement: to secure a sustainable, resilient workforce, allowing for skills retention and knowledge transfer, we have included additional resources, particularly in the asset steward teams for RIIO-2. They support the management of attrition and allow for apprentices, graduates and engineering trainees to cover the retirement profile. We've included an overlap, so they can develop capabilities, competencies and authorisations on the job rather than filling vacant roles after they finish their studies. These have been shown as a recruitment peak of an additional 26 resources in year one of RIIO-2 to prepare for the forecast retirement profile as well as covering for normal attrition, which is higher in the asset steward population at 9% than it is in the wider business which averages at 2%. These people will be required across the country for a range of disciplines to allow knowledge transfer from retiring team members, so our teams can continue to deliver maintenance, operate the network and respond as required**.**

NIS Directive requirements[49]: to comply with cyber security standards our business plan includes eight[50] more technicians to support the operating requirements, i.e. regular patching, software code checks and independent auditing. Two additional roles are planned in the asset manager team to support new cyber work under the NIS directive

Supporting increased project work: because we plan to increase our asset health work, we will need more people for project support and enabling activities. Most of the cost will be directly attributable

[47] The OPEX costs of running PMC are not included in the business plan. These costs are funded through asset projects, emergency response and income for services to other networks and customers

[48] PMC is the emergency responder to gas pipeline emergencies across Britain's distribution and transmission networks.

[49] Network and Information systems Regulations 2018 which aim to minimise the risk of cyber-attack and the resulting impact on UK Critical National Infrastructure, the economy and consumers

[50] 2 in our 3 geographic areas (Scotland, East and West) and 1 at each of the Bacton and St Fergus terminals

to projects and so be part of project cost, but there is a small element that will be opex. We will also need a few people to support development of IT projects (e.g. asset health methodology refresh).

Our RIIO-2 resource proposal assumes funding of our proposals for asset health investment so that the current reliability of the network is maintained; we don't need additional resources to respond to increasing rates of failure.

The resourcing requirements of our asset owner and asset management teams in the first year of RIIO-2 are based on the organisational efficiencies being delivered through the 2018/19 restructure plus an additional 8 full time equivalent (FTE) for graduates, IT projects and cyber. The FTE then grows incrementally to enable delivery of the asset health plan, peaking in financial year 2026.

The resourcing requirement for our asset steward function in the first year of RIIO-2 is based on the organisational efficiencies being delivered through the 2018/19 restructure plus additional resources for attrition and NIS compliance. The FTE then remains largely static through RIIO-2 although we're delivering additional project work. The annual proposed costs for our asset management people costs are shown in table 22.16.

IT systems

Managing the network requires numerous IT systems that enable customers to connect, report events, and request information to ensure safety. We use other IT systems to analyse vast amounts of data and prioritise, plan and schedule work, carrying it out in an effective and safe way. In the RIIO-2 period multiple core systems that manage our assets, work and field force will be reaching their end of life. This is an opportunity to reassess our systems so that we continue to maintain our safety and reliability performance while extracting best value for money from our systems.

Understanding the condition of our IT assets is key to ensuring they are safe and reliable and that we are managing interventions on them in the most cost-efficient way. We have already developed multiple, targeted condition-monitoring techniques that capture data about our assets as well as a data and analytics platform to make sense of this data. We plan to build out from this capability over the RIIO-2 period. Our overall RIIO-2 IT strategy can be found in annex A28.03

Our proposed IT investments

We will be undertaking capex investment in our IT systems which have been split into three categories:

- Run: maintain current business capabilities
- Grow: expand existing business capabilities
- Transform: drive new business capabilities

A list of our IT project investments related to this chapter we are looking at delivering during RIIO-2 can be found in the annex A28.03

Table 22.16 asset management costs

(£m in 18/19 prices)	2022	2023	2024	2025	2026	Total RIIO-2	Annualised RIIO-2	Annualised RIIO-1
People	37.3	37.1	37.6	36.9	36.6	185.3	37.1	31.6
IT systems	10.7	12.5	13.7	9.0	9.7	55.7	11.1	7.5
Asset support costs	19.0	18.6	19.2	17.3	17.5	91.7	18.3	20.8
Total	**67.0**	**68.2**	**70.4**	**63.2**	**63.8**	**332.7**	**66.5**	**59.9**

Asset support costs

Costs to support the running of the assets can be broadly categorised into three main areas:

- commercial vehicles
- utility bills and
- equipment, consumables and spares.

We have summarised the costs associated with this part of the business plan in the table 22.17.

Commercial vehicles

Our commercial vehicle fleet attends remote sites and provides emergency response, with around three million miles per year driven. We will manage these vehicles in line with our existing replacement and

maintenance framework and our cost profile reflects the cyclical nature to deliver this.

We are increasing the number of commercial vehicles from 175 (2018/19) to 251 (end of RIIO-2), as we move 68 employees from company cars to commercial vehicles (by the end of RIIO-1[51]) and provide 8 vehicles for new cyber technicians during RIIO-2. There are occasions where employees provided with a company car, need to hire a commercial vehicle to transport equipment to sites. Transferring these employees from company cars to commercial vehicles will remove the need to hire commercial vehicles for these employees, reducing costs.

We will continue to source fleet procurement, maintenance and fuel card contracts as a competitively tendered procurement process. Through benchmarking exercises, we know this aligns with other utility companies and industry best practice. We will develop robust controls to ensure that our commercial vehicles are managed through their whole lifecycle as effectively and efficiently as possible throughout the RIIO-2 period.

Based on RIIO-1 data (and as to be expected), our CO_2 emissions are increasing as our commercial vehicle fleet grows. During the first three years of RIIO-2, we will conduct a trial to replace up to 30% of our commercial fleet with alternative fuel vehicles, installing 45 electric vehicle charging points across our network and carrying out a feedback gathering exercise. This will prepare the way for a roll-out across our full fleet by 2030. Further information on the decarbonisation of our commercial vehicle fleet and the associated costs are contained in chapter 24.

Utility bills

Utility costs for our operational sites include electricity, water and gas and we are required to ensure that gas turbine compressor units can operate and maintain legal and customer obligations. We had to ensure that pipeline cathodic protection systems provide required protection and that above ground installation (AGI) site security and monitoring systems operate. The costs included here are those associated with the network's operational sites, with 82% of electricity consumption relating to the asset category of compressors. Electricity consistently accounts for 99% of the total utility cost, and this is expected to continue over the RIIO-2 period.

There is a direct link between electricity consumption and compressor running and standby hours, so our forecast costs take into consideration past and forecast RIIO-1 consumption. Actual costs will be driven by the requirements to run compressors to meet customers' supply and demand patterns, therefore fluctuations in costs are expected.

Equipment, consumables and spares

Having the right tools, equipment, consumables and strategic spares is essential to maintain a reliable network, and we will continue to procure these efficiently in line with strategy and supply chain principles as in RIIO-1. The drivers behind these costs focus on asset resilience, legislative compliance and national spares stock requirements, and they are based on the expected workload on the network over the RIIO-2 period. Also captured are our non-operational capital costs (e.g. for vehicles) for PMC.

Our RIIO-2 costs are lower than RIIO-1 due to procurement process efficiencies and a RIIO-2 5% opex procurement efficiency commitment. This is partly offset by a small increase in RIIO-2 costs, relating to increased project workload.
To deliver this we will use competitive tendering wherever possible, leverage suppliers during contract extensions, use multi-year contracts to limit rate rises and seek reductions in demand from the operational business. It is normal practice for global organisations to have a supply chain community of around 1,000 suppliers over a four-year horizon.

As our assets age, the supply chain size increases to satisfy the ever-increasing scope of activities, from routine maintenance and outage works to larger-scale refurbishment programmes, replacement of assets and managing obsolescence. To achieve this, we need a comprehensive specialised supply chain. Competitive tendering also drives the strategy for a comprehensive supplier database because changing suppliers periodically achieves the best technical and commercial deals.

[51] We estimate this will save ~£0.5m during RIIO-1 and an enduring saving is embedded into our RIIO-2 OPEX costs.

Table 22.17 activity spend for asset support costs

(£m in 18/19 prices)	2022	2023	2024	2025	2026	Total RIIO-2	Annualised RIIO-2	Annualised RIIO-1
Commercial vehicles	3.6	2.8	3.4	2.0	2.2	14.0	2.8	1.8
Utility bills	3.1	3.1	3.1	3.1	3.1	15.6	3.1	2.9
Equipment, consumables and spares	12.2	12.7	12.7	12.3	12.3	62.1	12.4	16.1
Total	**19.0**	**18.6**	**19.2**	**17.3**	**17.5**	**91.7**	**18.3**	**20.8**

Network resilience

1. What is this sub-topic about?

We plan new investments at two locations to increase the resilience of the network and protect consumers from disruptions to supply that arise from planned or unplanned maintenance activities.

We are proposing to increase the resilience of gas supplies to ~2m gas consumers in the [redacted] area, by building a short new pipeline and above ground installation (AGI). This will remove the [redacted] offtake's reliance on a single pipeline.

At the Tirley above ground installation (AGI) site, we need to install additional isolation valves to allow filter maintenance to be undertaken without creating restrictions on gas flows in South Wales, including to the important Milford Haven entry terminal. These valves are necessary because of a 2017 revision to company standards for safe isolation of assets and adoption of a company minimum standard for isolations.

2. Our activities and what are our stakeholders telling us

In developing our RIIO-2 plan we initially identified 62 areas where increased resilience might be beneficial for consumers. These included offtakes that rely on a single pipeline and areas of the network that are difficult to maintain, test or inspect without risking disruption to entry or exit customers.

We refined this list based on the significance of the issue, levels of existing mitigations (including use of maintenance days where the impact was on a single industrial or power station consumer), views of impacted stakeholders and cost effectiveness of the potential solutions.

Gas distribution network (GDN) offtakes that are connected to single transmission pipelines were highlighted as a key area, as there is an increased risk of disruption to consumers when planned or unplanned maintenance impacts these offtakes. We talked to [redacted] about [redacted] and to [redacted] about the [redacted] offtake, which supplies ~800,00 consumers in [redacted] and is only connected to a single transmission pipeline. Having explored options with [redacted], there was insufficient support from them to justify considering transmission investment to improve resilience on this part of the network. We have therefore not proposed any investment for it.

Our proposals for RIIO-2 and how we will deliver

[redacted] offtake

We are proposing installation of a new [redacted] pipeline and a new AGI with pressure reduction capability. The proposed pipeline will connect existing [redacted] pipelines. This will connect the [redacted] offtake which supplies ~2m consumers, which this is currently only supplied by a single pipeline [redacted] to a second separate existing pipeline [redacted]. This would increase the resilience of supplies for consumers in the event of planned or unplanned maintenance on the feeder [redacted] pipeline.

During RIIO-1, we experienced issues along feeder [redacted] and these have been addressed without disruption to end consumers However under different circumstances they would have resulted in end consumer disruption. [redacted] are only able to flow swap offtake flows away from [redacted] up to 85% of peak winter demand levels. Such flow swaps also being reliant on [redacted] having an intact network (i.e. not having assets out on maintenance).

In 2013, safe inspection of corrosion at various sites was only possible with [redacted] undertaking flow swaps on their own network. If the pipeline had required isolation, demand had been higher, or if [redacted] had been undertaking maintenance on its own network, then those flow swaps may not have been possible.

An additional risk for this section of feeder [redacted] has been identified [redacted]. The overflow for the dam passes underneath feeder [redacted] and it doesn't have the capacity to deal with the required flow of water during flooding events. During heavy rainfall in December 2015, the limited capacity of the overflow resulted in water overtopping the dam. Several homes downstream were flooded but the dam was undamaged. The risk for us is that during a similar future event the top of the dam could wash out, with potential damage to (or loss of) feeder [redacted] with the subsequent loss of capability to supply to the [redacted] offtake and potentially ~2m consumers under certain conditions.
Working with [redacted], we have explored the issue of being unable to isolate the pipeline without risking disruption to domestic consumers, trying to find the best whole system solution. Solutions on the [redacted] network were approximately twice the cost of those available on our network and [redacted] is supportive of our proposed transmission solution to this issue.
Not wanting to raise unnecessary concerns about security of supply or to highlight this potential area of lower resilience on the network, we have chosen not to engage with wider stakeholders about [redacted].

The proposed pipeline route, subject to planning permission and negotiation with land owners, is significantly shorter than other pipeline connection options.

Further explanation of our proposal for a pipeline at [redacted] can be found in the [redacted] engineering justification report annex A22.06 and CBA annex A22.07.

Tirley AGI

For the Tirley site, we are seeking funding for the installation of new isolation valves that will allow individual filters to be isolated and maintained. As these filters can't be individually maintained, safety policy means they can only be maintained by isolating the whole site from the network. This results in a flow restriction in South Wales, including reducing entry capacity at the important Milford Haven LNG terminal to ~20mcm/d (against a contractual capacity of ~86mcm/d). The restriction would also impact gas flows into South Wales to meet demand, should Milford Haven not be exporting LNG to the network.

During RIIO-1 we have delayed filter maintenance at Tirley to avoid causing constraints on the network but continuing to delay it will result in non-compliance with policy, require emergency maintenance and/or result in entry constraints if filters become blocked due to lack of maintenance. For these reasons, we decided that 'do nothing' wasn't an option.

3. Our proposed costs for RIIO-2

We are requesting £6.5m of funding for this work. We didn't ask for any funding during RIIO-1 but, during this period, the current design of the network has on occasion made it difficult to complete planned or unplanned work while avoiding any disruption to customers.

Table 22.18 network resilience costs

(£m in 18/19 prices)	2022	2023	2024	2025	2026	Total RIIO-2	Annualised RIIO-2	Annualised RIIO-1
[redacted]	0.0	0.0	0.0	2.7	2.7	5.5	1.1	0.0
Tirley	0.0	1.0	0.0	0.0	0.0	1.0	0.2	0.0
Network resilience total	**0.0**	**1.0**	**0.0**	**2.7**	**2.7**	**6.5**	**1.3**	**0.0**

Environmental resilience

1. What is this sub-topic about?

Climate change is increasing the risks to our operations, for example from increased risk of flooding or changes to river beds that contain pipelines. This part of the plan covers costs and activities associated with managing these risks and supporting the delivery of a reliable and safe network.

2. Our activities and current performance

Pipeline watercourse crossing surveys

During RIIO-1 we have experienced issues where pipelines cross water courses. On feeder 9, rapid and unpredictable estuary movements have reduced the depth of cover on the pipeline under the Humber river and we are working on replacing this crossing. There have also been sand movements at Duddon Sands in Cumbria and there is a risk of the pipeline becoming exposed. We've responded by stepping up monitoring to check for exposure or free spanning of the pipeline. Working with a specialist marine consultancy, we have developed as a contingency remediation plan covering the materials, resource, methodology and costs to reinstate cover over the pipeline.

During RIIO-1, we put the work for surveying the river crossings out for re-tender. As part of the exercise we evaluated the performance of the incumbent supplier against the required specification and policy for the survey, which identified some areas for improvement. The process ensured that the new service provider was fully meeting all the necessary requirements and ultimately our obligations under the Pipeline Safety Regulations. This outcome increased costs during RIIO-1.

For RIIO-2, we will continue with the watercourse crossing surveys based on frequency and information on asset condition, or their immediate environment. We'll also re-tender the work periodically to ensure costs remain efficient.

Flooding risk

During RIIO-1, a number of environmental events have had a negative impact, or had the potential to negatively impact, the safe and reliable operation of our assets.

There were flooding events in 2013 and at Goxhill AGI these caused significant damage to electrical, communication and security assets with a remediation cost of ~£3m.

At the Gravesend Thames South AGI, the site was designed to accommodate flood water and no significant damage occurred during flooding in 2013, although minor site clean-up costs were incurred.

Figure 22.19 flooding at the Gravesend Thames South above ground installation in 2013

We have considered (and discounted) proactive installation of flood defences at our AGI sites as the pipeline and AGI assets are themselves largely unaffected by the presence of raised water levels[52]. Proactive investment therefore does not represent value for money for consumers.

We are, however, proposing to repeat and develop a survey across the network to assess the risk of buoyant lift on pipelines in the event of flooding and specific local ground conditions. The last survey in 2012 identified 501 pipeline sections that were classified as susceptible to lift, of which 71 were in the

[52] Providing appropriate electrical equipment is on raised platforms

highest risk category. Completion of the survey would support our compliance with Pipeline Safety Regulations and identify sections with reduced depth of cover, and hence increased risk from third party damage.

3. What are our stakeholders telling us?

We have talked to you about environmental risks at various events and meetings, including with environmental regulators and consumer groups[53]. We asked, "Should we be proactive or reactive in managing these impacts?" and we have analysed your responses:

- Proactive: mitigate against flooding by investing in flood defences etc. – 42%
- Risk-based: mitigate high risk sites and manage remaining as appropriate – 53%
- Reactive: insure against these impacts and manage the clean-up – 5%

We captured a variety of comments including:
"If you're in a flood zone, make sure your sites can cope with the floods." [redacted]

"The decision to manage impacts should be based on risk analysis." [redacted]

"National Grid need to have good risk management, so that they can maintain assets to deliver a reliable network for the customers." [redacted]

"In the circumstance that there is a large risk of harm you would have to take a proactive approach. Therefore, top risks should be prioritised such as erosion of pipelines under rivers, but everything else would fall into the reactive bracket." [redacted]

Based on the feedback, we have adopted a risk-based approach to environmental resilience.

4. Our proposals for RIIO-2

For RIIO-2, we are requesting continued funding to cover control of animals and maintenance of watercourse navigation markers.

In response to your feedback we are taking a risk-based approach to managing the threats associated with pipeline watercourse crossings and the risks associated with flooding. We are also asking for funding to carry out work that will allow us to understand these risks better.

We are not, however, requesting funding to mitigate any of these. We do not believe this would be efficient until we've identified any specific need and there is no way of proactively targeting any such funding to specific sites across the whole of Great Britain.

If any specific risks are identified, we would consider whether these must be mitigated during RIIO-2 or could wait until RIIO-3. If in RIIO-2 mitigation is required, our approach to managing this situation would be to consider risk trading across assets types, as permitted under the asset health methodology. Given the potential risks, we are proposing that the mechanisms for justified over- and under-delivery of NARMs outputs are retained for RIIO-2, which is consistent with Ofgem's Sector Specific Methodology Decision in May 2019.

5. Our proposed costs for RIIO-2

We are seeking £4.2m of funding over the RIIO-2 period for four core activities:

- **Condition-based monitoring surveys of pipeline watercourse crossings** to identify whether the pipeline is at risk of additional loading, impact from reduced depth of cover, exposure or free spanning. The drivers for this work are compliance with the Pipelines Safety Regulations 1996 and meeting the minimum requirements in the industry standard IGEM/TD/1.

- Developing work to assess the **risk of buoyant lift on our pipelines in the event of flooding**. Building on our 2012 survey work.

- **Control of animals** within our AGIs or on our pipelines. For example, ongoing work to prevent badgers or rabbits burrowing around pipelines, resulting in ground movement or damage to pipeline coatings.

- **Maintenance of watercourse navigation markers.**

We have based the RIIO-2 costs for these activities on tendered contract rates from our procurement events and on the known volumes of activity (e.g. based on survey frequencies).

[53] See our environment engagement log in annex A24.06

Table 22.20 environmental resilience spend

(£m in 18/19 prices)	2022	2023	2024	2025	2026	Total RIIO-2	Annualised RIIO-2	Annualised RIIO-1
Environmental resilience	0.8	0.7	0.8	1.0	0.8	4.2	0.8	0.5

Gas system operation

1. What is this sub-topic about?

As the combined gas transmission system operator, we work hard to balance our directly connected customers' need to move gas on and off the network when and where they want. We need to maintain, refurbish and replace our own assets as well as allowing third party access to our sites and assets. We constantly balance these priorities in our day-to-day operation of the network, using combinations of physical assets and commercial tools to meet our obligations and to deliver value.

Our customers' needs have changed during RIIO-1 and they are likely to change further; examples of this can be seen in the different supply patterns that have been experienced during RIIO-1, which have driven the need for us to use different assets. We have been able to accommodate some of these changes by changing our own access plan, driven by our incentives to do so. One of the benefits in facilitating these changes to supply patterns is keeping the wholesale market price of gas low.

However, as our assets get older the need to access the network will increase during RIIO-2. There will be more occasions when we have fewer asset solutions available and so we will be more likely to need to use commercial tools to request changes to customer flow patterns.

Our ability to forecast and manage the risk associated with facilitating increased network access, and to identify and develop appropriate commercial options to help us do this, will depend on the development of new capabilities. These capabilities will drive value for consumers by allowing us to better model our own network, the market and risk. This will ensure we continue to facilitate the cheapest, most reliable sources of gas for consumers.

Our business plan allows us to continue the efficient operation of the system, to keep our existing IT infrastructure up to date and to develop the new capabilities required by customers with a combination of people and systems.

2. Our activities and current performance

The timescales of the activities included in this section range from 10 years ahead for long-term network planning through to the real-time operation of our network. The main activities captured in this chapter are:

- Responding to long-term customer requirements by comparing the capability of the network with those requirements, identifying gaps and carrying out engagement and CBA on the options to meet customers' needs. These options include asset investments and/or contractual solutions. We use supply/demand data based on the Future Energy Scenarios (FES) to undertake network analysis to identify risk and support efficient decision-making.

- Delivery of safe network access[54] for maintenance, asset health or connection activities and to allow external parties[55] to carry out their own maintenance. We analyse the risks to optimise access and coordinate maintenance activities with customers to minimise disruption. We publish seasonal maintenance plans and operate a permit-based process as part of the Safe Control of Operation framework.

- Implementing commercial/regulatory change around capacity processes. Ensuring capacity processes are in place to reflect the regime and to facilitate the right network access and capacity products for our customers.

- Compliance with our obligations relating to the balancing and capacity processes, including under the NGGT licence and Uniform Network Code (UNC), for example around quantities of capacity to be released, processes to be followed and provision of methodology statements.

- Meeting varying customer needs in our day-to-day operation of the network. Continuing to

[54] Taking assets out of service to allow work to be undertaken.

[55] e.g. GDNs, power stations, storage sites and large industrial customers.

provide the critical continuity of real-time operation through the people, processes, systems and infrastructure associated with the Gas National Control Centre. Meeting our legal and regulatory obligations, as set out in our licence, safety case and the UNC.

Under the RIIO-1 framework, we have 13 reliability and availability outputs. In 2017/18, we met 11 of these. The two that missed the annual target[56] remain on track to progress towards the remainder of our eight-year RIIO-1 output. Further information on our RIIO-1 outputs can be found in our regulatory reporting pack (RRP)[57] and incentive performance can be found on the incentive's pages of our website[58] and in our incentives annex A29.03.

During RIIO-1, we replaced the suite of systems that allow us to monitor and control the network, including the supervisory control and data acquisition (SCADA) system. These are all designated Critical National Infrastructure (CNI) systems. We adopted a holistic approach to CNI costs, so although we overspent allowances on delivery of the suite of systems we offset this by making savings against allowances for maintaining and refreshing them in the latter part of RIIO-1.

During RIIO-1, we have focused on efficient delivery of our system operator activities. These have been subject to company wide efficiency programmes during RIIO-1[59], that have informed our RIIO-2 proposals.

3. What are our stakeholders telling us?

We engage stakeholders talk regularly at events such as our Operational Forum, both to discuss operational issues and to develop deeper understanding of customer needs

Through our wider RIIO-2 engagement, stakeholders have told us they require unconstrained access to a safe and efficient network (see Annex A22.01). Our system operator activities support delivery of these requirements.

4. Our proposals for RIIO-2

We will continue to drive the efficient operation of the network, working with our customers to understand what they want and striving to deliver those needs with the assets and commercial tools available to us.

To do this while facilitating higher levels of network access we must invest in developing new capabilities for our people and systems. These will allow us to drive the best performance of our assets and ensure appropriate market solutions are in place.

Maintaining IT systems

We use a suite of IT systems known as the Gas Control Suite to monitor and control the gas transmission network and to receive and share data with our directly connected operators and shippers. Elements of these systems are designated Critical National Infrastructure (CNI) and so they are subject to specific regulations governing their resilience and levels of security. We must continue to invest in these systems to ensure they stay secure and up to date while delivering the level of performance required by our operators and other parties we need to share data with. We must also maintain the non-CNI systems that support day-to-day processes for capacity management, balancing and information provision.

In RIIO-2, we are proposing to invest in maintaining the core IT systems that support delivery of gas on and off the system, now and in the future. This investment covers maintaining, refreshing or replacing hardware and software to ensure vendor and supplier support, including maintenance and security patches. It also includes maintaining our Gas Control Suite, network simulation and forecasting systems and our control room telephony and voice recorder systems.

New capabilities

We want to exploit technologies to develop new capabilities that can drive greater value for consumers from the networks and markets. We are focusing on the following areas to meet the challenges of delivering future customer need:

- developing new capabilities to analyse and manage the risk of not meeting stakeholder requirements with an ageing asset base. Optimising how we operate the network and

[56] Delivery of capacity auctions and the price differential to system average price for undertaking residual balancing trades.

[57] https://www.nationalgridgas.com/data-and-operations/operational-forum

[58] https://www.nationalgridgas.com/about-us/system-operator-incentives

[59] further information on these can be found in chapter 28.

develop new market tools to deliver customer and consumer value
- delivering increasing levels of access to the network, whilst minimising the risk of affecting customers' gas flow onto and off the network.

To meet these challenges, we plan to:
- develop enhanced analytical and modelling tools to improve our insight and therefore, to manage these risks effectively
- take advantage of automation where it is cost-effective to do so.

Further detail on our proposed project investments during RIIO-2, and the justification of these can be found in the IT investment annex A28.03

Output delivery incentives

Our gas system operation activities in relation to taking gas on and off the network are already incentivised for RIIO-1 under the 'residual balancing', 'maintenance (use of days and changes schemes)' and 'entry and exit capacity constraint management' incentives. We believe all these schemes, with a level of refinement, should be retained for RIIO-2.

In addition, we believe there is potential for a new incentive around linepack management that has arisen from the work on developing our thinking around network capability and gas future operability planning (GFOP). This is an existing activity that is not recognised in the current regulatory arrangements but customers' changing needs mean it is likely to become more important to them. Management of linepack is an activity that allows our customers of all types to flow gas at various within day profiles and to change their mind about location, volumes and profiles within day. We will continue to explore potential incentivisation of linepack management as we develop our work on network capability. Our incentives are summarised in table 22.23 below. Our rationale for the proposed package of RIIO-2 incentives can be found in chapter 29.

Table 22.21 gas system operation incentive summary

Output category	Output	Business plan proposal
Output delivery incentive	Residual balancing	Retain scheme. Incentive set with appropriate rewards and penalties to meet the needs of consumers, recognising the impact of a changing energy landscape. Propose options to amend linepack component of scheme to better drive the right behaviour during seasonal transitions between winter and summer. Metrics to be agreed with Ofgem.
Output delivery incentive	Maintenance (use of days and changes schemes)	Retain existing schemes and expand to cover the wider range of maintenance activities supported by stakeholder feedback. Incentive set with appropriate rewards and penalties to meet the needs of consumers, recognising that the volume of planned maintenance is likely to be significantly higher in RIIO-2. Metrics to be agreed with Ofgem.
Output delivery incentive	Entry and exit capacity constraint management	Retain scheme. Incentive set with appropriate rewards and penalties to meet the needs of consumers, recognising the impact of a changing energy landscape. Propose options to amend linepack component of scheme to better drive the right behaviour during seasonal transitions between winter and summer. Metrics to be agreed with Ofgem
Output delivery incentive	Potential new incentive on linepack management	Develop and consult on options and consider interactions with existing incentives (e.g. residual balancing and constraint management).

5. Our proposed costs for RIIO-2

Table 22.22 gas system operation costs

(£m in 18/19 prices)	2022	2023	2024	2025	2026	Total RIIO-2	Annualised RIIO-2	Annualised RIIO-1
IS and Xoserve	28.6	32.5	29.2	30.6	27.1	147.9	29.6	18.7
GSO	12.0	12.2	12.3	12.2	12.1	60.8	12.2	11.7
Total	**40.5**	**44.6**	**41.5**	**42.9**	**39.2**	**208.7**	**41.7**	**30.4**

6. Next steps

We need to do more work on developing the detail of the outputs under this stakeholder priority, including for incentives. This will be informed by Ofgem's framework decision and ongoing work around network capability.

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

What is this stakeholder priority about?

UK infrastructure is subject to many security threats, that are increasing in sophistication and persistence. These threats include terrorism, criminality and vulnerability in information technology (IT) and operational technology (OT) systems. Our network is part of Great Britain's Critical National Infrastructure (CNI) and appropriate protection from threats is therefore essential to underpin the safety, security and reliability of the nation's energy supply. The UK Government sets the requirements for the appropriate levels of physical and cyber resilience that are to be achieved in the national interest.

What have you told us?

You say that the way we manage security threats should be a priority. We understand this is because you identify with the increasing threat both to society and to your own businesses. You recognise that disruption to the gas network and to your energy supplies would have immediate, direct and adverse consequences for you.

What will we deliver?

- Our RIIO-2 plan is to deliver the security hardening that has been mandated by the government, as efficiently as possible. This will improve the safety and resilience of the transmission system to ride through and recover from accidental or malicious events such as cyber-attack, which otherwise threaten to disrupt continuity of GB energy supply.

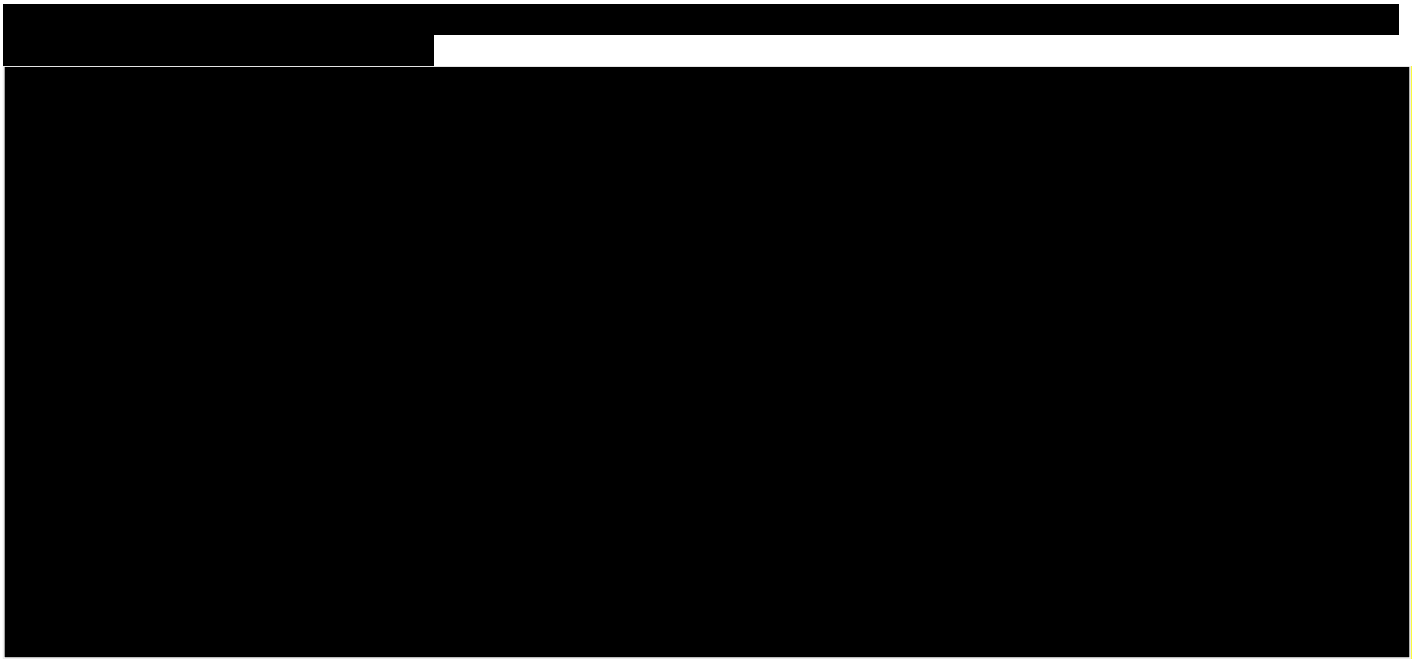
- We will deliver a strategic long-term programme to replace key operational technology used for the safety and control of critical systems. This work is driven by age and obsolescence as well as cyber resilience and the programme will extend through RIIO-3 and beyond.

- This is an area of significantly increasing expenditure driven by the growing level of threat and by new legislation steering the action that we must take to protect the network. Our plan includes £123.4m per year (21% of our RIIO-2 total costs) for this priority. We propose that funding for this known scope of work is included within our base revenue. Our plan does not include any provision for unforeseen costs that may arise from future changes in security requirements or in response to actual security events. We propose that uncertainty mechanisms allow us to adjust our scope and costs during RIIO-2 in response to changing circumstances.

What efficiencies have we included in our plan?

- Our physical security capex plan locks in 15% cost reductions so far attained in RIIO-1.

- Our operational technology capex plan incorporates efficiencies of around 30% through improved delivery contract strategies and bundling of work to maximise volume discounts from the supply chain.



1. What is this stakeholder priority about?

This priority is about protecting our network from threats that could otherwise disrupt continuity of GB energy supply, with serious consequences for society. We rely on industrial control systems to control and protect processes ranging from valves to compressor machinery. Loss or compromise of these systems could pose a serious safety risk – for example, failure to contain gas could result in fire or explosion with a knock-on impact on adjacent assets and facilities.

Our key activities and costs covered in this chapter include:

- strategic capability to monitor, detect, respond and recover from malicious threats
- Enhancing cyber security resilience
- delivery of the Physical Security Upgrade Programme (PSUP)
- policing at gas facilities as required by the Counter-Terrorism Act, 2008
- response to actual or new threats that emerge during RIIO-2.

We have consciously included our asset replacement costs for operational technology and enhanced physical security in this chapter rather than in chapter 22. We have done this because protection from threats is the primary cost driver and we expect specific RIIO-2 outputs to be attached to this work, separate to the NARMs asset health outputs.

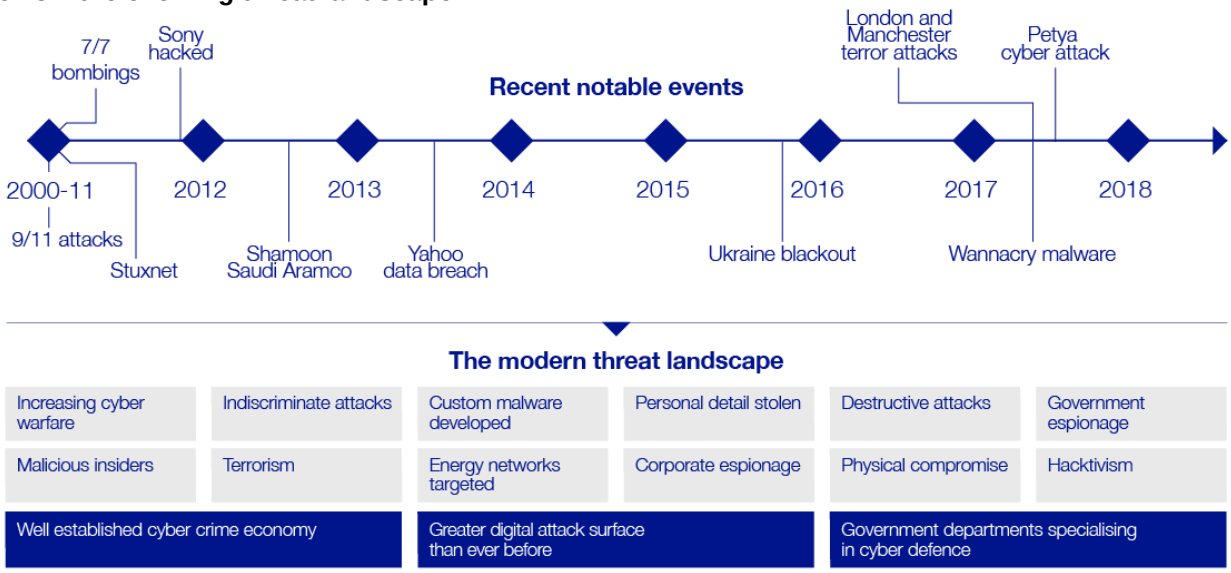
Evolving threat

The network was designed with sound engineering and safety considerations at the forefront, rather than with a mindset of protection from malicious threats. As threats emerged we mitigated them through a programme of physical security hardening at our sites leading up to the 2012 London Olympics, and this work has continued throughout the current price control.

Cyber security threat is the risk to computer systems from theft or damage to their hardware, software or electronic data, as well as from disruption or misdirection of the services they provide. The danger to energy systems is increasing due to the rapid digitisation of energy assets and the convergence of information technology (IT) systems (used for data-centric computing) with operational technology (OT) systems (used to control industrial processes and equipment).

The cyber threat landscape is evolving rapidly, and security experts think that, for every major cyber-attack in the public domain, four more major attacks are not reported. The energy sector has experienced a significant increase in the volume of reported attacks since the Iranian Natanz nuclear facility was attacked by ‘Stuxnet’ malware in 2010. Since then, Ukrainian energy companies have experienced attacks in 2015, 2016 and 2017. In 2017, there were reports that Saudi Arabia’s national oil company had suffered an attack on the safety computer systems designed to prevent disaster at its critical infrastructure facilities.

Figure 23.2 the evolving threat landscape



Security services process

Elements of our network are classified as critical national infrastructure (CNI). This means loss or compromise would have a major detrimental impact on the availability, delivery or integrity of essential services, leading to severe economic or social consequences or to loss of life.

The UK Government, in conjunction with the Centre for the Protection of National Infrastructure (CPNI) and the National Cyber Security Centre (NCSC), set requirements for the appropriate levels of physical and cyber resilience to be achieved in the national interest. We work closely with these agencies to identify the most efficient way to meet these requirements, which call for significant operating and capital expenditure.

Some of our assets are co-located with those of other energy companies and it is important that we work closely with these and other operators of essential services to achieve joined-up protection across the energy industry. When considering the impact of any loss of gas transmission supply, the consequential impact on the electricity transmission network and market must also be considered; gas is our largest primary fuel source for electricity generation, typically accounting for around 40% of electricity production.

Mitigating cyber threats – the NIS Regulations, 2018

Heightened awareness of cyber threats is underlined in the UK Government's National Cyber Security Strategy[60] and through the launch in October 2016 of the NCSC[61]. The NCSC provides a single point of contact for expertise and guidance in the prevention of, and response to, cyber security incidents.

The requirements for a co-ordinated response across network companies have been established through the Security of Network and Information Systems (NIS) Regulations 2018[62]. The NIS Regulations aim to minimise the risk of cyber-attack and the resulting impact on UK CNI, the economy and consumers. This is in keeping with the NIS Directive[63] aiming to co-ordinate and raise overall levels of cyber security across the European Union (EU).

The NIS Regulations apply to a defined list of operators of essential services (OES), each with a relevant 'competent authority' (CA) supporting and monitoring compliance. We are a designated OES and within the energy sector the CA role is jointly held by the Department for Business, Energy and Industrial Strategy (BEIS) and Ofgem.

[60] https://www.gov.uk/government/publications/national-cyber-security-strategy-2016-to-2021
[61] https://www.ncsc.gov.uk/
[62] http://www.legislation.gov.uk/uksi/2018/506/pdfs/uksi_20180506_en.pdf
[63] https://eur-lex.europa.eu/eli/dir/2016/1148/oj

Mitigating physical threats – the Physical Security Upgrade Programme

The Secretary of State initiated the Physical Security Upgrade Programme (PSUP) and it is now governed by BEIS. It is a national programme to enhance physical security at CNI sites. Requirements arising from this programme have been a key driver of our activity both before and during the current regulatory period. This will continue through RIIO-2. We follow standards and guidelines for good practices endorsed by BEIS and CPNI[64].

2. Our activities and current performance and learnings from RIIO-1

Strategic capability to monitor, detect and respond to threats

Our shared-service corporate teams manage how we handle security threats. They work with the lines of business to understand how threats may affect business performance and to devise a balanced security strategy to mitigate these risks.

We have adopted a security standard based on five core principles[65] to drive a coordinated approach across personnel, physical, cyber and information security:

IDENTIFY what is important

PROTECT with appropriate risk-based controls

DETECT incidents and events, automate detection where possible

RESPOND to incidents and events

RECOVER what is important in line with agreed timescales and levels of business criticality

During the RIIO-1, period it has been a key focus to develop the capability of our organisation in line with the above principles. Training, awareness and the right security culture across our teams are as important for risk reduction as headline expenditure on hardware and software measures. Our people are our most important defence. All our operational personnel interfacing with operational technology undertake mandatory cyber security training. [redacted].

Enhancing cyber security resilience

A major cyber security breach of business, operational technology, and/or critical national infrastructure systems/data is one of the key operational risks monitored by the National Grid Board. It receives quarterly cyber security updates and board members have received cyber security training. We've included scenarios of cyber security breach and reasonable worst-case examples in our executive committee risk workshops.

In recent years, we have completed a series of assessments against the five principles to assess the level of our security and identify capability gaps and risks in line with the evolving threat landscape. We've worked closely with the security services to conduct these, as well as third party specialists and external auditors. The outcome of these assessments has driven the focus of our targeted risk mitigation activities in RIIO-1 and shaped our long-term strategy for RIIO-2 and beyond.

The three principal areas of our cyber security spending in RIIO-1, stemming from our targeted risk mitigation activities, are:

- data centres
- cyber security programmes 1 and 2
- NGGT specific cyber investments.

These three programmes have been funded during RIIO-1 through a re-opener uncertainty mechanism described below.

Enhanced security costs reopener

Ofgem provided a reopener uncertainty mechanism to adjust allowances for actual/planned enhanced security costs when those costs became more certain. As a result of our application in the May 2018 re-opener window our allowances for enhanced security costs were adjusted by £63.4m. These adjustments relate to the three key risk mitigation activities described above, for which additional output measures and reporting requirements have been established. For further information, refer to the reopener publications[66].

[64] https://www.cpni.gov.uk/protecting-my-asset
[65] https://www.nist.gov/cyberframework
[66] https://www.ofgem.gov.uk/publications-and-updates/informal-consultation-riio-1-price-control-reopeners-may-2018

Enhancing physical security resilience - Physical Security Upgrade Programme (PSUP)

We have been delivering enhanced physical security measures since before the RIIO-1 period, with expenditure ramping up from around 2010. During this time, we have worked very closely with the government to assist its assessments of the criticality of sites and evaluation of the most appropriate security solutions. It has been essential for us to be flexible about planning and delivering work due to changes in threat, priority or required response.

Our PSUP work is being delivered in phases. Security solutions for the phase one sites were completed by 31 March 2018, with all sites now being monitored by our alarm-receiving centre. Phase two work is ongoing and scheduled for completion by 31 March 2021, while phase three work is proposed for delivery during RIIO-2. The typical scope of a PSUP solution includes a mixture of the following physical elements:

- high security perimeter barrier, with substantive foundations and anti-burrow cills
- various controlled access points (e.g. vehicle gates, pedestrian access)
- intruder detection
- high technology closed circuit television and lighting systems
- power cabling and ducting
- on-site asset and building protection (e.g. transformers, switchgear, control rooms)
- on-site communications infrastructure (cabling, transmitters, receivers)
- two-way 24/7 communications to the central alarm-receiving centre.

Across our programme to date we have achieved capex efficiencies of around 15% and we are now forecast to complete our in-flight RIIO-1 work approximately in line with the 2015 allowance.

The May 2018 re-opener also considered potential adjustments to allowances to reflect work no longer required and future PSUP work at shared site locations where our assets are alongside those of other network companies such as gas distribution networks. The outcome of this process highlighted that, with our current methods, it would not be possible to deliver this additional work in the RIIO-1 period at a cost that Ofgem considers to be efficient for consumers. No further adjustment was made to our RIIO-1 allowances at that time. Ofgem will assess our efficient costs as part of the RIIO-1 close-out process.

In response to this challenge, we are re-evaluating our delivery model and targeting delivery of the shared sites with our phase three work in the RIIO-2 period. We have incorporated an £8m efficiency target in our RIIO-2 forecast compared to our view at the time of the May 2018 re-opener. We are reviewing our contracting approach and delivery methods needed to achieve this ambition and aim to update our cost efficiency evidence for inclusion in our December 2019 final RIIO-2 plan.

Policing costs

The Counter-Terrorism Act 2008, sections 85 to 90, governs the arrangements for policing at gas facilities. The security requirements and associated costs are set by the government and are outside our control. Because of this, our policing costs are recovered via a cost pass-through uncertainty mechanism.

Physical security – summary of current performance

In summary, the enhanced physical security we have delivered to date includes:

- security at our highest priority sites, which has been protected in line with government requirements
- enhanced security [redacted]
- working closely with the UK Government to assist their assessments of the appropriate security response in the national interest.

The key benefits delivered for consumers include:

- significant reduction in the risk of security breaches that could have severe societal consequences for GB consumers
- identifying sites where lower cost operational solutions can be deployed in place of costly physical measures and other sites where PSUP is no longer required, to make sure resources are directed efficiently
- 15% cost efficiencies in solution delivery during the programme so far.

3. What are our stakeholders telling us?

The direction of our plan meets your expectations

You've told us that the way we manage security threats should be a priority. We understand this is because you identify with the increasing threat to society and your own businesses. You recognise that disruption to the network and to energy supplies

would have direct, adverse consequences for you. There is a close interdependence between the work we do to protect the network from external threats, to enable consumers to use energy as and when they want (chapter 22) and to keep the gas system safe (chapter 21).

In 2017, we carried out public attitudes research in conjunction with [redacted] and found that the survey group (around 2,000 representative UK domestic consumers) placed a high priority on developing resilience to cope with a terrorist or cyber-attack.

At our shaping the future engagement events in autumn 2017 and our future needs of the network events in summer 2018, we explored your attitudes to security threats. Feedback included:

"Agree 100% with the critical need to protect the transmission system against cyber and external threats…" [redacted]

"Cyber security is very important to us" [redacted]

"Outputs need to include cyber security and this needs to be funded" [redacted]

In autumn 2018, the independent stakeholder user group looked at how we are developing the physical and cyber security elements of our business plan. The group noted that the measures we take are mandated by government and the security services. To protect national security, the government restricts what we can say publicly about our current level of resilience and the specific measures we will take in the future to reduce vulnerability. For these reasons, it is not appropriate for us to engage the group or wider stakeholders on the detail of our plan and the substance of it can't be influenced by customer or consumer preferences. Our approach is therefore to build the confidential detail of our plan with government agencies, while providing transparency about the process that we follow. In its role as economic regulator, Ofgem protects consumers by scrutinising our costs to ensure that only efficiently incurred costs are allowed.

We also engage other networks to ensure learning from best practice, and with our US business to ensure efficiency and innovation from a group level can be applied to our activities.

The detail of our plan is driven by government agency requirements

The key stakeholders whose requirements have shaped our plan for dealing with external threats are the government (BEIS), its security specialists (CPNI and NCSC), Ofgem (in its role as Competent Authority for the NIS Regulations) and the Health and Safety Executive (HSE). We collaborate on best practices across the National Grid Group where we own gas and electricity transmission and distribution networks across the north eastern United States. Working closely with our US colleagues helps us to gain more powerful insights in our 24/7 analysis and management of global security information and event data.

We take a strategic, risk-based approach to cyber security and its impact on gas network resilience. This is consistent with voluntary best practices advised by the US National Institute of Standards and Technology[67] and mandatory requirements now introduced in the UK through the NIS Regulations. We are working with Ofgem and BEIS in their joint role as NIS Competent Authority, and with the HSE, to assess our existing cyber protection capability and confirm further work to protect against threats.

We use a risk assessment methodology and evaluate current capability against the criteria set out in the Cyber Assessment Framework provided by the NCSC. The framework is a systematic method intended to meet the requirements of both the NIS Regulations and wider CNI needs. The assessment is done, and we have developed an improvement plan of tactical actions for the rest of the RIIO-1 period. The work included in our RIIO-2 plan is part of our longer-term strategic investment plan for cyber resilience. We are talking to the NIS Competent Authority to agree the scope and priorities, and we will update our plan as required during 2019.

In its 2018/19 business plan[68], the HSE reflects an increased focus on the emerging risks of cyber security and it has recently updated its operational guidance[69] on cyber security for industrial automation and control systems. This is specifically relevant to us because we operate these systems for major hazard risk reduction and continuity of gas supplies, and our planned RIIO-2 cyber resilience activities are in line with latest HSE guidance:

[67] https://www.nist.gov/cyberframework
[68] http://www.hse.gov.uk/aboutus/strategiesandplans/businessplans/plan1819.pdf
[69] http://www.hse.gov.uk/foi/internalops/og/og-0086.pdf

"Operators subject to both health and safety and NIS legislation should carry out risk assessment(s) that cover both major accident and loss of essential services consequences and then use the highest risk to determine the countermeasures to be applied."

The requirement for physical security at our operational sites has been reviewed in 2005, 2009, 2010/11, 2014 and 2017. At each review we worked closely with BEIS to decide how many sites required enhanced protection. The resources we commit and the work we will carry out in the RIIO-2 period will continue this programme. Where our assets are co-located with other parties, such as gas distribution networks, we work with them to ensure an efficient, joined-up approach. While much of the government's focus at the start of RIIO-1 related to physical security, it has shifted to cyber security as we head toward RIIO-2.

4. Our proposals for RIIO-2 and how they will benefit consumers

Our mission is:

"We protect our people, our premises, and digital systems with the objective of maintaining trust in National Grid services.

We take our responsibilities as an operator of essential services (OES) seriously. Our proposals to protect the gas system from cyber and external threats in the RIIO-2 period are:

- to continue to take proportionate measures to protect the integrity of the network in line with best practice, government and HSE requirements
- to strengthen the ability of the gas transmission system to cope with and recover from malicious events that threaten GB energy supplies
- to deliver the cyber resilience improvements agreed with the Competent Authority for the NIS Regulations
- to deliver physical security upgrades at the sites required by BEIS, ensuring that all our PSUP solutions remain compliant with CPNI high level security principles
- to comply with our legislative requirements (the Counter-Terrorism Act 2008)
- to monitor and report our performance and adapt our plans and delivery as circumstances change
- to pursue greater cost efficiency, deploying innovation and best practice where we can

Outputs

In this section we provide a short description of the proposed RIIO-2 work in each of the key areas:

- cyber resilience – operational technology
- cyber resilience – information technology
- physical security upgrade programme (PSUP)
- policing.

We have set out further details of the business plan proposals for each area in the accompanying engineering justification reports. These reports explain in greater depth the drivers for the activity, the options considered (including 'do nothing'), and the analysis of costs and benefits. We have used further templates to set out our proposed outputs in the form of price control deliverables and, where appropriate, our proposals for the design of uncertainty mechanisms.

Our 'protect from threats' priority maps to Ofgem's output category: 'Maintain a safe and resilient network.' In the following table we have summarised the proposed outputs, the relationship to uncertainty mechanisms and additional supporting information.

Table 23.3 outputs summary 'protect from threats'

PCD name	Business plan proposal - what the PCD measures	Related UM	Supporting info
1. **Cyber resilience**	Delivery of cyber security enhancements to reduce the risk of events which could have a severe impact on GB consumers. Upfront allowance & Totex incentive sharing applies for known work with defined outputs.	UM_1	National Grid UK Cyber Security Strategy (Annex A23.01) Gas Transmission and Gas System Operator NIS Self-Assessments (Annexes A23.03 and A23.04) Gas Transmission and Gas System Operator draft NIS Improvement Plans (Annexes A23.05 and A23.06) Justification Paper –NGGT Cyber Resilience (Information Technology) (Annex A23.02)

			Operational Technology and Cyber Resilience Justification Paper (Annex A23.07)
2. **Physical security**	Delivery of physical security enhancements to reduce the risk of events which could have a severe impact on GB consumers. Upfront allowance & Totex incentive sharing applies for known work with defined outputs	UM_2	Enhanced Physical Site Security Asset Health Justification Report (Annex A23.08) Enhanced Physical Site Security Major Project Justification Report (Annex A23.09)

How do our RIIO-2 proposals benefit consumers?

Our plan to protect from threats delivers benefits for industrial and domestic consumers:

Consumer priorities	How does our plan support this?
"I want to use energy as and when I want"	- We improve the safety and resilience of the network to ride through and recover from malicious events that threaten to disrupt continuity of GB energy supplies.
"I want you to facilitate delivery of a sustainable energy system"	- Our plan delivers security enhancements that the government has identified as being in the national interest. This reduces the risk of actual events that could have severe societal consequences for GB consumers.
"I want an affordable energy bill"	- Including uncertainty mechanisms involving the security agencies to monitor and adjust our delivery during RIIO-2 will ensure our effort and expenditure continues to be directed at maximising consumer benefit even when circumstances change.

5. How will we deliver?

To manage our cyber and physical security programmes we will regularly monitor potential interactions with network developments. For example, if assets become more or less important as we review network capability or as customer activity changes (for example, disconnections) we will re-prioritise our work.

Through our portfolio planning process, we have confirmed that the proposed cyber resilience operational technology scope is deliverable as part of our longer-term programme that will continue through RIIO-3. The necessity to balance system access outages with maintaining secure supplies, limits how many sites we can work on simultaneously. Our delivery programme is part of an enduring, sustainable, asset replacement cycle that fits with the economic optimal average asset life of 15 years.

The programme of work will be subject to competitive procurement events to ensure we achieve value for money. With upfront funding we'll be able to interest the supply chain in a longer term, larger portfolio of work, and drive efficient delivery. We plan to grow our in-house cyber delivery capability by recruiting eight more people so that we achieve the right balance between internal expertise and outsourcing.

Our RIIO-2 plan embeds innovation from our Network Innovation Allowance (scheme NGGT0114) strengthening security with our Supervisory Control and Data Acquisition (SCADA) systems.

We will continue to focus on applying innovation to drive efficiency in delivery our work.

6. Risk and uncertainty

The threat landscape has changed significantly during RIIO-1, particularly in relation to cyber security. Our close work with the security agencies has helped us to a good understanding of the work we need to deliver in RIIO-2 to meet current government requirements. We consider this known work to be 'no regret'. It constitutes around 80% of the scope in this part of our RIIO-2 plan. The key assumptions underpinning our approach are set out in chapter 31.

We propose that in relation to the known work, where the outputs and costs are sufficiently clear, base revenue funding should be included in our RIIO-2 price control allowance for the full scope of this

planned work. We should be strongly incentivised to deliver this work efficiently in the interests of consumers.

We are working with the NIS Competent Authority to confirm our RIIO-2 scope informed by our NIS self-assessment and NIS improvement plans.

We believe the regulatory framework must allow for our outputs and costs to be adjusted in the RIIO-2 period as circumstances change and we support Ofgem's proposal to include uncertainty mechanisms in RIIO-2 for physical security and cyber resilience. In our response to Ofgem's RIIO-2 framework consultation, we made suggestions for how the uncertainty mechanisms could be improved, learning from RIIO-1 experience. Our proposals are summarised in the table below and further details are set out in chapter 29.

It should be noted that there are important interactions across the whole of our business plan. For example, elements of our asset resilience and cyber resilience programmes of work will also bring important safety and reliability benefits. The scope of work we have included in this chapter is consistent with the categories of work in the RIIO-1 enhanced security costs and/or it goes far beyond previous business as usual activity. We expect these areas of work to have their own RIIO-2 outputs, monitoring and reporting regimes.

Table 23.4 uncertainty mechanisms

UM name	Type	Business plan proposal – what the UM addresses	Frequency
1. **Cyber resilience**	Reopener Upfront allowance & Totex incentive sharing applies for known work with defined outputs.	There is some uncertainty above our baseline scope and costs for cyber resilience work in RIIO-2. An ongoing adjustment mechanism avoids security works being over or underfunded in RIIO-2.	Process undertaken annually May or may not result in required changes
2. Physical security	Reopener Upfront allowance & Totex incentive sharing applies for known work with defined outputs.	Scope and cost of physical security work that is in consumer interests in RIIO-2. Ongoing adjustment mechanism to avoid us being over or underfunded for physical security works in RIIO-2.	Process undertaken annually May or may not result in required changes
7. New threat vector	Reopener	Bespoke UM proposal relating to new threat vectors - "unknown unknowns". Concept to be developed further through future iterations.	Only triggered in exceptional circumstances, so that we can respond to stakeholder requirements.
9. **Policing cost associated with Counter-Terrorism Act 2008**	Pass through	Policing costs cannot be controlled by NGGT or predicted, therefore treated as pass-through.	Annual

7. Our proposed costs for RIIO-2

Our proposed total expenditure to meet this stakeholder priority is summarised in the tables below. Our cyber resilience – operational technology costs include:

[redacted]

[redacted]

[redacted]

*It should be noted that in relation to the above work, some 80% of the costs would be incurred for replacement of these systems on grounds of age and obsolescence even if additional cyber resilience requirements did not apply. Our operational technology capex costs incorporate efficiencies of around 30% through improved delivery contract strategies and bundling of work to maximise volume discounts from the supply chain. These systems have asset lives of up to 15 years.

Our cyber resilience – information technology costs reflect NGGT's allocation of common services and systems shared with National Grid Electricity Transmission and National Grid Electricity System Operator. These include:

- [redacted] capex for secure data centres in keeping with the strategic approach approved by Ofgem in the 2018 enhanced security reopener
- [redacted] totex for security hardening of hardware and software systems, provision of 24/7 cyber security monitoring, training and recruitment of cyber skilled personnel. These costs are incurred through our coporate teams.

Our physical security costs reflect:

- [redacted] capex for new Physical Security Upgrade Programme (PSUP) solutions
- [redacted] capex to commence asset replacement of our first generation enhanced security installations as they reach end of life (this programme will extend into RIIO-3). These assets typically have asset lives of 7 or 15 years
- [redacted] opex includes 24/7 alarm monitoring, routine maintenance and fault repairs representing NGGT's allocation of a common service shared with NGET and a third party
- [redacted] opex for policing costs as dictated by the Counter-Terrorism Act and treated as cost pass-through

No provision for unforeseen costs that may arise from future changes in security requirements, as these would be handled by uncertainty mechanisms.

Our physical security capex costs lock in the 15% efficiency so far attained in RIIO-1. We have incorporated £8m efficiency ambition compared to our view at the time of our May 2018 reopener submission.

[redacted]

Business plan data templates

Our business plan is accompanied by a set of spreadsheet business plan data templates (BPDT) in a format required by Ofgem. We have provided the table below to show you how our protect from threats activity costs feed into the BPDTs. This table is not yet included. At the time of writing Ofgem is still working on the detail of the physical security and cyber resilience BPDT to reflect the proposed RIIO-2 framework.

8. Next steps

We wish to discuss with Ofgem the detailed content and regulatory treatment for the various elements that make up this part of our plan. Ofgem intends to hold workshops in 2019 and publish further guidance for the development of our cyber resilience plans. In tandem, further guidance is expected from the NIS Competent Authority for development of our NIS strategic investment plan. We expect this engagement will result in refinements to our RIIO-2 work plan and costs for presentation in our final RIIO-2 business plan.

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

What is this stakeholder priority about?

We care about the environment and the communities we serve. As a responsible business we are committed to delivering environmental and community benefit, prioritising the issues that matter most to you. We believe this is vital if we are to operate as a socially responsible business and play our part in helping Britain to meet the challenges of decarbonisation. These challenges have been laid out through people across the UK and beyond voicing their concerns about climate change, culminating in the government setting out legally binding targets to achieve "Net-Zero" carbon emissions by 2050. We will step up to meet this challenge by embedding sustainability in our business strategy and using it to guide the way we work. We are driving more efficient performance and future-proofing our organisation as the environmental and social landscapes change and we want to protect the environment by providing options to reach Net Zero carbon by 2050 at lowest impact on society.

Our approach in RIIO-2 remains consistent with the UK Government's Clean Growth Strategy, 25-year environment plan and commitments on climate change. This approach links to the Ofgem priority 'Deliver a sustainable network'.

What have you told us?

You've said that we have an important role to play in protecting the environment and moving towards decarbonisation, particularly around emissions and air quality. Your responses to our playback consultation confirmed that you would like us to demonstrate the value and cost of going beyond the legal requirements, and to consider the value of those actions to current and future generations.

What will we deliver?

We will shift our focus from environmental protection to environmental enhancement and:

- improve air quality and reduce emissions by replacing two compressors with more efficient ones in RIIO-2. We'll start work on delivering five more units in RIIO-3
- increase our focus on reducing all methane emissions because methane is a major contributor to climate change. We'll monitor leaks on the network and work on ways to reduce them
- reduce the carbon footprint of our business by moving to 30% low carbon-fuelled vehicles in our commercial fleet by the end of RIIO-2, installing solar panels on our sites, ensuring the energy we use in our office buildings is from sustainable sources and reducing carbon in construction projects
- focus on 77 redundant sites, assets and asset groups, enhancing the natural environment around these and make sure new construction projects include initiatives to protect and promote biodiversity
- continue our support for the communities we work in and commit 0.3% of the value of major projects spend to support community initiatives
- develop our work on delivering benefits to wider society, through supporting communities, education initiatives, promoting small and medium-sized enterprises, supporting local employment through the supply chain and implementing human rights strategies.

These commitments result in the following outputs to meet this stakeholder priority:

Table 24.1 output summary 'I want you to care for the environment and communities'

Output Category	Output	Business Plan Proposal
Price Control Deliverable	Compressor emissions	Deliver compressor emissions compliance at Wormington in RIIO-2 and begin work to deliver compliance at Kings Lynn, Peterborough and St. Fergus in RIIO-3
Price Control Deliverable	Redundant assets	Address redundant assets across 77 sites, assets and asset groups.
Price Control Deliverable / Output Delivery Incentive	Environmental Action Plan	A requirement from Ofgem's May decision, across all sectors, was the delivery of an Environmental Action Plan and Annual Environmental Report. This is new for gas transmission. We have included an initial draft EAP in our submission. This is in early stage development, is due to be updated as per Ofgem's revised guidance, and stakeholder views will be sought.
Output Delivery Incentive	GHG emissions (venting)	Retain scheme with incentive set with appropriate rewards and penalties to meet the needs of consumers. Include upside to encourage further performance improvements. Potentially develop further as part of broader environmental incentive package.
Output Delivery Incentive	NTS shrinkage	Retain scheme with potential improvements to drive further consumer savings for RIIO-2. Incentive set with appropriate rewards and penalties to meet the needs of consumers.

The total RIIO-2 spend for this priority is £361m, with an annual spend of £72m (compared to £48m per year in RIIO-1). This is around 12% of the value of our full business plan. Nearly three quarters of this relates to our compressor emissions compliance programme. The spend profile across price controls is shown in figure 24.2 below. Table 24.3 shows the spend for this chapter in RIIO-2 by activity.

Figure 24.2 RIIO-1 and RIIO-2 spend profile 'I want you to care for the environment and communities'

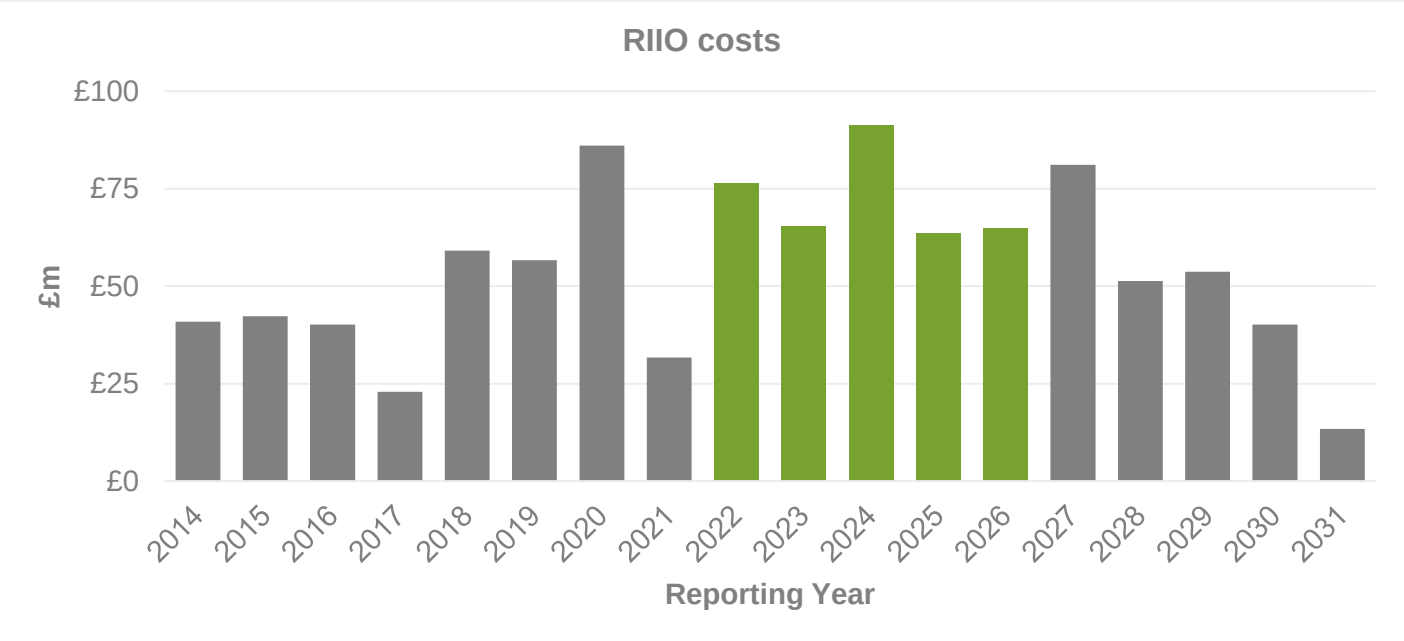


Table 24.3 activity spend 'I want you to care for the environment and communities'

Activity Spend	2022	2023	2024	2025	2026	Total RIIO-2	Annualised RIIO-2	Annualised RIIO-1
Compressors - emissions legislation	46.2	46.2	65.2	48.4	50.3	256.3	51.3	37.8
Redundant assets	19.6	13.1	20.0	10.7	10.0	73.3	14.7	2.7
Quarry and loss	4.3	4.4	4.4	3.0	3.0	19.1	3.8	5.3
Our climate commitment	6.2	1.7	1.7	1.5	1.4	12.5	2.5	1.7
Total spend (£m)	**76.3**	**65.3**	**91.3**	**63.6**	**64.7**	**361.2**	**72.2**	**47.4**

This is broken down by Business Plan Data Template (BPDT) category as follows.

Table 24.4 Business plan data template spend 'I want you to care for the environment and communities'

RRP Category	2022	2023	2024	2025	2026	Total RIIO-2	Annualised RIIO-2	Annualised RIIO-1
Closely associated indirects	1.2	1.2	1.2	1.2	1.2	5.9	1.2	1.6
Cost subject to uncertainty mechanism	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1
Direct costs	4.5	4.5	4.5	3.1	3.1	19.7	3.9	0.7
Non load related	70.5	59.4	85.4	59.2	60.3	334.9	67.0	41.9
Non-operational capex	0.2	0.2	0.2	0.2	0.2	0.7	0.1	0.1
Grand total	76.3	65.3	91.3	63.6	64.7	361.2	72.2	47.4

How do our RIIO-2 proposals benefit consumers?

Our proposals deliver benefits for industrial and domestic consumers:

Consumer Priorities	How does our plan support this?
"I want to use energy as and when I want"	Our plan supports security of GB gas supply because: - compressors are vital to moving gas around the system, enabling consumers to use gas as and when they want. We are installing new compressors to reduce the environmental impact of doing so and will plan to limit running hours or decommission others by 2030, subject to meeting stakeholder needs.
"I want you to facilitate delivery of a sustainable energy system"	Our plan supports a sustainable lower carbon future by focusing on: - reducing greenhouse gas emissions such as methane, carbon dioxide and other emissions to reduce our impact on climate change, with clear benefits for society - improving air quality through our compressor emissions compliance programme, ensuring the most polluting compressor trains are decommissioned and replaced where necessary with cleaner machinery - responsible demolition including asset re-purposing - releasing materials back into the value chain to reduce the need to mine raw materials - improving biodiversity on non-operational land and reconstructing the environment when we have demolished a site, to bring positive benefits to nature and communities - having a certified environmental management system to prevent incidents.
"I want an affordable energy bill"	Our plan supports an affordable energy bill: - responsible demolition – protecting future consumers from the costs of disposing of assets they may not have benefited from - prioritising and innovating to deliver compressor replacement, to bring consumers value for money.

Chapter overview

1. What is this priority about?

We care about the environment and the communities we work in. This topic is important for National Grid, as well as for consumers and society. Having a positive impact on the environment and communities is vital if we are to operate as a socially responsible business and meet the challenge of decarbonisation.

Our business operates at the centre of one of society's greatest challenges: to build affordable, reliable and sustainable energy systems meeting the needs of current consumers and supplying tomorrow's world with energy to thrive and prosper. A key strand in our vision for the future of the energy sector is concerned with limiting the dramatic impacts that climate change could have on our environment and way of life.

Our commitments around caring for the environment and communities are aligned to global and government ambitions as well as to stakeholder, society and end consumer impacts. We have signed the United Nations Global Compact, which has a strategy to drive business awareness and actions to achieve the UN Sustainable Development Goals (SDGs) by 2030.The goals promote prosperity while protecting the planet. More information on how these SDGs link to our business areas can be found on our website[70], and the relevant SDGs are shown under each section of this chapter.

Our approach in RIIO-2 will continue to be consistent with the UK Government's Clean Growth Strategy[71], 25-year environment plan[72] and commitments on climate change.

We are also mindful of potential future changes to emissions legislation (for example new air quality legislation) and where possible test our proposals to ensure solutions are future-proofed.

We are also mindful of potential future changes to legislation (for example new air quality legislation) and where possible test our proposals to ensure they are future-proofed.

Figure 24.5 relevant UN Sustainable Development Goals for this chapter

At a corporate level our strategy is to move from environmental protection to environmental enhancement. At a gas transmission level, we have an environmental action plan, see Annex A24.01, which sets out how we plan to take forward our business-specific actions relating to the environment. This covers both legislative and non-legislative drivers. We recognise that much of this work provides wide benefits for society and you have told us that you support going beyond legislative requirements in some cases to deliver additional environmental benefit.

The rest of this chapter focuses on these areas:

Sustainability and leadership for change: our role in the environment and communities, and our sustainability strategy.

Air quality – compressor emissions: our work to comply with relevant emissions legislation to 2030, making sure there is adequate, compliant compressor capability on the network. This is needed to allow customers to take gas on and off the system as and when they want to, while ensuring local air quality is maintained and GHG emissions are reduced.

Air quality and compressor emissions account for the largest area of spend in this chapter. Legislation is driving increasing requirements in air quality. To meet these requirements we need to invest in our compressor fleet to ensure compliance. Our investment programme covers the period up to 2030. Spend is required during RIIO-2 to respond to this challenge without jeopardising gas supplies and make sure we continue to have a robust compressor fleet that can meet changing customer requirements.

[70] https://www.nationalgrid.com/group/responsibility-and-sustainability/our-progress/defining-our-priorities
[71] https://www.gov.uk/government/publications/clean-growth-strategy
[72] https://www.gov.uk/government/publications/25-year-environment-plan

If tighter emissions legislation is introduced (for example air quality) it would affect our older, non-electric compression fleet before the new gas units we propose to install in RIIO-2 and RIIO-3. Compressor equipment manufacturers are continuing to invest in new technology and innovate to reduce emissions from compression. We will include all commercially available technologies in our tenders and use Best Available Techniques (BAT) to minimise the risk of new compressors being caught out if legislation is tightened further.

Climate change - our climate commitment: our commitments around decarbonisation include better monitoring to reduce methane emissions, plans to decarbonise our vehicle fleet, moving to clean renewable energy on site, our participation in the EU Emissions Trading Scheme and our environmental incentives on reducing GHG emissions and shrinkage.

Responsible asset use and caring for the natural environment: our plans to address our redundant asset base and move to develop our sites, undertaking responsible construction to promote better environmental outcomes and improve biodiversity where possible.

Quarry and loss: how we continue to deal with our contractual obligations with landowners where our assets impact on their businesses

Supporting the communities we work in: our ongoing commitment to supporting communities that are impacted by our work and also wider society.

Sustainability and leadership for change

We play an important role in the sustainable development of Great Britain's energy sector, building affordable, reliable and sustainable energy systems to meet the needs of our current and future stakeholders. By embedding sustainability in our business strategy, we are future-proofing our organisation against environmental and social change, ensuring we continue to operate as a responsible business.

Our group environmental sustainability strategy focuses on managing the direct environmental impact of those of our operations that can make the greatest contribution to a more sustainable future. These National Grid commitments are:

- ***Our climate commitment*** – as an infrastructure business, our day-to-day activities result in GHG emissions and by cutting these we can reduce both costs and our environmental impact. Our targets are a 45% reduction in GHG emissions by 2020, a 70% reduction by 2030 and an 80% reduction by 2050 (against a 1990 baseline).
- ***Responsible resource use*** – making the most of our assets through reuse and recycling of recovered assets. Our target is to reuse or recycle 100% of recovered assets by 2020 and send zero office waste to landfill from major office sites by 2020.
- ***The natural environment*** – working in partnership with local and national stakeholders to manage our natural assets, enhance ecosystems and improve the quality of nature across our UK landholdings. Our target is to recognise and enhance the value of our natural assets on at least 50 sites by 2020 and drive net gain in environmental value (including biodiversity) on major construction projects by 2020.

During 2019 we are reviewing and updating our corporate commitments in this area beyond 2020. We recognise the role we have to play in decarbonisation of our industry and the importance we give to this is demonstrated by senior management's targets on environmental performance.

Our focus on environmental sustainability is underpinned by an Environmental Management System (EMS) that is certified to ISO14001:2015[73], covering all our operational and non-operational businesses in the UK. The EMS gives us a clear, systematic process to manage environmental risks and to realise opportunities to enhance the environment. This can be found in Annex A24.02 and our Business Management Standard can be found in Annex A24.03.

We also have a stakeholder, community and amenity policy[74], which we apply to all our work in the local community. Under this policy, we look to enhance the local environment, mitigate our works or where this is not possible, provide other benefits that deliver lasting value to the people and communities affected.

[73] **ISO 14001** is the international standard that specifies requirements for an effective environmental management system (EMS).

[74] https://www.nationalgridgas.com/document/81026/download

We have undertaken benchmarking exercises across environmental and supply chain sustainability activities. These can be found in Annexes A24.04 and A24.21 respectively.

Air quality - compressor emissions compliance

1. What is this sub-topic about?

This sub-topic is about delivering consumer value through cleaner air in the local environment. There is a greater focus on local air quality as society starts to understand the causes and implications of poor air quality. Here we look at how we play our part in improving air quality while continuing to deliver reliable energy supplies to consumers.

We use compressors to move gas around the network to meet your need to move gas on and off the transmission system as and when you want. We have 71 operational units[75] on 24 compressor sites across the network. These compressors maintain the pressure of the gas in the network and move it around the country to areas of demand. There's more information about the need for compressors in Chapter 22 'I want to take gas on and off the transmission system where and when I want'.

Our activities in operating and maintaining the network can have a negative impact on the environment. The most significant of the environmental impacts comes from emissions to air, from burning gas in gas-fired compressors to keep the gas flowing through the system and from methane emissions when compressors vent. Carbon emissions from compressors are covered in the next topic 'climate change: our climate commitment'.

Deteriorating air quality as a result of Nitrous Oxide (NOx) emissions is linked to increased health risks such as asthma and other lung conditions. To combat this, legislation has been introduced through the clean air programme[76] to encourage a reduction in NOx emissions. The legislation affects 28[77] of our gas turbine-driven compressor units as well as a small number of water bath heaters, boilers and standby gas generators, which are also used in the operation of the gas transmission system.

The key pieces of legislation that affect our compressors are:

- **the Industrial Emissions Directive (IED) 2010,** which combines the Large Combustion Plant Directive (LCP) 2001 and the Integrated Pollution Prevention and Control Directive (IPPC) 2008. The IED has driven much of the RIIO-1 compressor work
- **the Medium Combustion Plant Directive (MCP) 2015,** applies specific limits on emissions to air from combustion plant and is the major driver behind our RIIO-2 emissions investment programme.

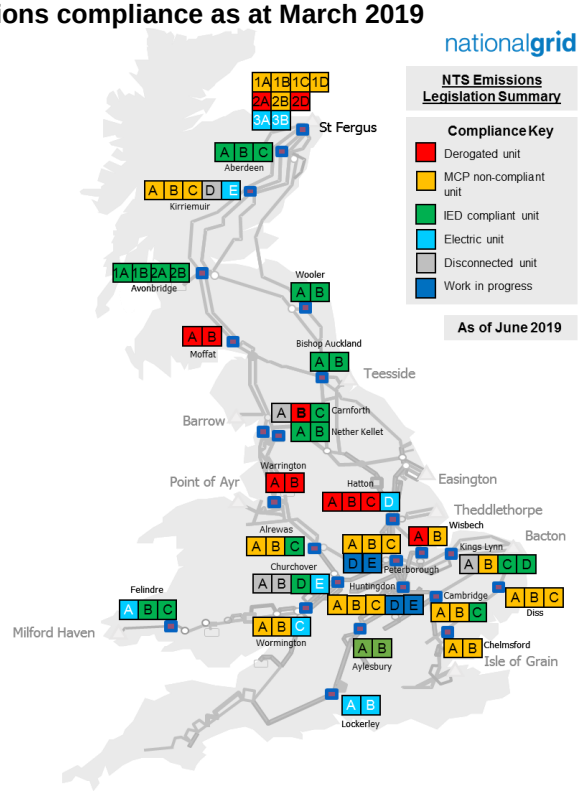
Figure 24.6 shows our compressor compliance as at the end of March 2019.

[75] 71 operational units do not include new units at Peterborough and Huntingdon that are currently not commissioned

[76] http://ec.europa.eu/environment/air/index_en.htm

[77] Including Kings Lynn A which was recently disconnected

Figure 24.6 – compressor emissions compliance as at March 2019



We need to be compliant with the MCP legislation by 1st January 2030 and we can achieve that in the following ways:

Decommission and reduce network capability	Close and decommission units if changing gas flow patterns render them no longer required.
Derogate	Existing medium combustion plant operating for no more than 500 hours on a rolling five-year average after 1st January 2030 does not need to comply with the new Emission Limit Values (ELVs).
Make compliant	Two high-level options for achieving compliance: 1. Install abatement technology to achieve the specified Emission Limit Values with asset health work as required on the machinery train. This doesn't come out as a preferred option due to the age of our non-MCP compliant assets. 2. Install a new, emissions-compliant compressor machinery train.

Where building new compressors is the best option for maintaining legislative compliance this will require an investment of time and resource. Several of our compressors will have to be replaced and there is only limited availability of network outages to accommodate the work. This means we can't wait until RIIO-3 (2026 onwards) to make a start and we need a programme that allows us to provide continuous use of the network from 2021 to 2030. Activity is required during RIIO-2 to achieve the compliance date.

Even for compressors that can be addressed in RIIO-3, some of the initial costs will need to be incurred in RIIO-2. We set out what (and how) we intend to deliver at a high level in this chapter, and in more detail in our Compressor Emissions Compliance Strategy (CECS) annex A24.05.

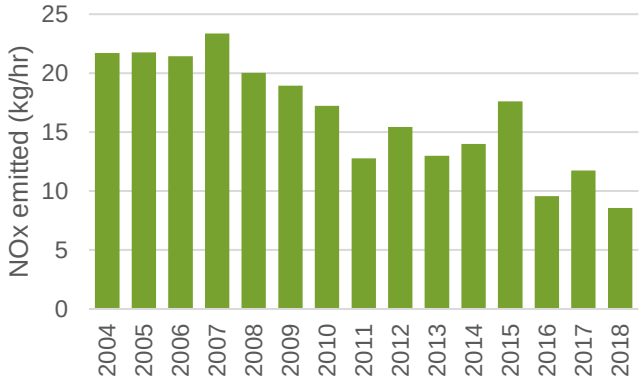
2. Our activities and current performance

At the outset of the RIIO-1 period, the requirements for our compressor fleet to achieve Industrial Emissions Directive (IED) compliance were still uncertain. But now we've reached greater understanding of what's needed and the costs of doing it. We have completed Aylesbury and Wisbech in RIIO-1 under Large Combustion Plant emissions legislation. In delivering our first IED-compliant unit at

Aylesbury, using an innovative catalyst solution, we saved around £68m against our allowance for entire new units.

Our investment in RIIO-1 led to a reduction in the amount of NOx emitted for each hour of compressor running.

Table 24.7 NOx emitted for each hour of compressor running (Kg/hr)



In total we spent £279.7m on compressor emissions compliance in RIIO-1. We also achieved derogations for a number of units. This allowed us to deliver the network capability customers needed at a cost that is best for consumers, while meeting compliance requirements. As a result of a successful derogation request we've been able to schedule capital works across RIIO-2 and RIIO-3 to ensure compliance while making sure outages can be scheduled in a way that ensures minimal disruption and cost to our customers while ensuring compliance with legislation. For some compressor sites, where they won't be used for enough hours to make investment in new ones worthwhile, it may be in consumers' interests for the compressors to continue to be derogated rather than replaced.

Work is in progress to make sure Huntingdon and Peterborough can become compliant with IPPC emissions legislation. We are continuing to work with Ofgem on our proposed solutions for emissions compliance at St Fergus and Hatton. We expect a decision on the needs case in July 2019.

Learning from RIIO-1

RIIO-1 has given us experience of managing changes on live compressor sites, and our cost confidence has improved as a result. We have also been investigating whether innovative techniques such as abatement (making an existing unit compliant through additional works) might be an option in RIIO-2. However, abatement seems unlikely to achieve the necessary reduction in NOx emissions and isn't a cost-effective option for our non-compliant MCP units because of their age and asset characteristics. We will continue to look at how innovation may be applied during RIIO-2.

Following the 2015 reopener, we undertook further stakeholder engagement, fully assessed requirements of the legislation and challenged ourselves on our cost performance, including: undertaking a comprehensive CBA; for each option considering a comprehensive set of regulatory, commercial and asset options. Given the scale of work required to make all our compressor sites compliant with legislative requirements, we targeted business improvements and learnings from best practice to ensure our programme is delivered in the most efficient way

3. What are our stakeholders telling us?

We engaged extensively with you on emissions compliance across the RIIO-1 period, both for the May 2015 reopener and for the May 2018 Industrial Emissions Directive reopener. However, the reopener timing and decision (Ofgem's decision was published in September 2018) impacted our stakeholder engagement on MCP as part of the RIIO-2 business plan. We did not feel it would be appropriate or productive to start a fresh round of engagement while the reopener consultation was ongoing.

Even so, you have recognised how NOx levels have decreased per hour of compressor running and you acknowledge that we are treating compressor emissions with an appropriate level of seriousness:

"NOx and CO2 reduction systems are very high priority and it seems NG are taking it seriously" – [redacted]

We have some insight from our broader environmental engagement and this is captured in the environment engagement log in Annex A24.06. This shows some of you feel that emissions affecting air quality should be treated the same as carbon emissions and managed to reduce their impact on the environment as cost-effectively as possible. You have also asked us to appreciate and account for the wider cost of constraints beyond just the financial cost incurred by our business.

Working with our stakeholders is important, and we have heard that you expect us to demonstrate a constructive partnership with Ofgem and the industry in the environmental space, including with the Environment Agency (EA), Scottish Environment

Protection Agency (SEPA) and Natural resources Wales (NRW). Building on our business as usual interactions, we engaged specifically on the February playback document through one-to-ones and we heard during these engagements about the value of making our compliance strategies clear. So, we've worked collaboratively with the three environment agencies on the development of the Compressor Emissions Compliance Strategy (CECS) through which we aim to improve transparency in investment decisions and address the greatest risks on the network, providing you with the most value from the investment.

Network capability engagement will look at how our compressor fleet contributes to the service we provide to our customers. Because of this interdependence, we intend to address the two areas together when we talk to you.

4. Our proposals for RIIO-2

Our compressor proposals across RIIO-2 and RIIO-3 is set out in our draft CECS Annex A24.05. It sets out how we intend to meet our legislative deadlines by starting and delivering several compressor projects within the price control period.

Our proposals are measured through the following price control deliverable (PCD) set out in table 24.8 below. Further information on the price control deliverable can be found in annex A29.01

Table 24.8 Output summary air quality - compressor emissions compliance

PCD name	Business plan proposal - what the PCD measures	Related UM	Supporting info
4. Compressor emissions	Deliver compressor emissions compliance at Wormington in RIIO-2 and begin work to deliver compliance at Kings Lynn, Peterborough and St. Fergus in RIIO-3	UM_5	Compressor Emissions Compliance Strategy (Annex A24.05) Wormington Justification report & CBA (Annex A24.10 & A24.11) Huntingdon Justification report & CBA (Annex A24.14 & A24.15) Kings Lynn Justification report & CBA (Annex A24.18 & A24.19) Peterborough Justification report & CBA (Annex A24.12 & A24.13) St. Fergus Justification report & CBA (Annex A24.16 & A24.17)

Achieving this compliance delivers value in several ways. For you, delivery of these outputs ensures that you can move gas on and off the system as and when you want. From a consumer and wider social perspective, local air quality will be improved as network reliability is enhanced. We will also meet our regulatory compliance requirements.

The compressor plan is underpinned by our work on network capability and more information this can be found in part three of this business plan.

Table 24.9 summarises the options selected for each unit for RIIO-2 and RIIO-3. To develop our proposals, we have carried out cost benefit analyses (CBAs) for each compressor affected by emissions legislation. It has informed our understanding of the most cost-effective way of meeting our obligations and the needs of our customers while delivering the best value to consumers. We have tested a wide range of options and stress tested our solutions are robust against a range of scenarios. Our draft CECS sets out our consideration of the final options alongside outputs of the CBAs and relevant engineering justification reports as appendices.

Commercial options are an important consideration when assessing how to meet the network needs. These solutions potentially avoid compressor use and so reduce the emissions impact of the fleet overall. Typically, the commercial and regulatory options are suited to short-term scenarios, meeting a peak demand and supply pattern linked to a single-entry point; they aren't a complete alternative option to investment in the compressor fleet. It is also important to note that commercial solutions to meet emissions requirements will have corresponding physical requirements in other areas

Compressor proposals detail

We have delivered a strategy across RIIO-2 and RIIO-3 to achieve compressor emissions compliance by 2030. We propose replacing 7 compressor units by 2030. For other units we will need to make a decision on whether to decommission or derogate. Our initial proposals can be found in Table 24.9. However, our proposals for RIIO-3 are only initial thinking at this stage and further work is required to refine which units will be decommissioned and which will be derogated at the end of RIIO-3. As we engage on the broader business plan, we will test the suitability of this plan to achieve the costs and operability that our stakeholders are looking for

Table 24.9 compressor proposals

		New units	Derogations	Decommissioning
RIIO-2	MCPD	Wormington x 2	-	-
	IED	[redacted]	Carnforth B [redacted] Moffat A & B Wisbech A	[redacted] Huntingdon A & B** Peterborough A & B** [redacted]
1st January 2030	MCPD	Kings Lynn x 2 Peterborough x 1* St Fergus x 2	Cambridge x 1 Chelmsford x 1 Diss x 2 Huntingdon C	Alrewas A & B Cambridge x 1 Chelmsford x 1 Diss x 1 Kings Lynn A* & B Kirriemuir A, B & C Peterborough C [redacted] Wisbech B Wormington A & B
	IED	-	Moffat A & B Wisbech A	Carnforth A & B
Total		[redacted]	[redacted]	[redacted]

*we will try to move this unit build into RIIO-2 if it is possible to schedule around other outages.

** Two units at Peterborough and 2 units at Huntingdon are being replaced under IPPC in the May 2018 reopener.

The other compressor sites not impacted directly by this plan are required during RIIO-2 so we can meet our 1 in 20 obligations[78], facilitate diverse sources of gas supply into the UK as our customers say they need, make it possible to access the network more frequently for asset health work, replace compressor units and deliver our cyber programme.

Compressor MCP compliance and proposals for RIIO-2 & RIIO-3 by site

The next table summarises initial proposals for impacted MCP compressor sites and a summary for our initial proposal decision. Existing processes have been used for these. As the network capability framework develops and we test these proposals with our stakeholders, we will be able to provide further rationale for our proposals.

Table 24.10 compressor summary by site

Proposal	Rationale
Wormington A and B **Complement the existing single electric drive compressor with two compliant back-ups (replacing two existing non-compliant units)**	Wormington compressor site is essential for providing entry capacity at Milford Haven LNG terminal and it also meets exit capacity requirements, including meeting 1 in 20 obligations, in South Wales when Milford Haven is not flowing. Forecast future running hours at Wormington are driven by assumptions about the decline in UK gas production and how much of this is replaced with LNG (as opposed to shale gas supplies). Under different FES scenarios, forecast running hours range from 1,300-2,200 hours in 2020, and 1,700-12,000 hours in 2045.

[78] 1 in 20 defines the level of obligation for capability to meet peak winter demands

Proposal	Rationale
	The electric drive compressor will be the lead unit, but the other units are required to support very high flows from Milford Haven and for periods when the electric drive is unavailable. Assuming the electric drive unit is 80% available there is a need for other units for more than 500 hours per year. Without these additional units there would be a risk that entry and exit capacities or 1 in 20 obligations could not be met should the electric drive unit be unavailable.
Peterborough C **Complementing two compliant units that will be built through IPPC with one compliant back up unit (replacing a non-compliant unit)** **Huntingdon C** **Complementing two compliant units that will be built through IPPC with one derogated back-up unit**	There are close links between these sites and are considering Peterborough and Huntingdon in a cluster. There is a joint CBA for these sites and separate justification reports. These will be fully brought together in the next version of the business plan. We cannot meet our 1 in 20 licence obligations for demand in the South of the country without Peterborough and Huntingdon. We have already invested in new units to meet these needs in the long term; however with a need for two units, it is important to have resilience. In 2020 we forecast over 4,800 running hours for Peterborough. This is expected to decline as national demand falls, reaching ~1,200 hours in 2045. In 2020 we forecast over 2,000 running hours for Huntingdon. We expect this to decline in the future as gas demand in the South declines, reaching ~1200 hours in 2045. Both sites operate with two units running in parallel. We propose that one of the non-compliant back up units is replaced at Peterborough and one of the backup units at Huntingdon is derogated to ensure sufficient robustness across the sites. For Huntingdon, should either lead unit not be available, operation of the site would be limited to 500 hours. There is an increased risk of unexpected outages and maintenance costs as existing non-compliant units age.
Kings Lynn A and B **Complementing two compliant units with compliant back-up(s), replacing two non-compliant back-up units (one of these is already disconnected)**	The Kings Lynn compressor site provides entry and exit capacity at Bacton, and entry capacity to the Isle of Grain terminal. It also supports flow profiling and changing flow patterns (e.g. Bacton switching from import to export). Under our FES scenarios, running hours in 2020 are forecast at around 900 hours. Future running hours are dependent on the rate of UK Continental Shelf (UKCS) decline and levels of exports at Bacton. By 2035 forecast flow ranges under the FES scenarios range from ~150 – 6,500 hours per year and 300 – 4,200 hours per year in 2045. The site operates with two units in parallel. Should either lead unit not be available, the site would be limited to 500 hours (per retained back-up unit). There is an increased risk of unexpected outages and maintenance costs as existing non-compliant units age. If the non-compliant back up units were not replaced there would not be availability to cover planned and unplanned outages of either lead unit.
St Fergus **Complementing two electric drive units** [redacted]	As one of the highest utilisation compressor sites on the NTS, St Fergus enables UK Continental Shelf (UKCS) and Norwegian gas supplies entry capacity. Peak flow through this subterminal is ca. 75 mcm/d, which represents over 20% of supplies on a winter day. The only route for this gas to reach consumers is via the compression facility at St Fergus, there is no other physical substitute available. Running hours are anticipated to remain high until the 2040s. In the absence of additional new build units there would be a risk that entry capacities at St Fergus would not be able to be met should there be outages on the remaining units on site. This could also have a knock-on impact on oil and gas production.

Proposal	Rationale
Decommissioning remaining non-compliant units on site.	[redacted]
South East cluster (Cambridge A & B, Diss A, B & C and Chelmsford A & B) The only compliant unit at these sites is one at Cambridge. **We are proposing to derogate a unit on each site and decommission the remaining non-compliant units (2 at Diss, 1 at Chelmsford, 1 at Cambridge)**	These sites are considered as a cluster as together these sites deliver 1 in 20 compliance in the south east to support demand when the supply from Isle of Grain is low or to ensure entry pressures at the Bacton terminal are kept low when entry levels are high. Current running hours are often less than 500 per year, but these compressors are required to meet south east exit capacity requirements under certain supply/demand patterns. We saw combined running time of 3000 hours for Chelmsford and Diss in 2017/18. FES suggests LNG flows are increasing overall, however this increase is likely to be volatile on a day-by-day, month to month and year to year basis as LNG supplies respond to commercial drivers. The outcome of our processes is not to replace any of the units. This does introduce risk as it leaves sites where the only units have limited running hours. We will test out stakeholders' appetite for this level of risk in our engagement on the July draft business plan.
Kirriemuir ABC **Existing electric drive unit E retained** **Three non-compliant units. Current proposal is to decommission all three in 2030. However, we believe derogate may be a more appropriate solution.**	Kirriemuir compressor provides entry capacity at St Fergus and improves resilience if Aberdeen or Avonbridge compressors are unavailable. With its smaller units, the site is likely to move up the merit order in Scotland in the 2020s as UKCS supplies decline in the future (e.g. running hours nearly doubled from 1,776 in 2017/18 to 3,165 in 2018/19 as St Fergus supplies increased compared to the previous year). Whilst our CBA indicates decommissioning three units in 2030, this is fairly marginal and we believe that there are additional factors that need to be considered. We believe that there is a short-term need for the three non-compliant units until flows at St Fergus reduce post 2040, and that customers may value this. As the flows into St Fergus begin to drop, the non-compliant units can be decommissioned. We will test whether it is appropriate to move these units from decommission to derogate as part of our stakeholder engagement on the July draft business plan.
Alrewas A and B **Existing compliant gas driven unit C retained** **Two non-compliant units. Current proposal is to decommission both in 2030. However, we believe derogate may be a more appropriate solution.**	Alrewas compressor provides within network capability to move gas north from Milford Haven and to accommodate changing flow patterns on the network. This is typically a low-use site but use can increase under certain flow conditions (e.g. 1,700 hours in 2017/18) Whilst our CBA indicates decommissioning two units in 2030, this is fairly marginal and we believe there is a proven need for Alrewas in the future. Most of the duty can be performed by the lead DLE unit with the non-compliant units derogated as back-ups. We will test whether it is appropriate to move these units from decommission to derogate as part of our stakeholder engagement on the July draft business plan
Wisbech B **Existing non-compliant IED derogated unit to be retained. Propose to decommission remaining non-compliant unit.**	Wisbech is used to facilitate Entry flows from Easington and Bacton, and support exit requirements in the south west. The site can also provide some resilience to Peterborough and Huntingdon, although recent and proposed investment on those sites should mean less resilience is required there. Wisbech has been used historically to support flows from Theddlethorpe terminal, which is now disconnected from the NTS. The lead unit at Wisbech is derogated to 500 hours per year under LCPD and there is no longer a need for a further unit on site.

Our initial draft proposals are not to replace 21 of the 28 units impacted by MCP legislation that will become non-compliant with emissions legislation in 2030 through either derogation or decommissioning.

We have more work to do before deciding whether to derogate or decommission these units during RIIO-3 and beyond, and the network capability framework will help us to articulate these decisions. This includes testing the principle of if we should leave non-compliant units as primary units on a compressor site, which would leave us vulnerable to changes in supply patterns and would mean knowingly running polluting units whenever that site was required. This principle could change our plans primarily in the south east, where, based on the current plan, we would be reliant solely on derogated units at three strategic sites from RIIO-3 onwards. It also includes further work to capture the associated asset health and cyber investment costs to support some of these decisions. This will be informed by associated stakeholder engagement.

Whether these units are decommissioned or derogated it is currently proposed to leave them in place during RIIO-2. In addition to meeting customer need, keeping these units operational during RIIO-2 supports us as we replace the other compressor units and undertake asset health work. However, there are costs associated with maintaining these units to the required levels of availability and reliability during this period.

Figure 24.11 and figure 24.12 shows where our planned work is due to take place on the network across RIIO-2 and RIIO-3.

Figure 24.11 compressor emissions compliance proposed at end of RIIO-2

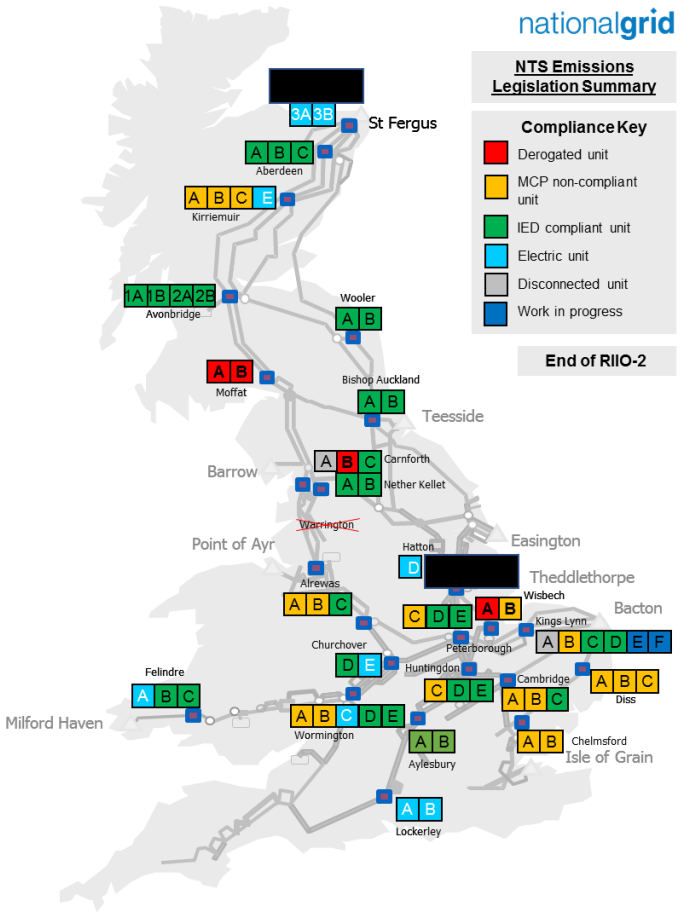
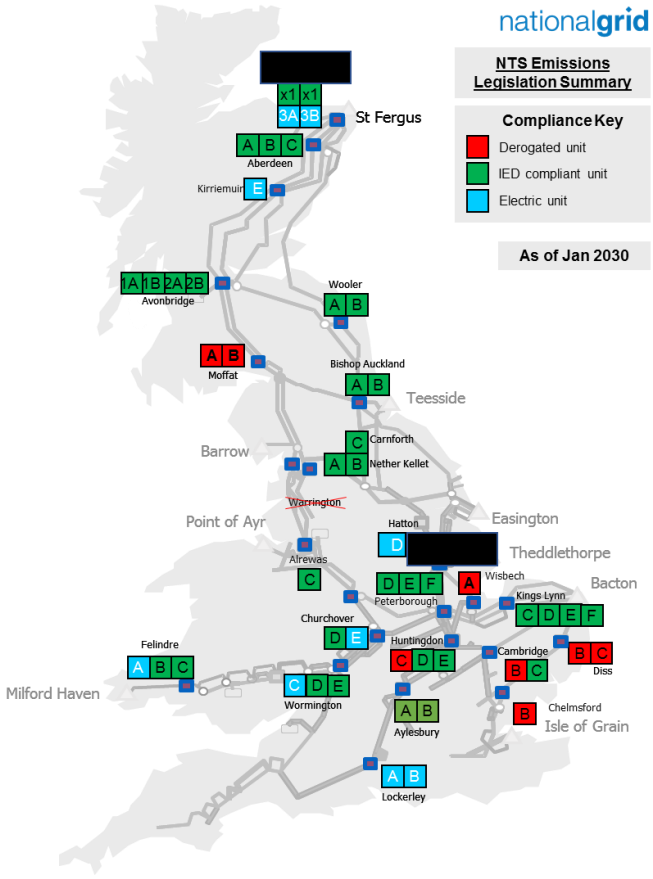


Figure 24.12 compressor emissions compliance proposed at end of RIIO-3



5. How will we deliver?

We are confident about the needs case and solution options for compressors that we propose to deliver in RIIO-2 and these are set out in our CECS in Annex A24.05.

Even for compressors being addressed in RIIO-3, some costs will be incurred during RIIO-2, for example to complete the tender processes. The output of this feeds the best available techniques (BAT[79]) assessment with environmental regulators, which is required starting mobilisation. Further information on BAT can also be found in the CECS. We believe the option that delivers the best outcomes for consumers is requesting ex-ante funding in RIIO-2 to cover the preparatory works for projects due to be started in RIIO-2 but delivered in RIIO-3. This

option minimises the risk of not meeting compliance deadlines if work can't be started until certainty around RIIO-3 is agreed.

We are incentivised to deliver capital projects efficiently through our totex incentive mechanism. Our approach to contracting and procurement is laid out in chapter 28 'Our plan is efficient and affordable, providing value for money'.

The UK government recently committed the UK to a new binding target of Net Zero carbon emissions by 2050. We expect an asset life of around 25 years for new compressor investments (and are currently replacing assets with a life of over 40 years). This means that the compressors we are delivering in RIIO-2 and 3 are likely to remain in use to 2050, so it is important that we consider how they will interact with a Net-Zero world.

As set out in our external context chapter, there are ways in which this decarbonisation challenge may be met in the coming years. The different routes that decarbonisation might take could impact our compressor fleet in a number of ways, from needing to capture carbon emissions to adapting compressors to hydrogen blends.

You challenged us about whether replacement compressors should be electrified to reduce our primary carbon emissions, particularly in the light of Net Zero ambitions. Our analysis of the costs of construction and operation of these units means investment is only cost effective when the compressors run for more than 5,000 hours per year. This is not the level of operation expected from the currently non-compliant units. Our current UK black start strategy (how the electricity system would be reenergised after a complete or partial shutdown) depends on gas supplies being available to power stations. Therefore the need to move gas around the network means that it is currently not feasible or cost-effective to move to a fully electrified compressor fleet.

We are working across the industry to identify and develop innovations that would support the range of potential decarbonised futures. The gas turbine suppliers are developing their product lines, for example by exploring how to develop existing combustion technology within their machinery that is compatible with fuel gas containing high hydrogen content; at this stage one OEM has a commercial offering capable of running on a fuel mix that's 68% hydrogen. Investing in this technology future-proofs our network by ensuring that we will need to do nothing to adapt our equipment as hydrogen becomes more widely used. Our emissions will reduce by default as the proportion of natural gas in our systems reduces over time.

Innovation also has a role to play in reducing carbon emissions from compressors through the development of Carbon Capture Usage and Storage. We have recently begun our Captivate project to prove the concept of carbon mineralisation from boiler house emissions at our Stallingborough site, building a fully containerised emissions capture demonstrator. As well as our existing projects we will continue to explore how innovation may help us move towards a lower carbon compressor fleet.

6. Risks and uncertainty

We don't think we will need to use Ofgem's proposed reopener for new compressors commissioned during RIIO-2 where we have demonstrated the needs case through CBA and the CECS, which will form part of our final Business Plan submission in December 2019.

If tighter emissions legislation is introduced (for example new air quality legislation), it would affect our older, non-electric compression fleet before the new gas units we propose to install in RIIO-2 and RIIO-3. Compressor equipment manufacturers are

[79] We are bound through legislation to undertake a process with relevant environmental bodies which defines the Best Available Techniques (BAT) in relation to new build compressors. BAT is the primary selection mechanism for all new and substantially modified compressor trains and will continue to be so during RIIO-2 and RIIO-3.

continuing to invest in new technology and innovate to reduce emissions from compression. We will include all commercially available technologies in our tender and Best Available Techniques (BAT) process. Using this approach minimises the risk of new compressors being caught out if legislation is tightened further.

A full BAT process requires the outcome from tender events to establish the most cost-effective way of reducing emissions. Tender events cost time and money for us and our supply chain and, if they are conducted too early, they could lead to us not considering the best available emissions reduction technology and/or incur additional costs from the supply chain to hold prices for a number of years. So, our business planning process will involve a preliminary BAT assessment using currently available information. We will carry this out during 2019 in preparation for our December business plan submission.

The future requirement for compression could change depending on how the network is used and this could be impacted by changes in government heat policy or other factors. Some of the new compressors we plan to install in RIIO-3 replace ones with historically low running hours and they are required to support our 1:20 obligation to maintain gas supplies. At this stage in our business plan development we believe we should not plan to rely on old units with a restriction on running hours to supply gas at critical peak winter supply times, when consumers are reliant on gas to heat their homes. However, we understand that significant change in government policy on environmental legislation or heat could affect our proposals. For these compressors we would support a reopener in year two of the price control. Please see Annex A29.02 relating to our proposed uncertainty mechanisms for how these would work in more detail. This is also summarised in table 24.13 below.

There is a known uncertainty around the EU Emissions Trading Scheme (EU-ETS); the UK government is consulting on the future of the scheme in light of uncertainties around Brexit. These costs are factored into the CBA for compressor investments. However, it is unlikely that these changes would be significant enough to change a proposed build solution.

Table 24.13 uncertainty mechanism compressor emissions compliance

UM name	Type	Business plan proposal – what the UM addresses	Frequency
7. **Compressor emissions**	Reopener Upfront allowance & Totex incentive sharing applies for known work with defined outputs.	Reopener for costs relating to compliance with emissions directives.	Year 2 of price control True up at end of period

7. Our proposed totex costs for RIIO-2

We propose to spend £256m on meeting our compressor emissions legislation requirements in RIIO-2.

Table 24.14 spend compressor emissions compliance

	2022	2023	2024	2025	2026	Total RIIO-2	Annualised RIIO-2	Annualised RIIO-1
Compressors – emissions legislation (£m)	46.2	46.2	65.2	48.4	50.3	256.3	51.3	37.8

Our proposals will be further tested against network capability and updated to reflect stakeholder requirements in October 2019.

These costs may change in the next iteration of the business plan as we refine the compressor proposals. Linked to this there will be associated changes on impacts on asset health and cyber costs in other areas of the plan.

Climate change: our climate commitment

1. What is this sub-topic about?

This sub-topic is about delivering consumer value by reducing our impact on climate change.

Our climate is in crisis. The Committee on Climate Change (CCC) predicts that, without intervention, global temperatures could rise by as much as 7°C over the next century, exposing Britain to increased inland and coastal flooding, water scarcity and heatwaves. The scale and impact of these events on our population will be dramatic; if we don't respond urgently we will fall far short of our responsibility to future generations to protect our society and environment from irreparable damage.

We fully support the UK government's ambitions to achieve Net-Zero carbon by 2050. As an industry we believe we have the greatest responsibility to address our climate challenge urgently. More fundamentally, we believe that business has a responsibility to lead the transition and secure the investment and shift in consumer attitudes needed to deliver it.

Emissions of greenhouse gases such as carbon dioxide and methane are harmful to the environment. As a gas transmission business, our normal business activities contribute to these emissions. There are ways we can reduce them, ranging from taking actions targeted at particular types of emissions such as methane, to embedding the principles of carbon reduction in our everyday business practices. We are mapping our risks and opportunities from climate change and will be working to reduce these, in line with the recommendations from the Task Force for Climate Related Financial Disclosure. We will also propose incentives to drive performance and innovation in this space.

This part of the chapter will cover:

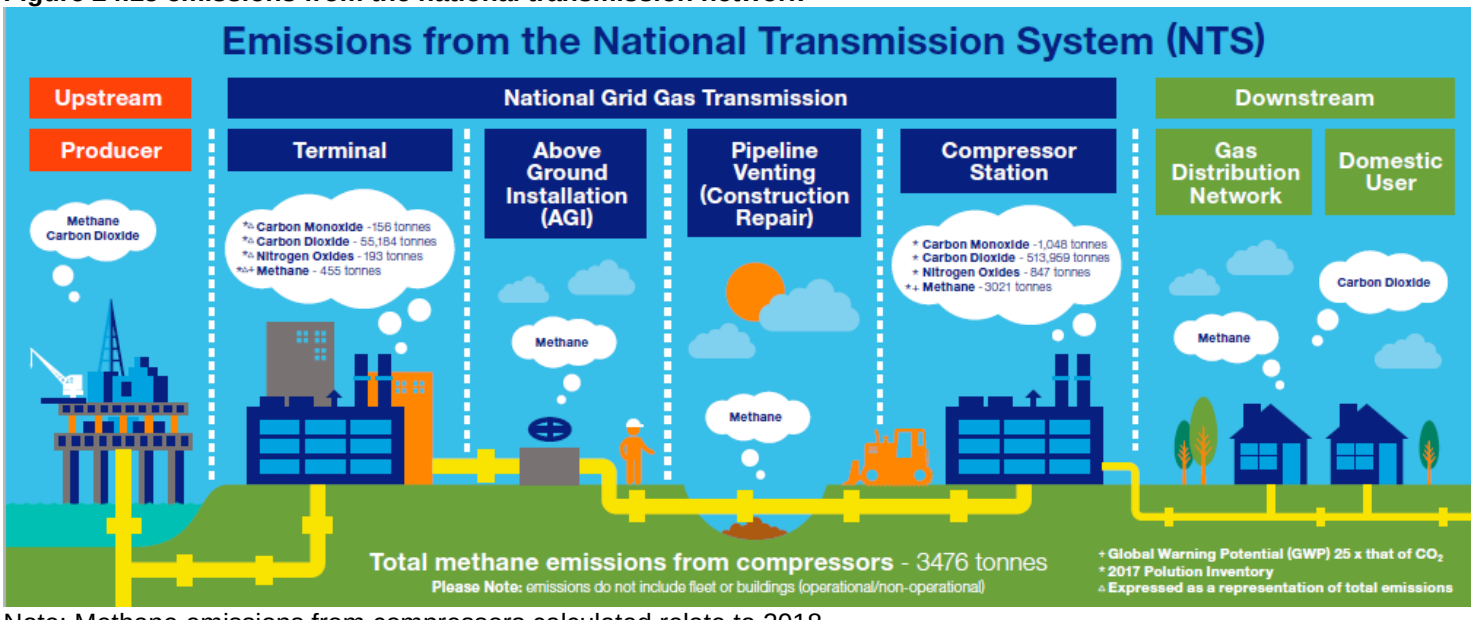
- targeted activities relating to direct and indirect emissions
- reducing emissions associated with our business e.g. offices and fleet
- reducing shrinkage on the network by reducing methane emissions.

2. Our activities and current performance

Emissions of Greenhouse Gases (GHGs) from our assets

Emissions that are produced from the network are shown in figure 24.15 below.

Figure 24.15 emissions from the national transmission network



Note: Methane emissions from compressors calculated relate to 2018.

NOx - Nitrogen oxide(NOx) emissions are addressed through relevant emissions legislation in the previous part of this chapter 'air quality – compressor emissions compliance'.

CO_2 - Carbon dioxide emissions result from the operation of our compressor fleet. The carbon emissions from our gas-fired compressor units are subject to the EU Emissions Trading Scheme (EU ETS). This is a market-based cap and trade programme that applies a carbon price to emissions. We have bought additional credits in three of the last five years to cover our carbon dioxide emissions, because, in those years, we have had to use compressors more frequently due to changes in supply and demand patterns. We also report on carbon dioxide emissions via our Business Carbon Footprint (BCF) reporting[80].

Methane - Methane, which has 25 times[81] the global warming potential of carbon dioxide, is also emitted through many of our activities. We are currently incentivised to reduce methane from compressor venting activities through our GHG incentive. This is a challenging downside-only incentive that converts methane emissions into carbon dioxide equivalent and uses a non-traded carbon price, sometimes referred to as the 'social cost of carbon'. Our performance in RIIO-1 demonstrates the level of challenge. During RIIO-1 there was some performance improvement in the initial years of this incentive being set. However, there have been some years where, due to changes in supply and demand patterns and the needs of our customers, venting on compressors has had to be carried out more frequently. This has led to higher than anticipated emissions in relation to this incentive in some years and we incurred penalties. Further information on how this incentive has been set and how we have delivered against it in RIIO-1 can be found in Annex A29.03.

During RIIO-1 we set up the Monitoring of Real-time Fugitive Emissions (MoRFE) project to better understand leaks from equipment on the network. This project is being funded through the Network Innovation Allowance (NIA) and it will identify and quantify methane emissions, accurately and cost effectively. Starting in four locations MorFE is being used to test against a set of project criteria. If it proves successful, it will be rolled out across all compressor stations to provide a network of real-time detection equipment for methane leaks.

Shrinkage (system losses and unaccounted for gas)

Shrinkage represents a financial and environmental cost to consumers both in terms of cost for all elements and in terms of methane leaked into the atmosphere through losses related to operation of the network and unaccounted-for gas. During RIIO-1 we were incentivised to reduce the cost of shrinkage to align our interests with those of the end consumer. We performed well in reducing these losses during the price control period by taking risk on price and volume. For example, without these actions, costs would have been increased in the range of £2-12m in 2017/18 compared to target. Therefore, both National Grid and end consumers have benefited by actions we have taken to perform against this incentive. Please see Annex A29.03 for further information on this incentive and RIIO-1 performance against it.

Whole life carbon

Our policy is to implement carbon pricing in our investment decision-making processes. This means that we don't only consider the capital cost of new assets but the carbon cost of them as well. We'll roll this out in the gas transmission business during the 2019/20 financial year and it will be in place by the beginning of RIIO-2. We have also worked in RIIO-1 to reduce our capital carbon from construction.

Supply chain

We engage with 250 of our most carbon-intensive global suppliers annually with a target of 80% response rate to complete the Carbon Disclosure Programme (CDP) supply chain submission. We achieved an 85% response rate in 2018 and have received an 'A' for our supplier engagement rating as a result of this. We work collaboratively across industry to share best practice in this space and we are members of initiatives such as the Supply Chain Sustainability School, United Nations Global Compact, Achilles UVDB, among others.

3. What our stakeholders are telling us

We have received a great deal of feedback from you about our climate commitments, particularly in relation to emissions and air quality. When asked "Should National Grid Gas Transmission do more, continue as is or do less to manage emissions?" everyone said we should "Do more to manage emissions". Some stakeholders also felt we should

[80] https://www.nationalgrid.com/group/responsibility-and-sustainability/our-progress/our-performance/performance-environmental

[81] IPCC figure https://www.ipcc.ch/report/ar5/syr/

reduce emissions and carbon offset all construction activity.

> *"You would need funding to be able to deliver low carbon emissions e.g. through the price control"* [redacted]

You also shared your views around the desire to see an increased focus on methane.

> *"Would like to see more focus on methane emissions such as there are in Europe"* [redacted]

In terms of incentives, we received feedback related to managing our vented compressor emissions. The key point from this was the importance of getting the right framework for an emissions incentive to deliver maximum benefit to consumers.

Regarding carbon, we received the feedback that we should be applying a single cost of carbon in our decision-making processes. We have adopted carbon pricing in our decision-making processes and will be clear about where it is not possible to use consistent pricing due to legislative requirements etc.

You said you support moves to decarbonise our vehicle fleet, with one stakeholder suggesting a 2030 target was appropriate while others felt this should be phased in as vehicles came to the end of their life. Support was also given for generating own-use electricity on site from renewables.

We also heard from our February stakeholder playback consultation that working with our supply chain in environmental matters is important.

We will be doing more work with consumers to understand the level of ambition for us to manage our global emissions alongside our other commitments. Outputs from this will be available for the next iteration of the business plan.

Your detailed views are set out in our engagement log in Annex A24.06.

4. Our proposals for RIIO-2

We aim to reduce the GHG emissions our business produces. We will do this on a carbon dioxide equivalence basis because methane is about 25 times more damaging to the environment than carbon dioxide.

Emissions from our assets

NOx **-** meeting compliant levels of NOx emissions from our compressor fleet is addressed elsewhere in this chapter in 'air quality – compressor emissions compliance'

CO_2 – we don't anticipate that our CO_2 emissions will reduce significantly as a result of compressor investment; technological advances in the compressor space focus on NOx rather than fuel efficiency. However, we will continue to participate in the EU ETS as required and use this as an opportunity to provide focus on our CO2 emissions across the business.

Methane - industry focus over the last couple of years has pushed methane emissions up the environmental agenda and this is reflected in your feedback. This implies we should be treating all emissions the same. During RIIO-2 we will establish a baseline for methane emission leaks on the network through improved monitoring using equipment trialled as part of the MoRFE RIIO-1 innovation project and use that information to understand how to begin to reduce these where possible. This is important in the path to achieving Net Zero by 2050.

Whole life carbon

We will also continue to use a single consistent carbon price in our investment decisions for each tonne of controllable carbon dioxide equivalent (CO2e) emitted. Using a carbon price is an effective way of weighting carbon in the decision-making process so it can be considered alongside all other factors.

Other emissions associated with our business

This covers emissions where we have some, or full control.

In RIIO-2 we will trial low carbon fuel vehicles with the commitment to rolling out to 30% of our commercial vehicle fleet by 2026. This will enable a smooth transition to full roll-out by 2030, delivering consumer benefit through reduced local air pollution from particulates.

We will also reduce indirect emissions from electricity generation for our own use on operational sites. We are committing (where practical) to deploy renewable generation on our sites for our own use.

In addition, we plan to:

- continue to reduce the carbon impact of our construction activities, and will seek to offset any residual carbon emissions in 2025-2026.

- progress our work with our supply chain through the CDP submission by setting targets on the number of suppliers with their own carbon reduction targets
- embed sustainability and low carbon requirements in the tender process to select carbon efficient contractors and supply chain partners, including for 75% of our top 250 suppliers to have carbon reduction targets reported through the CDP climate change supply chain programme
- select contractors who demonstrate they will be more sustainable and deliver lower carbon projects by including sustainability in our tender process
- reduce carbon emissions through sustainable energy procurement for energy used in office buildings.

Output delivery incentives

We have summarised the incentives in this part of the chapter as follows. They are addressed in more detail in our incentives annex A29.03:

Table 24.16 incentives relating to climate change: our climate commitment

Incentive name	Type	Business plan proposal
NTS shrinkage	ODI financial	Retain scheme with potential improvements to drive further consumer savings for RIIO-2. Incentive set with appropriate rewards and penalties to meet the needs of consumers.
Environmental action plan	Potential ODI or PCD	A requirement from Ofgem's May decision, across all sectors, was the delivery of an Environmental Action Plan and Annual Environmental Report. This is new for gas transmission. We have included an initial draft EAP in our submission. This is in early stage development, is due to be updated as per Ofgem's revised guidance, and stakeholder views will be sought.
GHG emissions (venting)	ODI financial	Retain scheme with incentive set with appropriate rewards and penalties to meet the needs of consumers. Include upside to encourage further performance improvements. Potentially develop further as part of broader environmental incentive package.

5. How will we deliver?

Emissions from our assets

We will measure and reduce methane leaks on our network by:

- Following on from MoRFE, installing real-time methane monitoring equipment at the highest risk areas of the network (compressor stations). This will give us accurate emissions readings at these locations, improving intelligence for maintenance and asset health programmes and providing the basis for more accurate emissions reporting.
- Using innovative recompression equipment at points in maintenance works that require pressure reduction through gas venting. This will prevent more methane from escaping to the atmosphere, which will be even more important in RIIO-2 due to anticipated higher workloads.

Other emissions associated with our business

To reduce our carbon emissions from transport, we will start a trial of low carbon vehicles and install electric vehicle charging infrastructure on operational sites. We will learn from this trial and seek to replace 30% of our commercial vehicle fleet with low carbon-fuelled vehicles by 2026.

We are committed to deploying renewable technologies and we will install solar panels on our compressor sites to generate own-use electricity.

We will

- achieve carbon neutral construction for major projects by 2026 by following an external framework to reduce our capital carbon from construction as much as possible, then offset the remaining emissions
- buy 100% of our energy from renewable tariffs where available, and where possible replace

other fuel sources such as diesel for generators with low carbon fuels
- target 75% of our top 250 suppliers to have carbon reduction targets reported through the CDP programme.

Output delivery incentives

GHG (venting) incentive, Business Carbon Footprint reporting and Environmental Action Plan

We believe that the GHG and BCF reporting incentives have provided an opportunity to focus efforts to deliver significant societal benefit for consumers at global level with regards to reducing our carbon footprint. However, we do not believe a downside-only incentive is the most appropriate way to incentivise this. Beyond our current GHG incentive, Ofgem proposes an Environmental Action Plan and we agree there could be further consumer value from incentives on our wider environmental impacts. During this business planning cycle we intend to work with you to better understand how this might work.

Shrinkage (system losses and unaccounted for gas)

We propose to retain the shrinkage incentive in RIIO-2. Shrinkage represents a cost that is borne by customers and ultimately by consumers, and the incentive provides for a closer alignment of all interests since we are exposed to a proportion of those costs.

We believe there may be opportunities to make some incremental improvements to the design of this incentive. We will work with you in the next few months before we submit our final business plan to understand potential for improvements in this space.

6. Risks and uncertainty

We believe it is important to reduce our emissions as much as possible, and this aligns with your feedback. We propose to use recompression equipment to help us reduce methane emissions during asset works. However, there will be a residual amount that cannot be recompressed, and it would therefore need to be vented. Black box flaring is a technology we haven't used before and it could further reduce methane emissions. We would have to install vents which enable combustion of the vented gas to produce CO_2 instead of methane, with reduced environmental impact. We need to do more work to understand if this would deliver consumer benefit and we will seek to explore the costs and application of the technology in the run up to RIIO-2. We will also continuously look for innovative techniques to further improve performance and delivery to meet your needs and those of end consumers.

Our work to enhance our understanding of methane emissions from our network will stand us in good stead should there be further tightening of emissions legislation in this space.

In terms of other uncertainties, there is a known uncertainty around the EU Emissions Trading Scheme; due to Brexit the future of the scheme is being consulted on by the UK government. The outcome may increase costs for us as a business in meeting our climate change commitments, but this is currently unknown.

7. Our proposed totex costs for RIIO-2

We are requesting £12.5m across the RIIO-2 period to reduce the impact we have on climate change. Of that, £0.4m relates to deployment of renewable generation on our operational sites, and £0.9m to rolling out low carbon-fuelled vehicles as part of our fleet. It also includes support staff for delivery of our environmental commitments.

The largest expenditure in this chapter relates to methane monitoring and recompression, and the proposed expenditure for RIIO-2 would be approximately £5.3m. This will deliver long-term value for consumers by allowing us to identify leaks and make repairs earlier, reducing venting quantities.

Table 24.17 spend 'our climate commitment'

Activity spend	2022	2023	2024	2025	2026	Total RIIO-2	Annualised RIIO-2	Annualised RIIO-1
Methane monitoring	4.7	0.2	0.2	0.1	0.0	5.3	1.1	0.0
Methane recompression equipment	0.1	0.1	0.1	0.1	0.1	0.4	0.1	0.0
Fleet emissions reductions	0.2	0.2	0.2	0.1	0.1	0.9	0.2	0.1
Renewables on site	0.1	0.1	0.1	0.1	0.1	0.4	0.1	0.1
Support staff	1.1	1.1	1.1	1.1	1.1	5.5	1.1	1.5
Total spend	6.2	1.7	1.7	1.5	1.4	12.5	2.5	1.7

Responsible asset use and caring for the natural environment

1. What is this sub-topic about?

This topic delivers consumer value through reusing sites and materials once they are no longer required for operational purposes and improving the biodiversity of land on and around our sites.

The UK government's 25 Year Environmental Plan, published in January 2018, sets out a comprehensive long-term approach to protecting and enhancing the environment. The vision at the heart of the plan is that the current generation will be the first to leave the environment in a better state than they found it. As an asset-based business, the impact of our assets on the environment is incredibly important. This impact can be minimised through responsible procurement and construction processes, reusing and recycling assets and materials where possible and being responsible custodians. We will look to enhance the environment on and around our sites where appropriate in the interests of consumers.

Our network is getting older and we are faced with a challenge about how we should manage redundant assets in a way that is in line with our environmental and sustainability goals and delivers value for consumers. Assets become redundant for a number of reasons. The needs of stakeholders or individual customers may have changed, legislation changes may mean that assets can no longer be used, or investment in new assets may mean that life-expired assets are no longer required. We are anticipating more work in this area, exacerbated by the changing uses of the network.

Looking at the current network and anticipated requirements, we have identified 77 sites, asset groups or single assets that are already redundant or will become so during RIIO-2. This represents a small proportion of our asset base such as 132km of our 7660km pipeline network and 3 out of 240 block valves. We will continue to monitor operational assets using our normal annual planning processes and when customers tell us of a change in system use so more assets may become redundant before and during RIIO-2. Our approach to addressing redundant assets should be driven by our social, economic, health and safety and environmental responsibilities. We are also mindful that there may be increasing mandates set by government in this space in the future.

We have considered what we should do with these types of sites. Broadly, our options are:

- **Do nothing**. We would still incur maintenance spend.
- **Disconnection.** Disconnecting the asset or site from energy supplies and leaving it in place, with expenditure to ensure the site environment remains safe.
- **Decommissioning**. Disconnecting the asset or site from energy supplies and removing part or all of the asset. Assets could then be re-purposed or the materials could be sent for recycling.

In this section we will describe our commitments around land and resource use and improving

biodiversity as well as how we are embedding sustainability into the supply chain.

2. Our activities and current performance

Redundant assets

We have spent more than our allowances in RIIO-1 (£13.15m compared to £12.41m) as we have seen more customer disconnections than anticipated. Unless specified in customer connection agreements, the costs of decommissioning fall to us. We also had unanticipated expenditure on rationalisation of Paull AGI which was not in our original business plan. However, this was partly offset by deferring the removal of Feeder 1 as this decommissioned pipeline was too close to our Feeder 9 Humber river crossing to be able to carry out work safely.

Land and resource use

Over RIIO-1 we have worked to improve our non-operational land. To do this we have developed sustainability action plans for five sites.

National Grid also has a strong history of supporting local communities. One way we do this is by managing our non-operational land in innovative ways. In 2015 we developed an innovate tool to recognise and account for the value of benefits provided by these natural assets, both to National Grid and our neighbours and communities, and this approach is called Natural Capital. A natural capital valuation is an assessment that looks at the services we get from the natural environment - e.g. air quality, visual screening, noise, wellbeing, flood defence - based on the habitat. We cost these services and this gives us the natural capital value. It is a way of monetising these services to effectively incorporate them into decision-making.

We are reusing and recycling materials. From a group perspective, in the last year, we reduced waste (in tonnage) from our offices by 20% and eliminated 8 types of single-use plastic from our main head office site. We already divert 100% of our office waste from our main sites away from landfill.

Supply chain

In line with our approach on responsible asset use and caring for the natural environment, we have a supplier code of conduct which sets out how we expect our suppliers to operate.

3. What our stakeholders are telling us

Redundant assets

We received feedback from you that doing nothing in this space is not acceptable. We asked as a principle if current or future consumers should pay for demolition of assets that are no longer required for operational use. Eighty-seven per cent of you told us that we should prioritise projects on a risk basis and maintain the remaining assets until the point of removal, then share costs between current and future consumers. A further 10% told us we should deliver it all in RIIO-2 even if it means costs for current consumers are increased. Only 3% believed we should defer all works and pass the costs on to future consumers.

> *"From a societal fairness view you should pay now. Passing on the cost doesn't seem socially fair".* [redacted]

There was general agreement that assets and land should be reused wherever possible, and you told us that we should seek to repurpose pipelines and not remove them until it is clear they are not likely to be reused.

> *Use redundant pipelines for electricity cables or water rather than removing/scrapping* [redacted]

> *Which other utilities can we engage with to re-life or re-use our redundant assets? Fibre, carbon capture?* [redacted]

We also received feedback about the visual impacts when assets aren't decommissioned, and you asked us to consider the societal impact on local communities when considering what to do, particularly with above ground assets.

We have asked you specific questions on redundant assets as part of our stakeholder engagement, and you can find our engagement log in Annex 24.07.

Land and resource use

You encouraged us to consider returning land to a good state when we have used it.

> *"Want to see the decommissioned sites/land returned to a good state for community benefit. Returned to good as a bare minimum"* [redacted]

We are now talking to consumers to understand their views on using sites once assets have reached the end of their life, and how we should use land around

our sites. We will incorporate feedback from this in the next iteration of our business plan.

Supply chain

In our February stakeholder playback consultation you told us that we should consider our supply chain practices and their impacts on the environment and communities.

4. Our proposals for RIIO-2

Redundant assets

We believe it is important to address redundant assets in RIIO-2 and propose to address the 77 identified sites, assets or asset groups during this period. We propose these are addressed under a price control deliverable, as set out in Annex A29.01 and summarised in table 24.18 below:

Table 24.18 Output summary redundant assets

PCD name	Business plan proposal - what the PCD measures	Related UM	Supporting info
5. Redundant assets	Address redundant assets across 77 sites, assets and asset groups	-	Justification report (Annex A24.08)

We feel that deferring these actions would not be in line with the direction of travel from government policy or stakeholder feedback. Future costs and requirements for decommissioning are uncertain as legal requirements around them are subject to change. Therefore, there is a potential that the impact of delaying this work could result in increased costs through more stringent specifications for the management of waste from decommissioned assets, and for the remediation of land or higher costs of disposal. Any increased costs would be passed on to future consumers who have not had the benefit of using those assets and, if delayed for many years, could fall on a smaller number of consumers who haven't benefited from the assets.

Based on the environmental impact of our redundant assets our opinion is that addressing these now rather than later is the correct approach to take. We plan to develop a programme to prioritise action on assets that pose greatest environmental and safety risks and to comply with our contractual obligations.

When assets become redundant, we commit to considering how they could be reused for existing and future customers before disposal. Based on your feedback about what we should be doing around the re-purposing of assets, we are mindful that the future needs of network users may change. This is likely to be particularly relevant for pipelines. The few small sections of pipelines identified as redundant are predominantly customer driven. Physically removing redundant pipeline can be disruptive for the environment and costly, therefore as well as potential options for reuse, leaving pipelines in place isolated and made safe reduces the environmental impact and saves money for end consumers. We will reassess these pipelines for RIIO-3.

Where whole sites are affected, we will remove equipment totally, and for partial sites reduce to ground level. On top of this, we will take proactive steps to return redundant sites to a better state than they were in before, in line with government strategy and stakeholder feedback.

Land and resource use

Throughout RIIO-2 we aim to expand our work to improve non-operational land around our sites. We propose baselining the natural capital and biodiversity unit value of our non-operational land and to set a target to improve this year on year. Working with local partners such as wildlife trusts, we will try to change how we manage our land to deliver benefits both for our business and for the natural environment.

Our construction activity also has an impact on the local environment and biodiversity. We supported a Construction Industry Research and Information Association (CIRIA) working group to develop industry guidance 'Net Gain Best Practice Principles' for how to approach to net gain in biodiversity and have been working to embed it as a requirement on our major construction projects. Throughout RIIO-2 we will continue to expand on this by ensuring all our construction projects result in a net gain in environmental value.

In terms of waste, we will increase the recycling rate at our offices by 60% and deliver a 20% waste tonnage reduction target for our offices by 2025-26. We will also seek to minimise waste in construction activities through achieving zero waste to landfill, increasing the amount of recycled materials used in construction projects and reduce the waste intensity of our construction projects year on year.

For our main offices, we will develop a 2019/20 water use baseline, against which we will set a 20% water use reduction target, to be achieved by the end of the RIIO-2 period.

Supply chain

We will embed sustainability and responsible sourcing in the procurement tender process even further and be more proactive through our contract management processes in RIIO-2 in holding our suppliers to account in relation to the code of conduct.

5. How will we deliver?

For redundant assets, we propose a Price Control Deliverable (PCD), and this can be found in Annex A29.01. In summary, it will address work across the 77 sites we've identified so far as well as any others we identify during RIIO-2. Within this PCD we propose to build in flexibility so that we can respond to newly identified changes by removing the highest risk (commercial, safety or environmental) assets first. The justification report for the work being undertaken under this proposed PCD can be found in Annex A24.08.

As part of decommissioning activities, we will return sites to a more natural state. This contributes to restricting the general biodiversity loss, which is currently accelerating around the globe; it controls the risk of ground and water contamination and promotes environmental net gain.

We will continue to embed our values around sustainability into the supply chain. We will ensure that tenders are all assessed against a set of prequalification questions about sustainability to make sure we take relevant metrics into account.

6. Risks and uncertainty

During RIIO-1 more assets became redundant than we'd anticipated so we have completed an exercise to understand how many redundant assets we should expect over RIIO-2. However, the final number will be influenced by customer behaviour. Where possible, we will recover costs from customers but, as many of our older contracts don't allow this, we propose the allowance enables us to re-prioritise smaller projects based on risk.

7. Our proposed totex costs for RIIO-2

For our work on responsible asset use and caring for the natural environment we anticipate a spend of £73m across the RIIO-2 period as per Table 24.19 below.

We will commit to funding costs for other elements of this chapter such as sustainable procurement and biodiversity investments from within the wider business and so we are not requesting specific funding for these activities during RIIO-2.

Table 24.19 – Spend 'redundant assets

	2022	2023	2024	2025	2026	Total RIIO-2	Annualised RIIO-2	Annualised RIIO-1
Redundant assets spend	19.6	13.1	20.0	10.7	10.0	73.3	14.7	2.7

Quarry and loss

1. What is this topic about?

We have contractual relationships with owners of the land that our pipelines pass through. As part of these contracts we are liable for the impact of our pipelines and this includes a responsibility to compensate and make good where the presence of a pipeline affects drainage or crop production. Some contracts require us to divert our pipeline if the land is needed for other purposes such as quarrying or development.

2. Our activities and current performance

We are committed to honouring these long-standing contracts. However, we have well-established processes to validate the claim and challenge the amount of any compensation when landowners apply for it. In each case we adopt the solution that delivers value for consumers. For example, we might make annual payments, make full and final settlements, or carry out investigation and repairs (e.g. for drainage issues). During RIIO-1 we made a number of full and final settlements (106 at the time of our reopener submission) and these reduce some elements of our RIIO-2 liabilities.

Funding for this suite of activities during RIIO-1 was provided via a quarry and loss reopener rather than through ex-ante funding. Ofgem observed during the RIIO-1 reopener that some of our costs in this space were predictable and therefore should be part of funding in the future.

3. What our stakeholders are telling us

We understand that a key stakeholder priority is for us to be efficient and affordable, and this principle feeds into driving down costs wherever possible.

4. Our proposals for RIIO-2

We will continue to work with landowners to meet our legal and contractual obligations relating to the presence of our pipeline network. This will cover issues such as loss of crop, impacts on drainage, loss of development or restrictions on extracting minerals.

5. How will we deliver?

We will deliver the best possible value for consumers while ensuring our legal obligations relating to quarry and loss are met. As in RIIO-1 we will negotiate outcomes that keep costs low in the long-term, such as the use of full and final settlements.

6. Risks and uncertainty

We are requesting funding for £19m for costs relating to compliance with our contractual requirements. However, for loss of development and costs relating to loss of mining of sterilised minerals we propose to retain an uncertainty mechanism in case these breach the base revenue funding requested. This avoids us being subject to a windfall gain or loss because of circumstances that we can't control or predict. This uncertainty mechanism proposal is outlined in more detail in Annex 29.02 and is summarised in Table 24.20 below.

Table 24.20 uncertainty mechanism 'quarry and loss'

UM name	Type	Business plan proposal – what the UM addresses	Frequency
6. Quarry & loss development	Reopener Upfront allowance & Totex incentive sharing applies for known work with defined outputs.	Reopener to deal with unpredictable loss of development and mineralisation costs.	Year 2 of price control True up at end of period

7. Our proposed totex costs for RIIO-2

Table 24.21 spend 'quarry and loss'

Activity Spend	2022	2023	2024	2025	2026	Total RIIO-2	Annualised RIIO-2	Annualised RIIO-1
Quarry and loss (£m)	4.3	4.4	4.4	3.0	3.0	19.1	3.8	5.3

Supporting the communities we work in

"Our purpose is to bring energy to life. In its simplest form 'Bring energy to Life' means getting the heat, light and power that customers rely on for their homes and businesses. But for me 'life' also means supporting the communities that we are part of and live amongst to support economic growth and the sustainability of wider society" ***John Pettigrew, Chief Executive Officer***

1. What is this sub-topic about?

We have an impact on many communities when we carry out work such as new connections or refurbishments. The expectation from external stakeholders, shareholders and communities affected by our work is that we should 'give something back'. Our purpose, vision and values articulate our desire to exceed the expectations of communities.

Our citizenship work through our employee volunteering and fundraising programmes supports charities and community organisations. We also give grants to community groups, so they can deliver a range of social, economic and environmental benefits.

2. Our activities and current performance

We have built on our track record for supporting communities in all these ways and worked on a number of activities that support wider society, including social mobility projects.

Highlights of National Grid's activities during RIIO-1 include:

- investing £103m (so far) for 32,000 first-time central heating systems for vulnerable households across England, Scotland and Wales through the Warm Homes Fund
- launching a pilot programme called 'Grid for Good', which is a social mobility project to connect those in need to support services and networks. We are currently running a pilot to help us define the initiatives that could offer the best value for communities
- partnering with designated charities each year including Macmillan Cancer Support, the Alzheimers Society and City Year UK, raising £2.24m for partnered charities in RIIO-1 to date
- encouraging and supporting 5,000 employee volunteering hours and providing £1.13m to their chosen charities in matched giving
- awarding £1.2m in grants for communities located near to (or impacted by) our business activities
- spending more than 2,500 hours with young people to inspire them about science, technology, engineering and maths (STEM) subjects
- implementing human rights and supply chain due diligence strategies (including meeting modern slavery and conflict minerals commitments). We are now 12th in the FTSE100 Modern Slavery rating index
- supporting the government's Inclusive Economy Partnership to protect and improve mental health and equip people to get back to work
- being a member of the Living Wage Foundation and promoting commitment to the real living wage, both in our organisation and in the wider supply chain
- delivering the Energy & Utility Procurement Skills Accord commitments, which promote skills development and work towards bridging the skills gap in the energy sector; we received a recognition of our contribution
- committing to align with the government's own targets by awarding 33% of annual spend to small and medium-sized enterprises (SMEs) by 2020
- promoting local employment by using the CompeteFOR tool for major projects with packages of work advertised to the local supply chain
- managing our environmental education centres with 35-40k visitors on average per year
- providing grants for community projects that are focused on delivering local social, economic or environmental benefits, where communities are affected by our work
- managing EmployAbility, an employee-led supported internship programme for young people aged 17-25 years with special educational needs. In 2018/19 we provided 13 placements at three of our office locations. We have achieved great results so far with 68% of our supported interns going into paid employment.

3. What are our stakeholders are telling us?

We asked you about our role in local communities. Sixty per cent of respondents told us that we should do more with local communities while 40% said to continue as we currently are.

We also asked you who should be funding our activities in this space, and we will do the same thing with consumers in our Willingness to Pay research. The results will inform the next version of the business plan.

We have also done some new, evidence-based research to understand consumer preferences and what the resulting business behaviours are, to inform how we should direct our activity. This cultural analysis, combined with our team's research into Total Societal Impact (TSI), has concluded that the biggest positive societal impact will be felt if we focus on clean electricity, transport and heat. We know you are concerned that vulnerable and fuel-poor consumers are at risk of being left behind when major infrastructure changes take place so we will focus our societal impact work on mitigating these effects.

4. Our proposals for RIIO-2 and how we will deliver

We will reduce and simplify our RIIO-1 period initiatives to make sure that we prioritise the activities that offer the most value for society. We have signed the Social Mobility Pledge which means that we will work towards accreditation as well as adopting apprenticeship and employee recruitment practices that promote a level playing-field. We have other initiatives supporting the social mobility priority. One example, a pilot called 'Grid for Good'' connects people to zero-cost basic needs services in their area. At the same time, the pilot helps them gain key skills – through our volunteering employess, which will support them on the road to achieving meaningful employment. We hope to have further updates on progress in the October submission.

We are dedicated to working with young people, who are the future of our business – and our country. The Engineering UK 2018 report showed that engineering companies will need 203,000 more people with Level 3+ engineering skills every year to 2024. Based on our stakeholder feedback, our plan for RIIO-2 is to build on our current initiatives and work with schools, parents and children, particularly those in more deprived areas. We will promote engineering as a modern, dynamic and desirable career with a great future and continue to support our employees to act as education ambassadors. They can volunteer their time for a range of activities including careers education and work experience.

We work hard so that our construction activities tread softly in the community we impact by listening to local stakeholders, keeping them informed, minimising disruption, reinstating like for like and looking for opportunities to make enhancements for the local community to enjoy. We will assign 0.3% of all major project funding to consumer-led community improvement in locations where we have a presence, without requesting additional funds. Spend for support in areas where we are not building will continue to be discretionary.

We will change our volunteering approach. This will allow all charity and community partners the opportunity to showcase their volunteering opportunities directly to our employees. Employees will then be able to choose to support our strategic goals for supporting social mobility through education and employment, or will have the freedom to dictate support for an organisation of their choice.

Our reach as a business extends beyond our direct impacts. Just as our daily activity drives change, we want our procurement activity to drive a positive environmental, social and economic impact too. We will use our position as a client organisation to drive positive change down the supply chain. Further information on this can be found in our Ethical Procurement Action Plan annex 24.20.

We will continue to embed sustainability and responsible sourcing in the procurement tender process and be more proactive through our contract management processes in RIIO-2 in holding our suppliers to account in relation to the Supplier Code of Conduct. We are committed to providing small and local businesses, minority ethnic, female-owned and diverse business enterprises with an equal opportunity to participate in National Grid's procurement and sourcing processes and so we'll set ourselves the same target as the one the UK government has set itself - to award contracts for 33% of annual spend to SMEs. We care about our business's social footprint and our sourcing strategy can play a part in improving the lives of people in our communities. We plan to continue our activities to implement human rights and supply chain diligence, retain our top quartile performance on modern slavery and employ locally where possible. Where we can, we'll include social enterprises in our sourcing process to contribute to the initiatives they support.

In the UK, we have committed to pay all our employees and contractors working on behalf of National Grid the real living wage as defined by the Living Wage Foundation (LWF) and continue to meet the annual commitments agreed by the LWF. Through RIIO-2 we'd like to make sure our commitments supporting the Living Wage are applied consistently and reach further into the supply chain by requiring sub-contractors beyond tier 1 into tier 2 to apply the real living wage principles and encourage adoption of the Supplier Code of Conduct beyond tier 1. We will also encourage technical skills development in the supply chain.

4. Our proposed totex costs for RIIO-2

We have not requested specific allowances for spend in this area for RIIO-2. This was similar to RIIO-1 where we didn't set RIIO-1 targets to cover citizenship activities but many of our programmes have featured in the annual customer and stakeholder submissions to Ofgem.

Next steps for this priority

- **The following updates will take place targeting the October submission**

- Update our Environmental Action Plan in line with Ofgem's revised guidance.

- **Climate change - our climate commitment** – further develop environmental incentive propositions.

- **Responsible asset use and caring for the natural environment** – Stakeholder engagement relating to Theddlethorpe, make detailed site assessments including asbestos and other environmental issues, update delivery costs for decommissioning following an exploration of innovation options in this space.

- Further results from our consumer research will feed into the October submission.

- Engagement with environmental and procurement experts to ensure our targets are stretching enough and our measures suitable.

The following updates will take place targeting the December submission

- **Air quality - compressor emissions** – undertake preliminary BAT assessments.

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

What is this stakeholder priority about?

We are uniquely placed to drive decarbonisation and digitisation of the gas industry. We 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.

What have you told us

You have said that you want us to take a leading role in driving and enabling the energy transition. However we feel there are only certain aspects, where we feel best placed, to do this. For other aspects we should be collaborating and facilitating. You also want us to be innovative about how we meet the challenges involved, in particular the ones around decarbonising heat.

During RIIO-2 we will:

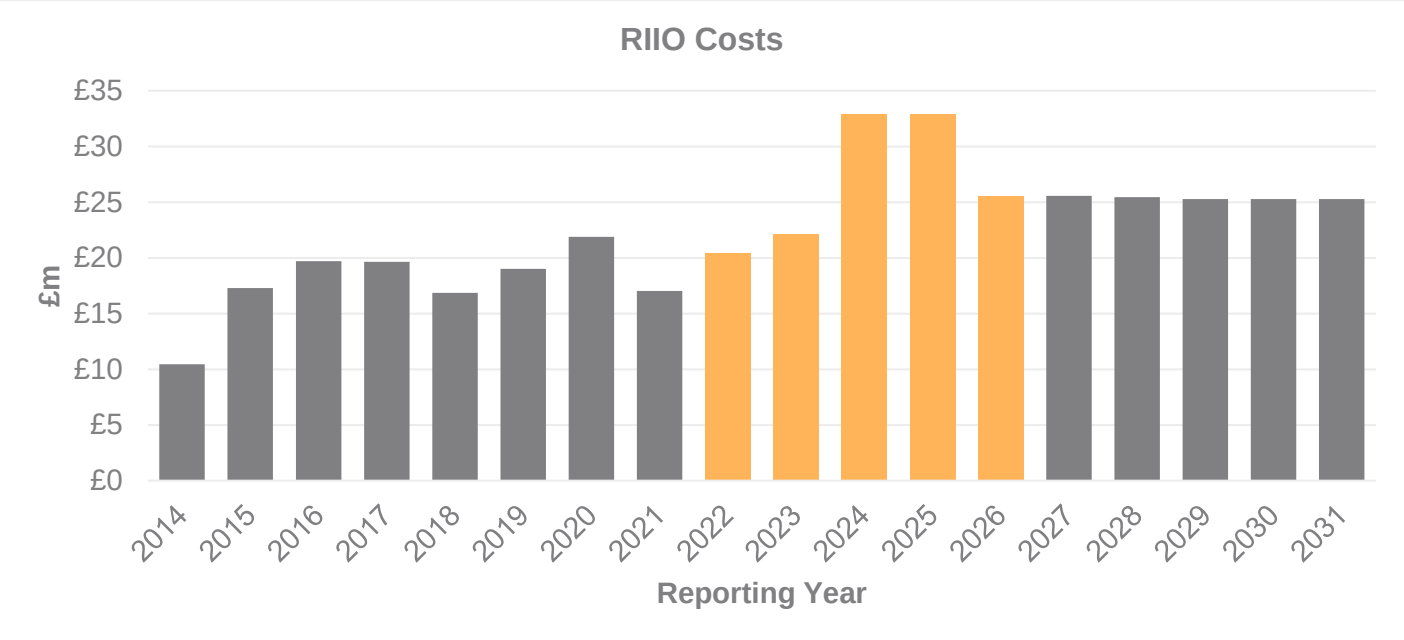
- **lead** on determining what the options are for Gas Transmission for the future decarbonisation pathways.
- **lead** the development of the Gas Markets Plan the development of changes to market codes and frameworks, enabling new fuels and participants to operate and enabling the decarbonisation of heat.
- **lead** innovation across the industry, working with other networks and industry partners to explore solutions in whole energy assets and markets to deliver consumer benefits.
- facilitate industry conversations to understand the most efficient options for the future whole gas system networks, market and frameworks.
- collaborate with the gas distribution networks on the options regarding the transportation of Hydrogen.
- invest in skilled people so we can respond effectively to lead regulatory change and also anticipate future regulatory developments and how these might affect you and our network
- continue to invest in our IT systems, making sure they are fit for the future and enabling you and gas consumers to benefit from digitisation
- replace our current balancing and capacity system ‘Gemini’, making sure it is adaptable for change

We are committed to investing 0.75% of revenue (~£6m p.a.) in business-as-usual (BAU) innovation. We also believe that delivery of innovation on decarbonisation and digitisation should be funded through an innovation incentive allowance. We believe in a regulatory framework that enables and incentivises networks to collaborate and work together and make changes easily when policy decisions are made.[82]These plans may have to be adapted as there is still uncertainty about how to decarbonise the energy landscape and about the future direction for the gas industry.

[82] “It is therefore vital that the business plan is flexible enough to be able to accommodate these developments in a customer-friendly manner – both for those obtaining grid connections and for users of the gas- UKOOG

Overall, to deliver on our proposals in this chapter, we plan to spend on average £26.8m each year with a total spend during RIIO-2 of ~£133.9m. Of this ~£30.9m, we are proposing will be through an innovation incentive allowance and is part of our non-controllable pass-through costs. This is an overall increase from our RIIO-1 annualised spend which was on average £17.7m. The change is mainly due to a forecast increase in expenditure on our capex costs relating to the Xoserve-Gemini replacement. This chapter's expenditure accounts for 3% of the overall RIIO-2 expenditure.

Figure 25.1 RIIO-1 and RIIO-2 spend profile "I want you to facilitate the whole energy system of the future, innovating to meet the challenges ahead"



1.What is this stakeholder priority about?

This priority is about how we can support the gas industry through the energy transition in a way that delivers benefits to consumers.

You told us you want us to lead the whole energy system of the future, driving the decarbonisation agenda forward[83]. You recognise that we must play an important role in this uncertain energy future[84]. You also expect us to look for innovative ways to meet the challenges ahead in the energy transition, especially in decarbonising heat. So, this priority looks at how the industry can decarbonise heat to contribute to Great Britain's progress towards meeting its 2050 environmental targets. It explores our role in the decarbonisation of heat and how we can drive the decarbonisation of the whole energy system.

As well as a focus on energy transition innovation projects, it is clear we also need to ensure that innovation is embedded as business as usual (BAU) wherever possible. This will ensure that solutions are delivered efficiently so that you and consumers can benefit. You also said we are well placed to have a 'say and influence' policy.

In RIIO-2, our proposals aim to deliver on decarbonisation and digitisation to support transition to a sustainable energy system, and ensure that all consumers enjoy reliable, affordable energy. Our proposals will deliver on Ofgem's output category of 'delivering a sustainable network'. Based on what our engagement activities told us, we will deliver this through three priority areas:

- **whole system and market transformation**: enabling and supporting market change and the drive towards a sustainable, decarbonised whole energy future
- **system transformation:** unlocking consumer and customer value through developing the right systems to deliver a digital future

[83] "Role for NG to provide Leadership in decarbonisation of heat" [redacted]
[84] "NGGT has a critical role in the transition a low carbon economy" [redacted]

- **innovation transformation:** driving innovation and increased participation across the energy landscape to help in meeting the challenges of the future while ensuring consumer bills remain affordable.

Whole system and market transformation

1. What is this sub-topic about?

This focus area is about actively working with the industry to decarbonise and enable whole system solutions through cross-sector collaboration.

2. Our activities and current performance

Whole energy system collaboration

During RIIO-1 and in preparation for RIIO-2, we have taken part in more discussions about what the whole energy system is, what the future of the energy system may be and what challenges we should expect around meeting these potential changes.

Good collaboration with other energy sectors is essential to deliver benefits to customers and consumers. We speak regularly with the gas distribution and electricity transmission networks and meet with regulators. Below, we've listed some of the topics that we have worked on, and they are described in more detail in our whole energy system engagement log annex A25.01.

- Future of Gas (FOG)[85]
- Gas Future Operability Planning (GFOP)[86]
- ENA Gas Futures Group (GFG)

At round-table events we've talked with industry partners, promoting how we can work together to enable whole energy system outcomes for consumers and exploring ideas about decarbonising transport[87]. Senior representatives from Ofgem, BEIS, networks, innovators and other energy industry experts took part in these events.

One of the key areas that you say you want us to focus on is the decarbonisation of heat. We are looking at the potential solutions for the future of heat and studying the key inputs required to influence policy decisions that support a whole energy system approach. We're also looking at what we (and industry generally) need to do.

Through Energy Networks Association (ENA) working groups we've contributed to various initiatives from innovation projects to the Future Gas Pathways. We're involved in the Gas Strategy Group, Gas Futures Group, Gas Innovation and Governance Group, Gas Networks Collaboration Forum, Gas Regulation Group and the Stakeholder Engagement Group.

One example of how we have worked across boundaries to look for the best solutions during RIIO-1 is our work with Scotia Gas Networks (SGN) on options to continue to meet our Scotland 1 in 20 winter demand obligations. As described in more detail in our gas ten year statement[88] (GTYS), we have taken these steps to arrive at the best option to meet our obligation:

- SGN assessed the impact and confirmed options on their network
- explored options on our network and combined these with SGN's options
- completed cost benefit analysis (CBA) for all options
- identified preferred options and agreed timing of investment.

This whole system approach highlighted that the best option is for us to carry out works on our network, because this will provide the most benefit to customers and consumers. However, after reviewing the drivers for the work, we decided that it was not in consumers' interests to proceed now. We will review the need for this and other similar works each year.

Delivery and facilitation of gas regulatory change

During RIIO-1 we've been developing and delivering regulatory and market change, focused on GB market compliance with EU legislation driven by the commitment to deliver the Third Energy Package. The work we've done ensured that the changes benefit GB plc and are completed in the least disruptive and most efficient way possible. As the GB transmission owner and system operator, we were responsible for delivering this change on behalf of the wider GB industry.

We have also shared the delivery of efficient and effective code governance, including adopting any future changes driven by Ofgem. To do this, we have taken a leading role in European Network of Transmission System Operators for Gas (ENTSOG) work groups and we speak regularly at other industry events.

[85] http://futureofgas.uk/news/the-future-of-gas-2/
[86] https://www.nationalgridgas.com/insight-and-innovation/gas-future-operability-planning-gfop
[87] 'Link to Utility Week articles'
[88] https://www.nationalgridgas.com/insight-and-innovation/gas-ten-year-statement-gtys

Track record and learning in RIIO-1

During RIIO-1 (up to the end of February 2019) we have raised 61 Uniform Network Code (UNC) modifications. We have also supported customers by providing legal text and/or developing the solutions to their modifications for another 57 UNC modifications. Some of the deliverables that we have supported are:

- gas charging review
- development and implementation of EU codes including constraint management principles, capacity allocation methodologies, balancing and interoperability
- security of supply significant code review.

During the latter parts of RIIO-1, we have led an exploration of future change. It has helped us determine where the medium to long-term focus should be for the gas industry through the future of gas programme[89]. It concluded that gas has a critical role in the transition to a low carbon economy and set out several of our commitments and policy recommendations. One such commitment was the development of a gas market plan (GMaP), which we are implementing now, and we'll continue in RIIO-2.

3. What our stakeholders are telling us

Our conversations with you about this have been wide-ranging and although they were mostly part of our RIIO-1 interactions there were several conversations specifically about RIIO-2. We talked about it via:

- three workshops on 'shaping the future'
- webinars
- four 'future needs of the network' workshops
- a collaborative workshop with other networks
- online consultation with major energy users.

The focus has been on what 'whole energy system' means to you and what we should look to do during RIIO-2.

The following quotes provide a qualitative insight into the views you've expressed. They have been chosen to reflect the majority of views given by stakeholders on the various topics:

"Collaboration in whole energy system – going beyond the high-level energy networks. More collaboration between future scenarios. High as critical to whole business." [redacted]

"National Grid could be more seamless between gas and electricity." [redacted]

"A new service that's of medium criticality is short-term flexibility for power sector, perhaps considering the whole energy system." [redacted]

"Increase the volume of low carbon gas by including hydrogen." [redacted]

"There should be new services for gas in transport." [redacted]

"National Grid need to be future fit, flexible and innovative." [redacted]

The key messages that we have taken away from our stakeholder engagement on 'whole energy', and that have helped determine our proposals for RIIO-2, are these:

1. You support the need for networks and industry to work more collaboratively across sectors, develop regulatory framework mechanisms and influence government policy as part of the cost-effective transition to a low carbon energy future.

2. You would be interested in us playing a stronger role in driving the debate over the future of the UK system. You recognise that networks are in a unique position to drive the whole energy system forward. This led us to organise round-table discussions with industry, networks, regulators and policy makers on discussing the challenges and next steps to facilitating a whole energy system.

3. Decarbonisation of heat is an area of particular challenge and we should support it[90].
4. We should have measures to enable the future energy system[91].

[89] http://futureofgas.uk/news/the-future-of-gas-2/

[90] *"While **half of electricity generation is fuelled by gas**, there is a huge interaction. **The choice between gas & electric heating** for the future will be interesting." ENA workshop*

[91] *"National Grid need to open up interaction and discussion between the two, this could be brought through in the price control for delivery in T3."* [redacted]
"National Grid should be incentivised to continue to facilitate the effective energy system of the future." [redacted]

5. You anticipate that there will be a significant amount of industry change as we move through the RIIO-2 period. You want us to lead the facilitation of industry change within the gas sector and, as a result, the gas markets plan has been developed.

For more information on our engagement see Annex A25.01.

4. Our proposals for RIIO-2

Our proposals for RIIO-2 relating to this focus area will be delivered through two main topics: whole system collaboration and market change.

Whole energy system collaboration

You have said you expect us to take a leading role in driving and delivering the future energy system. You also expect us to continue to work more collaboratively with industry and regulators to develop regulatory framework mechanisms and to influence government policy as part of the cost-effective transition to a low carbon energy future.[92]

Our proposals to deliver this are:

- We will collaborate to find and enable the best whole systems solutions working across all sectors and take a leading role in driving the energy transition through the various ENA working groups. As an example, whole system costs will be reduced at [redacted] site to improve security of supply to 2million consumers and this improvement has been achieved through collaboration at the [redacted] offtake. We will deliver this solution in RIIO-2 and it is covered in more detail in chapter 22.

- We will continue to use our unique position in the industry to drive and influence policy, particularly heat policy, which is due to be updated around 2025.

- We will examine what these changes could mean for us and wider industry. In relation to heat policy, we will be continuing to investigate the impact and effects of hydrogen and working with other networks and third parties on hydrogen-related projects.

- We will partner with other networks and ensure our data, modelling and processes are consistent where possible, and we'll investigate the different pathways for the future energy system. We know BEIS will be publishing a five-year workplan on decarbonisation of heat in summer 2020 to inform policy in 2025. BEIS will need us to carry out some of this work and to provide them with data and analysis.

- We will ensure that there is a joined-up approach to hydrogen projects through the Hydrogen Transformation Group (HTG). This forum includes members from BEIS, Cadent, Wales & West Utilities, Northern Gas Networks, Ofgem, Energy Networks Association (ENA) and National Grid.

- 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 be a leading voice in the ENA open networks whole energy system work group. The work group is exploring four workstreams: customer connections; real-time and day-ahead data; season-ahead forecasts, and least regrets investment.

- We will drive the decarbonisation agenda using forums such as the Gas Transmission Benchmarking Initiative (GTBI) forums to understand how other European TSOs are tackling decarbonisation and look for solutions that will benefit consumers. We will also bring ideas over from our colleagues in the US business where applicable.

Market change:

In RIIO-2 our regulatory change strategy moves from managing change to driving it. You have said you recognise there will be a significant amount of industry change as we move into and through the RIIO-2 period. You want us to continue to play a key role in improving the efficiency of the market through supporting customer modifications, improved modification governance and focusing on the changing need of the gas networks and markets over RIIO-2.

RIIO-1 was characterised by the implementation of the EU's Third Energy Package, which is designed to harmonise energy markets and drive efficiencies. The RIIO-2 period will see increased focus on

[92] *"We support National Grid Gas' proposal to have a greater coordination and facilitation role in the industry and across sectors"* [redacted]

decarbonisation of the energy sectors in which natural gas has traditionally met the energy demand, through EU or UK policy drivers or changing industry trends.

However, the direction and speed of change affecting gas markets and, importantly, efficient operation for end consumers, are all uncertain and this lack of certainty requires us to be flexible.

Decarbonisation drivers have had an impact on the role of gas and this will continue over the RIIO-2 period. The key question for now is how to maintain consumer value from the gas markets as energy markets transition to low carbon. The really big questions about how we will transition are still unanswered, and decisions about heat policy aren't due until around 2025.

We will deliver additional value for GB consumers by taking a leading, facilitating and or collaborating role as appropriate to do so. This will enable us to manage the gas markets' evolution as the role of gas changes and the transition to a low carbon energy system picks up speed.

The GMaP is a new tool that will be central to the way we work collaboratively with you to prioritise, scope and deliver changes to the market that unlock value for industry participants and support the energy transition. More detail of the plan is available on our website[93].

Through the Joint Office of Gas Transporters, we will continue to comply with our obligation (with the distribution networks) to provide code administration for the gas market.

We will accelerate change in our whole energy markets through innovation projects that support the continuing evolution of the gas industry towards low carbon and enhanced consumer value.
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5. How will we deliver?

This is a summary of how we plan to deliver our proposals for RIIO-2

Area	How we deliver
Whole system collaboration	Decarbonising the energy industry is a key driver for the all networks going into RIIO-2. **1.** We believe there should be a mechanism that helps networks to drive greater coordination and collaboration on whole system solutions. We are exploring with stakeholders what mechanism should be in place and how these interact with Ofgem's proposals. **2.** We will collaborate with other networks and third parties to determine the different decarbonisation pathways and the solutions required. **3.** We will continue to take a key role in industry work groups, such as the ENA and open network workgroups. **4.** To deliver and facilitate this, in a flexible and agile way, we will need a team of people embedded within our business.
Market change	We will need people and teams to inform, facilitate and deliver regulatory and market changes. These teams will work on things like UNC modifications, policy and regulation engagement, whole system engagement and coordination between networks, designing and delivering the market of the future.

System transformation

1. What is this sub-topic about?

This focus area is about how we are developing the systems our customers need to flow gas. It is also about how we unlock consumer value through enhancing our IT systems. We've split it into two parts: balancing capacity services and systems, and IT systems.

Balancing capacity services and systems

Shippers are required to book space (known as 'capacity') on the network so they can flow gas. We also need them to tell us when and where they are going to flow the gas, so we can balance the network safely.

The balancing and capacity processes and services we provide are our main interface with shippers, and they are at the core of how the gas industry operates. They support the efficient functioning of the gas market by allowing market participants to balance their portfolio daily and manage their capacity bookings up to 17 years ahead; making informed commercial decisions as well as enabling the efficient physical operation of the network.

[93] http://futureofgas.uk/news/the-future-of-gas-2/

Our services must reflect emerging market rules and requirements. Our ability to update our systems and services to adapt to the changing energy landscape is critical in delivering what you need from us. How we deliver these changes is particularly important for you, as any changes can affect your connected systems and processes. The lifespan of our systems is dependent upon vendors' support policies. The average lifespan is 5 to 7 years, at which point we need to plan to refresh or replace the system. We build our plans (RIIO-1 and RIIO-2) on this basis – given RIIO-1 was 8 years that's why we included two investments in that period.

Gemini is the main system we use to communicate commercial information to/from shippers. Gemini is a system owned by us but managed and operated on our behalf by Xoserve, the gas industry's central data service provider (CDSP). They deliver a full suite of vital services to gas suppliers, shippers and transporters.

2. Our activities and current performance

In our RIIO-1 business plan we said we'd re-platform Gemini at the beginning of the period, replace in the middle and refresh at the end. Instead, we carried out the re-platform forecast at the beginning of RIIO-1 and then a more substantial re-platform at the end of RIIO-1 without replacing the system in the middle.

We chose this option because:

- The volume of regulatory change that we expected did not materialise and we had expected this change would drive the need to replace Gemini. In RIIO-1 our strategy was to manage the change process to ensure implementation was at minimum cost (and required minimum system change). The fact that we didn't have to replace the system demonstrates that we were effective at executing this strategy.
- A re-platform for the Gemini system was enough to maintain support of the system and there were no other technical reasons to replace.
- In the circumstances, the decision to re-platform rather than replace was endorsed by stakeholders at the Gas Operational Forum[94].
- Re-platform rather than replacement has the extra benefit that our options for replacement are kept open for longer, ensuring the solution is as future-proof as possible. If we had replaced in RIIO-1 and then subsequently seen the need for significant functional changes, we might have had to replace the system again before the end of RIIO-2.
- Our stakeholders and Ofgem expect us to explore the most cost effective approach.
- A Net Present Value analysis across three options (Option 1 – re-platform in RIIO-1 and replace in RIIO-2; Option 2 – replace in RIIO-1 and re-platform in RIIO-2; Option 3 – replace in RIIO-1 and replace in RIIO-2) shows the strategy to re-platform in RIIO-1 and replace the system in RIIO-2 is the most cost-effective.

Option	RIIO-1	RIIO-2	NPV
1	Re-platform	Replace[95]	-£31.87m
2	Replace	Re-platform	-£33.06m
3	Replace	Replace	-£60.54m

One of the fundamental principles of the RIIO regime is the totex incentive mechanism (TIM). It incentivises us to ensure we make the right decisions, in the best interests of consumers. Through this mechanism, during RIIO-1 we have shared the outperformance we achieved with our consumers.

3. What our stakeholders are telling us

We have talked in detail about the current capacity and balancing services and system as well as about users' requirements for their provision in the future. We've asked stakeholders how useful the current capacity and balancing services are and also what their functional and non-functional requirements are for a future capacity and balancing system.

We targeted specific groups of stakeholders based on their level of interest/impact and influence on this topic, and we reached them through several channels including a specific workshop, webinars, one-to-one meetings, attending industry forums and surveys.

The three main messages we took from these conversations with stakeholders were: do the basics well, make our lives easier through greater automation and increased reporting functionality, and minimise the impact of change.

[94] https://www.nationalgridgas.com/sites/gas/files/documents/Gas%20Ops%20Forum%20full%20pack%20%20-%20Febuary%20%202018.pdf

[95] The NPV for replacement in RIIO-2 is based on £40m. As discussed in our next steps, this is an indicative number which we are revising and we expect it to be lower than £40m. We will provide full justification and CBA in our October plan.

For more details about this please see the engagement log annex A25.02.

4. Our proposals for RIIO-2

In RIIO-2, the Gemini system will require replacement. This belief is based on the following:

- The system will become unsupported during RIIO-2: The re-platform being carried out in RIIO-1 will only extend support for the system until 2025.
    - The skills and resource required for implementing and testing change are becoming harder to find. As the software becomes older and includes legacy programs, finding people who are familiar with these programs becomes harder and more expensive.
- We rely on software companies to keep releasing new versions, which they will only do while they're commercially viable.
- IT systems generally have a 5-7 year asset life, so there is an expectation that a replace or re-platform programme on our systems will need to be considered, alongside how we need to respond to customer needs.
- The expected volume and pace of regulatory change anticipated in RIIO-2 (which will require implementation via the Gemini system) means that action is required.
    - Since its inception in 2005, our Gemini system has been built up over time in response to evolving regulatory and business requirements, resulting in a very meshed and interwoven system. This makes any change costly and time-consuming because change can't be tested on a modular basis.
    - It's widely agreed that there will be a lot of change in the gas industry in the coming years and the current system can only implement one significant change at a time. Because our RIIO-2 strategy shifts to driving regulatory change (rather than simply managing it) we need a replacement system that supports our strategy.
- Our customer feedback about 'pain points' in the current system. Some of these can be addressed as part of the re-platform and enhancements, while others require replacement.

Our ambition is to implement a new system that is agile to future market change. We need a system that can handle change at minimal cost to consumers and the best way to achieve this is to replace the current system with a bespoke replacement solution. This is the basis of our cost forecast. We are taking forward lesson learnt from our RIIO-1 activities related to this to ensure that we deliver a system that benefits customers as efficiently as possible.

When looking at systems we might invest in, we will look for ones that represent value for money for consumers. That means ensuring systems are flexible when change happens and making sure we consider any innovative solutions. A list of some of our other information system investments we will be looking at can be found in our IT investment plan annex A28.03.

5. How will we deliver?

This is a summary of how we plan to deliver on our proposals for RIIO-2.

Area	How we deliver
System transformation	1. The 'Gemini' system and services, we will be delivering under an upfront allowance. This will allow us to explore other options for their provision, ensuring that these services are efficient, fit for the future, and will benefit the industry and end consumers. Our share of Xoserve costs[96] will be funded through a pass-through uncertainty mechanism. 2. To enhance other IT systems, we will look to deliver this through a combination of upfront allowances and innovation funding.

Innovation transformation

1. What is this sub-topic about?

Innovation is integral to our business. We aim to make things better for customers and communities, while being agile, flexible and responsive and maximising value. Innovation has continued to develop and embed into our organisation across RIIO-1.

2. Our activities and current performance

During RIIO-1, we set out with an ambition to embed innovation into what we do. We've expanded our

[96]This only relates to the share of costs for the Central Data Service Provider services which are provided by Xoserve.

network of collaborators, working with a wider range of third parties with expertise in many technical fields. We have also worked more closely with the other gas and electricity networks to co-ordinate innovation portfolios for maximum benefit to consumers.

We have run innovation calls and attended conferences and other events to talk to third parties and help them understand the opportunities for innovation and how they could get involved.

As a result, we've so far invested £34.4m in 156 projects[97] across Gas Transmission. We have used the funding that's available through the Network Innovation Allowance (NIA) and Network Innovation Competition (NIC). As we have progressed through RIIO-1, we have worked with consultancy firm PwC to become more transparent in tracking the value our innovation projects have delivered. The value delivered from embedded innovation is continually measured and tracked to ensure benefits are realised for our customers. So far, £4 of added value has been realised for every £1 spent[98]. More detail on our innovation value tracking can be found on our website[99].

We also play a key role in the Energy Networks Association (ENA) Gas Innovation Governance group, including taking the chair in 2017. Through this initiative we've been able to get involved in more collaborative projects and share learning. For example, we have collaborated with the gas distribution networks and third parties. We are involved in several innovation projects looking at the transportation of hydrogen as a means to 'greener gas' – a cleaner fuel that can help to decarbonise heat. We are working on two joint collaborative projects with SGN:

- Aberdeen Vision[100]: Feasibility study into 2% hydrogen blending at St Fergus and H2 pipeline and hub at Aberdeen
- Project Cavendish[101]**:** Feasibility study to explore the Isle of Grain's potential to act as a catalyst for hydrogen production and storage, to supply hydrogen to London and the south east of England.

You told us that our costs and timescales can be a blocker to connecting to our network, particularly for smaller, non-traditional gas producers and consumers. In response, we initiated Project CLoCC (Customer Low Cost Connections), a gas NIC project collaborating with three small and medium enterprises (SMEs). The project concluded in 2018 having met its goals of enabling small and medium connections for less than £1m and in less than 12 months from initial enquiry to 'gas on'. The project is talked about in more detail in 'I want to connect to the transmission system' chapter.

Your feedback shows that gas quality and blending is an area you want us to investigate, especially as more diverse gas supplies are found. So, we have commissioned a project to look at the feasibility of gas quality blending and the implications of this on the network from both a physical and a commercial point of view. If successful, this project could allow for gas from more diverse sources to be available to the wholesale market.

For more detail on our innovation projects, read our annual reports, these can be found in our innovation strategy in annex A25.03.

3. What our stakeholders are telling us

Innovation

You are at the heart of how we innovate. Throughout RIIO-1 we've developed strong partnerships and worked collaboratively to share learning between ourselves and other network companies. In the build-up to our RIIO-2 submission we have worked closely with you to make sure our strategy for innovation delivers what you need and helps build the network of the future. We've done this through existing channels including innovation workshops, the Energy Innovation Centre (EIC), conferences and events such as the Low Carbon Networks & Innovation Conference (LCNI) and through conversations with third parties.

Our take-home messages are:

- networks should be looking to provide information to policy makers through innovation projects or horizon-scanning
- decarbonisation of heat is an area of challenge that we should be supporting.

More detailed information is available in our innovation annex A25.03.

[97] http://www.smarternetworks.org/project/nia_sgn0134
[98] This is based on a sample of 10 projects- this resulted in £8.6m savings versus £2.1m spend.
[99] https://www.nationalgridgas.com/insight-and-innovation/transmission-innovation/delivering-value-innovation
[100] http://www.smarternetworks.org/project/nia_sgn0134
[101] http://www.smarternetworks.org/project/nia_nggt0143

4. Our proposals for RIIO-2

Our innovation aims during RIIO-2 are to:

- optimise investment in innovation through BAU investment and use of available allowances to innovate towards a decarbonised energy system
- drive a programme of roll-out to ensure completed innovation projects are integrated within the business
- embed an innovation culture at all levels across our organisation
- become an innovation leader in the industry, with a reputation that others want to emulate.

Due to the nature of innovation, projects have not always been successful. But when they aren't, we will take learning from it and update our processes and organisational structures to make sure we can innovate more successfully in future.

We will continue to drive innovation and increased participation across the energy landscape to deliver the changes required in a way that's beneficial for consumers. All the gas networks, via the ENA Gas Innovation and Governance Group, produced a gas network innovation strategy[102], which included stakeholder consultation. This was published in March 2018 and it is due for a review in March 2020. The strategy identified seven themes for innovation and looked at the short, medium and longer-term horizons. These focus industry efforts to meet the challenges of the energy system transition. Because of the strategy's publication, we've adapted our portfolio to make it clear how our projects and challenges fit in to the bigger picture.

Our vision is: 'Innovating to create your network of the future and facilitate UK decarbonisation'. Our innovation strategy is summarised by three broad areas: Fit for the Future, Ready for Decarbonisation and Decarbonised Energy System.

In figure 25.2, we've included some examples of the innovation themes that we propose to deliver for whole energy system outcomes, split out between BAU and innovation allowance.

A more comprehensive list, which covers themes that we will deliver across all our stakeholder priorities can be found in annex A25.03, please note that we won't disregard other ideas.

Our Innovation strategy key points:

- Collaboration remains key to delivering a decarbonised whole energy system.
- Network innovation is vital to ensure our assets can support a decarbonised energy system.
- Our stakeholders have a key role in how we innovate, with third parties pivotal to driving innovation across the sector.
- Our portfolio of innovation has developed throughout RIIO-1 providing a rich mix of projects delivering value to our customers.
- We've developed a strong foundation for innovation within our organisation, which our RIIO-2 plans build on to embed a process of innovation throughout our organisation.
- Our ambitious plans for RIIO-2 see an accelerated plan to develop and deliver innovation to meet our decarbonisation challenges.
- We plan to invest 1.5% gas transmission revenue per annum (estimated at £12m) in innovation. This will comprise of 0.75% (£6m p.a.) invested in BAU innovation and a further 0.75% (£6m p.a.) as part of the reformed NIA allowance from Ofgem.
- We will embed successful innovation within our business to realise value for our customers.

During RIIO-1 we have started projects looking at the feasibility of using our network for hydrogen use. These projects have given an early indication that our network could be potential to use our network for Hydrogen transportation.

[102]https://www.nationalgridgas.com/document/112016/download

Table 25.2 innovation themes

Fit for the Future (2020 – 2030)

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

Theme	Description	BAU innovation	Allowance Innovation
Modernising our Systems	Ensuring National Grid is operated utilising the latest in software and hardware across all its business functions.	• Update core systems such as Windows and Office to streamline / automate business processes • Pigging and corrosion monitoring • Storage solutions and data capture • Core systems updated • Drone applications • Monitor leaks from aircraft or drones • Continued use and improvement of Building Information Models (BIM) • Research into how a blend of gasses including CO_2 will impact all parts of the NTS • 3D printed parts • Composite parts • New methods of removing hazardous materials from site	• New methods of inspection • Studies into the effect hydrogen could have on the NTS • Smart drawings • Innovative 'in-field' data capture • Investigating AI solutions to drive equipment reliability • Research and trials into the latest prevention software • Swarm Robotics • Tools that remain in the network • Self-powered robots • Autonomous robotics on site • Networks capable of notifying if a leak is occurring. • Remote monitoring of emissions using AI driven solutions • New techniques and materials • Use of hydrogen machinery / generators • Digital twins • Pilot projects to define the impacts both offline and online • Research into what a decarbonised gas landscape could look like in the UK • Self-healing paint • Alternative pipeline materials • Maintenance free materials • Research and development centre on the site of a decommissioned site
Asset integrity management – fit for hydrogen	Confirming and maintaining the integrity of the NTS as the move towards a decarbonised energy system begins.		
Digitalisation	Migrating the huge amount of data National Grid owns into a digital format to facilitate more efficient interrogation and analysis. Investigating the part AI can play in digitalisation		
Cyber & Infrastructure	Protecting National Grid from the threat of cyber terrorism to all its operations.		
Robotics	Apply robotics to the operations of National Grid to automate functions or remove the need for the workforce to operate in hazardous environments.		
Leak detection & Emissions Monitoring	Early detection of leaks on the network and effective methods of monitoring emissions across the network.		
Decarbonising Construction	Driving down carbon emissions during all stages of construction from design, through build to considering the operation and maintenance once completed.		
NTS product Utilisation	To what extent can the NTS be used for to transport a variety of different gasses such as biomethane, hydrogen and carbon dioxide or a blending mix.		
New Materials	Research and trials into new materials that mimic the strengths of a material but none of the weaknesses.		
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.		

Ready for Decarbonisation (2025 – 2050)

Focus strongly on how the National Transmission System (NTS) will transport either a blended mix of 'green' gasses and focus on future technology to better manage the assets we own.

Theme	Description	BAU Innovation	Allowance Innovation
Compressor Strategy	Making full use of the existing compressors to handle the changes in flow of gasses around the NTS and looking towards mobile compressors.	• Existing compressor strategy • Data collection techniques • Proven and safe AR equipment for National Grid examples • On site 'smart' assets • Carbon mineralisation • Develop 3D printing techniques • Address legality issues	• Mobile compressor units • Innovative algorithms • AI / ML packages • Further applications of AR in the Utilities industry • Embedded sensors / wires on the pipeline • Integrated smart assets • Dashboards • Innovative CCS techniques • Transport of carbon through the NTS • CO_2 removal from the atmosphere • Printing out in the field
Artificial Intelligence (AI) & 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).		
Augmented Reality (AR)	Accessing a virtual data source whilst carrying out a task by wearing a device the user can interact with.		
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.		
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.		
Printing Parts	3D printing of parts for the NTS both in workshops and out in the field.		

Decarbonised Energy System (2020 – 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 market.

Theme	Description	BAU Innovation	Allowance Innovation
Hydrogen mix / blending	Understand the full potential of the NTS in terms of what blend of gasses can be transported, how this will be facilitated, where will it come from and how it will be extracted.	• Transportation of a low % of blended gas across the UK • Hydrogen to commercial customers • Provide a transportation network for trading blended gasses • Studies into whether this technology is available • An NTS capable of transporting decarbonised energy around the UK	• Can the NTS be used to transport up to 100% hydrogen • Allow specific quantities of blended gas to be extracted • Provide a network of offtakes to supply the hydrogen transportation industries as they develop • Research into ways the NTS could facilitate the trade of carbon and hydrogen around the UK or globally • Pilot schemes to trial the technology • Working towards a 100% hydrogen network
Hydrogen for Transport and Commercial	Provide hydrogen or blended gasses 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 gasses for their industries.		
Hydrogen and CO_2 trading	Play an active role in any new gas markets that are set up to trade biogases, hydrogen or carbon dioxide.		
Prime movers for Compressors	Use of hydrogen to power the prime movers used in compressor units		
Hydrogen for power	A fully decarbonised energy system consisting of up to 100% hydrogen for all consumers.		

5. How will we deliver?

This is a summary of how we plan to deliver on our proposals for innovation transformation.

Area	How we deliver
Innovation transformation	1. We plan to deliver innovation through a mix of funding: we are committing £6m a year (0.75% of NGGT revenue) to invest in BAU innovation. We believe an additional £6m per year in the form of an innovation allowance incentive is vital to support the strategic ambitions for a decarbonised energy system. 2. We will have a number of people to deliver innovation and embed it across GSO and GTO. Their main function will be to work with SMEs and other third parties to drive forward innovation projects and to undertake the relevant governance. They will also participate in cross-industry workgroups. 3. Projects will be delivered through the business and third parties as they have been during RIIO-1.

Summary of the overall priority 'I want you to facilitate the whole energy system of the future, innovating to meet the challenges ahead'.

How do our RIIO-2 proposals for this priority benefit consumers?

Our proposals will help deliver on Ofgem's output categories of 'meet the needs of consumers and network users' and 'deliver an environmentally sustainable network'.

Consumer priorities	How does our plan support this?
"I want to use energy as and when I want"	Our commitment is to support and deliver solutions that will continue to deliver the future energy system through enabling decarbonisation and digitisation. We will collaborate with other networks and third parties to deliver innovative solutions for our customers and consumers.
"I want an affordable energy bill"	Whole system collaboration offers networks the potential to respond to changing needs, reduce consumer costs and deliver a sustainable network. Through focusing on delivering and embedding innovation solutions to deliver the energy transition, we will ensure we are minimising consumer bills.
"I want you to facilitate delivery of a sustainable energy system"	We are working with other networks, regulators and third parties to determine the future pathways for the energy industry while keeping disruption to a minimum for consumers. We will define the solutions for decarbonising heat, providing the costs of these for the network and the implications for consumers.

6. Risks and uncertainty

There are risks and uncertainties that must be acknowledged around our proposals for this priority:

- There is uncertainty about the future energy landscape as we focus on how we can decarbonise the energy industry. With no clear decision due to be made on heat policy until around 2025, there's added uncertainty about the direction for the gas industry. It will be important that for RIIO-2 the appropriate regulatory frameworks are in place to manage this for consumers' benefit. For example, we believe that, to drive the energy transition forward, it is appropriate to incentivise networks to collaborate on whole energy system solutions. We also believe that, to manage the uncertainty of regulatory change, we should have upfront allowances for implementing the changes, through new or changed systems.
- There are risks around the assumptions, primarily associated with the cost of implementing change. Alongside the risk to our business plan there is the added possibility that customers may seek to recharge costs to us to adapt their systems and processes if we are driving levels of change that are beyond what they may have costed into their contracts. This includes uncertainty on what and how IT investments may be needed and funded, depending on the direction of the market and regulatory change.

The following uncertainty mechanisms apply to this chapter and further information can be found in annex A29.02.

Table 25.3 uncertainty mechanisms relating to whole system

UM name	Type	Business plan proposal – what the UM addresses	Frequency
8. **Whole systems**	Coordinated Adjustment Mechanism	Not yet defined (Ofgem potential option in May decision). Further discussion required with Ofgem	To be defined
11. Gas Transporter's share of Xoserve costs	Pass through	This only relate to our share of costs for central data service provider (CDSP) services.	Annual

7. Our proposed costs for RIIO-2

Our RIIO-2 spend is broken down under the activity categories displayed in figure 22.3, with a breakdown of spend per year and an overall total of £134m over the five-year period. This equates to an annualised cost of about £27m, which is an increase from our RIIO-1 annualised spend of about £18m. Most of the increase is due to a forecast increase in expenditure on our capex costs relating to the Gemini replacement.

Table 25.4 activity spend 'I want you to facilitate the whole energy system of the future, innovating to meet the challenges ahead'

Activity spend (£m in 18/19 prices)	2022	2023	2024	2025	2026	Total RIIO-2	Annualised RIIO-2	Annualised RIIO-1
Xoserve costs	6.1	7.4	17.9	18.4	11.1	60.8	12.2	4.5
IS applications	0.7	0.9	1.0	0.6	0.6	3.9	0.8	0.7
System operator activities	6.9	7.1	7.2	7.2	7.1	35.5	7.1	6.4
Other[103]	0.5	0.5	0.6	0.6	0.6	2.8	0.6	0.8
Sub-total – controllable costs	14.2	16.0	26.7	26.7	19.3	103.0	20.6	12.4
Innovation (network innovation allowance)[104]	6.2	6.2	6.2	6.2	6.2	30.9	6.2	5.3
Total spend	**20.4**	**22.2**	**32.9**	**32.9**	**25.5**	**133.9**	**26.8**	**17.7**

Business plan data templates

Our business plan is accompanied by a set of spreadsheet business plan data templates (BPDT) in a format required by Ofgem. The next table shows how the costs for this priority feed into the BPDTs.

Table 25.5 business plan data template spend 'I want you to facilitate the whole energy system of the future, innovating to meet the challenges ahead'

RRP category (£m in 18/19 prices)	2022	2023	2024	2025	2026	Total RIIO-2	Annualised RIIO-2	Annualised RIIO-1
Closely associated indirects	0.5	0.5	0.6	0.6	0.6	2.8	0.5	0.5
Direct costs	6.9	7.1	7.2	7.2	7.1	35.5	7.1	6.4
Items outside of totex including non controllable costs	6.2	6.2	6.2	6.2	6.2	30.9	6.2	5.0
Non-operational capex	0.7	0.8	1.0	0.5	0.5	3.5	0.7	0.6
SO capex total	6.2	7.5	18.0	18.5	11.2	61.3	12.3	4.6
Grand total	**20.4**	**22.2**	**32.9**	**32.9**	**25.5**	**133.9**	**26.8**	**17.7**

[103] This accounts for our FTE's relating to our GT innovation team.
[104] This cost is only the cost that we forecast to be spent through Ofgem's network innovation allowance (NIA)

8. Next steps

We are working up the detailed cost of the Gemini replacement and have included a cost of £40m against a broad scope. We will do further work on challenging the costs associated with delivering this, aiming to have updated costs for the October plan, as well as a justification report and cost benefit analysis (CBA). We will talk again to stakeholders to ensure that what we propose in December is what they want, and that it offers consumers value for money.

Ofgem's May framework decision document indicated that there will be innovation stimulus available for RIIO-2. We will ensure that our October plan reflects Ofgem's latest guidance. Also, early results from our Project Cavendish project have indicated that there could be an opportunity to progress further in RIIO-2. This may mean that further funding would be needed. This could include re-exploring the need for a heat re-opener as part of this. Our October submission will also detail our hydrogen pathway for the NTS, building on our learning from our HyNTS programme of work, the Gas Decarbonisation Pathways Project and engagement with the GDNs within the Hydrogen Transformation Group.

As indicated for delivery of whole energy system solutions, the appropriate mechanism needs to be in place to drive the right behaviours by networks and industry. We will be exploring with stakeholders to explore the options around the mechanisms available and how these interact with Ofgem's proposals. We will update our proposals to reflect this in our October draft plan.

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

What is this stakeholder priority about?

Transparency and information are fundamental to our stakeholders being able to operate their businesses efficiently and effectively. Our data and insights provide value for consumers by ensuring that the gas market runs smoothly. Our work in this area also promotes competition – allowing participants to plan, prepare and operate effectively. We recognise that our stakeholders need us to provide good quality information and data to inform their business decisions.

What have you told us?

Through our engagement activity we've developed a more detailed understanding about the information that you value, and what you want to use it for. You have told us you want more information, faster access to it and an easy way to ask us for new kinds of information.

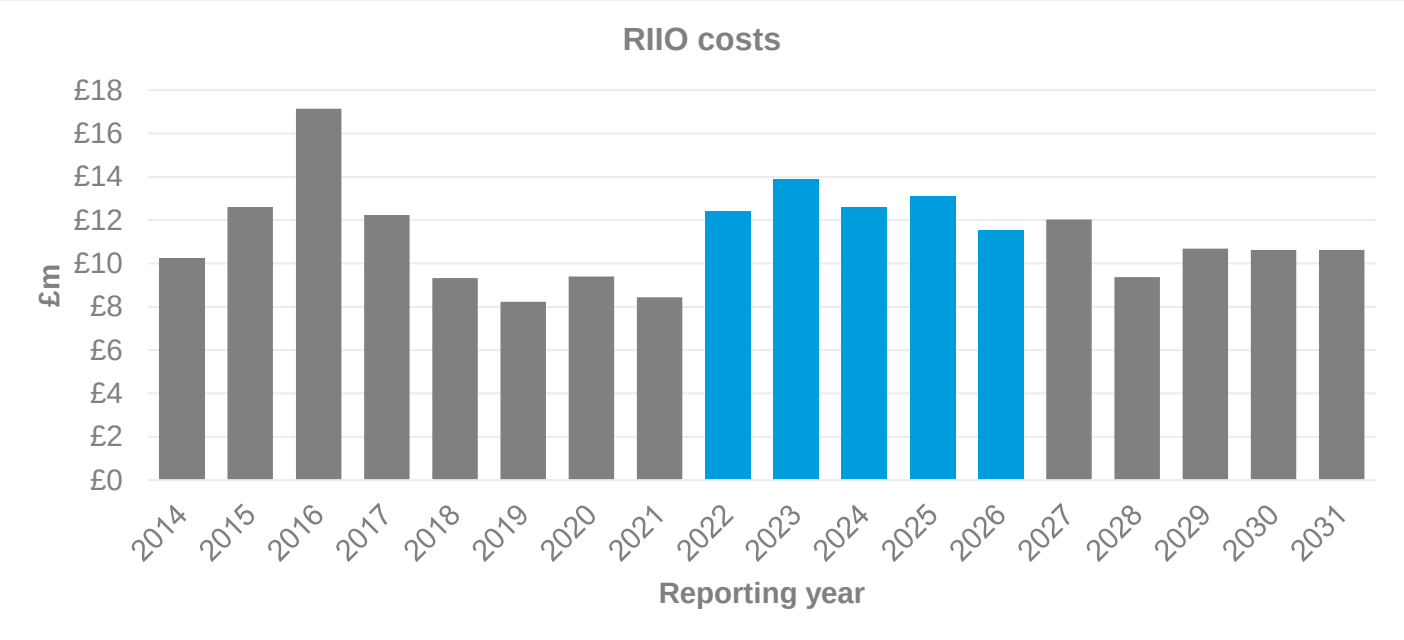
During RIIO-2 we will:

- champion open data sharing and governance across the energy industry
- collaborate and share data with network companies to build a whole system view
- invest in our people and IT systems, taking advantage of technology to develop new capabilities allowing us to share information better ways.
- provide more transparency around our operational performance.

There are risks associated with developing our information services in this way. For example, the growth in customer demand for information may outstrip our ability to absorb the costs through business efficiencies. We will be transparent about the fact that these resources are finite and work with the customer community when it's necessary to set priorities.

The total RIIO-2 spend for this area is £64m, with an annualised spend of £13m (compared to an annualised spend of £11m in RIIO-1). This is around 2% of the value of our total business plan.

Figure 26.1 RIIO-1 and RIIO-2 spend profile 'I want all the information I need to run my business and to understand what you do and why'



1. What is this stakeholder priority about?

This priority is about ensuring we provide the right levels of information to the wider industry to meet its needs. It's also about how we communicate with our stakeholders and provide transparency about our decision-making. Clear information enables stakeholders to operate their businesses efficiently and effectively.

The information we share allows market participants to make informed decisions. This might be about the investments they make, how they trade in the market or how they run their plant and equipment.

Our data and insights provide value for consumers by ensuring that the gas market runs smoothly. Our information also promotes competition in the wholesale market.

Being transparent about decisions enables our stakeholders to understand how we might act when similar events occur in future and how they could optimise their own operations. In short, information is crucial to the efficient operation of the gas industry which ultimately affects consumer bills.

2. Our activities and current performance

Our key activities associated with the information provision priority are summarised in figure 26.2 below. Much of the activity undertaken to operate the network is published as information for the industry.
We provide information that covers a broad range of areas and timescales. We publish documents such as the System Management Principles Statement and related procurement guidelines to set upfront expectations of how we will operate the system. Long-term insights show how the network could evolve in future and how we plan for that. They also provide transparency about the investment decisions we are making.

We provide guides and support for activities such as the connection and capacity reservation process. We do this so that people know what to expect from us as they go through these processes.

Figure 26.2 Our information provision

Our medium-term information informs the energy industry and allows it to prepare, offering a view on how they could use the system and the cost of doing so. The charging statements we publish set out how we calculate charges as well as the charges themselves.

Short-term 'on-day' and 'after-the-day' information supports efficiency in the capacity and energy markets. It does this by providing fair and timely access to operational and market information.

We intend that our information provides transparency to our stakeholders of what we do and why, in terms of our investment decisions, operational decisions and performance.

The next table lists the specific information that allows us to provide transparency in these areas.

Table 26.3 List of transparency Information

Activity	Information
Long term (>10 years)	Gas Ten Year Statement (GTYS) Gas Future Operability Planning Future Energy Scenarios document
Medium term (one year/within year)	Summer/Winter Outlook documents Winter Consultation document Maintenance plans Maintenance notices Capacity auctions Charging tariffs Operational Forums Collaboration site Liaison meetings Distribution network forums
Short term (a few days ahead / on-the-day)	REMIT information MIPI information PDWS information
Post event (after the day)	Incentives reporting MIPI information Collaboration site (day in brief) Winter Review document Charging and billing

Track record in RIIO-1

During RIIO-1 we have focused our efforts on being more proactive about the information we provide because we recognise that it has an important part to play in enabling society's transition to a low-carbon future and the shift to a 'whole energy system' approach.

You can see this in the changes made to the GTYS during RIIO-1 because it now shows our decision-making processes. It captures the thinking behind the choices we make as we move towards a low-carbon energy future.

During RIIO-1 we began producing the Gas Future Operability Planning (GFOP) document. The GFOP describes how a low-carbon energy future may impact gas network operability. Operability is a growing consideration for us and so we wanted to start a conversation about it so the market can work with us to meet these possible challenges.

Through 2018 we undertook a significant piece of work to engage with industry on ways to improve our operational data provision and we are putting new streams of information in place where demand from stakeholders is clear. One example is the week ahead pressure forecast launched in August 2018.[105] We have spent all our allowances to deliver these improvements.

We are supporting initiatives like the energy data taskforce. It brings together industry and the public sector to reduce costs and promote competition, innovation and new business models. It will review the data landscape, identify gaps and make recommendations for how data can be used more effectively in the energy system.

Learning from RIIO-1

We launched the Gas Operational Data Community[106] to create effective communications channels with our stakeholders and inform any improvements to information provision we make. To date, more than 250 customers have registered on the innovative and agile collaboration platform. The insights we've gathered provide an explicit link to consumer value. More than ever before, customers are sharing why they need the data they ask for.
Although primarily set up to inform our RIIO-1 information provision activities this insight has also been used to inform our RIIO-2 proposals.

3. What our stakeholders are telling us

You value the information we provide. You see the data we supply as crucial in managing your commercial processes. Data, information and insights are some of the most important outputs that we produce:

- information and data at a greater frequency – preferably as near real-time as possible
- the ability to pull data from our systems, less interest in having data pushed
- use of application programming interfaces (APIs) to manipulate raw data
- more consistency and accuracy of data
- more pressure and gas quality data
- more in-depth analysis and transparency around National Grid balancing actions

More information is available in our engagement log in annex A26.01

[105] https://www.nationalgridgas.com/data-and-operations/transmission-operational-data#tab-4

[106] https://datacommunity.nationalgridgas.com/

4. Our proposals for RIIO-2 and how they will benefit consumers

Our aim is to have a customer-focused, data centric approach, not just meeting our obligations on data provision but also enabling transparency that promotes efficiencies in the wholesale market. We have made significant strides to achieving this during RIIO-1 and will continue our efforts through RIIO-2.

Customers say the information we provide is important and there's an ever-growing list of improvements they would like to see, focusing both on the data itself and on how they can access it.

- We will be transparent in what we do, enabling competition and fostering innovation by sharing our data openly wherever possible. We will put an emphasis on collaborating and sharing data with network companies to build a whole system view.
- We will move towards providing open, automated, and machine-readable data wherever possible. Our data will be presumed open, with access only ever being restricted to mitigate security, privacy, legal or consumer impact risks.
- We will champion open data-sharing and governance across the energy industry. Data access improves market efficiency and creates the conditions for innovation across industry, leading to lower consumer bills and more benefits to society.

Transparency on our performance

Regulatory reporting

To make our performance transparent we publish annual information on our outputs and spend against our allowances.

This information can be complicated, but we will make it easy to understand what we have delivered for consumers and how our financial returns clearly link to what we delivered.

A key element of providing transparency on our performance is having targets for the service levels we will provide. In our annual RIIO-1 performance report we explain each year how well we have performed against our outputs. We will continue to do this throughout RIIO-2.

Updating our business plan with you

You told us that the opportunity to help shape updates to our annual business plan is something you expect. You want this to be a genuine two-way engagement process, although you'd also find it useful to have regular updates from us about what we're doing and how we're performing. Adopting a more externally-focused approach will increase transparency and ensure we deliver what is important for all stakeholders.

We will continue with our enhanced stakeholder engagement programme indefinitely outside of the price control preparation process, keeping up conversations about our long-term plans even when there is no regulatory or business need to do so. This should improve the outputs we deliver for all stakeholders and reduce the costs of delivery as resources become more focused on what people tell us they want.

Our proposal to retain the independent stakeholder user group during RIIO-2

We will increase the transparency of our performance by retaining an independent stakeholder user group during RIIO-2. The role of the group would be to continue to challenge our engagement activities, scrutinise our business plans and verify our annual reporting. We will increase the impact of our annual performance report by presenting it to the user group. The group will challenge us on the quality, transparency and accessibility of our reporting as well as our performance. This will build trust with our stakeholders and strengthen our reputation for transparency.

We recognise that on a periodic basis, members of the group will have to change, this allows continued independence and the opportunity to bring fresh perspectives. Following feedback from Citizens Advice we will also ensure that the group continues to have a strong consumer voice. This will provide added weight to consumers' views in our reporting.

For our annual stakeholder-led business planning process, we expect the independent stakeholder user group to continue to play a key role in challenging the way we engage and how we incorporate feedback into our plans. The group will provide challenge at the start of each year's process to ensure our plans are comprehensive, representative and inclusive. They will then provide further challenge at the end of each phase of engagement and prior to the next one. Their role will also be to challenge us on best practice and shape our engagement based on learning they have acquired from other sectors and organisations.

We are exploring how we tailor our reporting to our stakeholders' needs and clearly and simply set out what they want to know. We will continue to engage with our stakeholders to improve our annual

performance report and adapt it to our stakeholders' changing needs.

Outputs

Our information provision priority maps to Ofgem's output category: 'meet the needs of consumers and network users'. We propose retaining our existing RIIO-1 output delivery incentives around quality of demand forecasts. Stakeholders of all kinds gain value from this incentive.

We have summarised the incentives in this part of the chapter as follows. They are addressed in more detail in our incentives annex A29.03

Output Category	Output	Business Plan Proposal
Output Delivery Incentive	Quality of demand forecast – day ahead & 2-5 day schemes (D1/D2-5)	Retain schemes. Incentive set with appropriate rewards and penalties to meet the needs of consumers, recognising that demand forecasting is becoming increasingly challenging. Metrics to be agreed with Ofgem.

How do our RIIO-2 proposals benefit consumers?

Our information provision delivers benefits for industrial and domestic consumers:

Consumer Priorities	How does our plan support this?
"I want an affordable energy bill"	Our information and insights provide value for consumers by ensuring that the gas market runs smoothly. It also promotes competition in the wholesale market – allowing participants to plan, prepare and operate effectively.

5. How will we deliver?

We will deliver our RIIO-2 proposals by building a business capability that allows us to deliver change flexibly and to respond in an agile way to the deep insight we gain from customers. The capability will be built through the skills and capabilities of our people and the processes they follow. They will be supported by technology (or systems) to make these outputs available. We expect to deliver more for our customers during RIIO-2 with broadly the same number of people.

It is vital that we have a platform that is well maintained, secure and flexible enough to make as-yet unknown streams of data available externally. Many of the IT systems that underpin our information provision platform will need enhancement or renewal during RIIO-2. Through investment in systems we will build a foundation that enables us to continue meeting our customers' expectations.

We will deliver an agile, industry-enhancing IT solution that meets the changing needs of the industry both now and into the future:

- upgrading the externally facing information provision platform, including a new enabling infrastructure to provide for the changing ways the industry views and utilises data
- maintaining an industry engagement platform to discuss and enable data enhancements.

6. Risk and uncertainty

There is a risk created, by developing our information services together with customers. As their expectations continue to grow, we may need to invest more in people and systems than we can absorb through more efficient processes. External uncertainty also exists about the potential impact on our systems and processes of changes that become necessary because of UNC evolution.

We propose that through our community development approach we will be transparent about the limits of our capacity to implement changes in information provision. We will use the customer community to prioritise and make it clear where we will flex or trade our effort and investment through the RIIO-2 period.

Positive	Negative
• Transparent process to improve customer engagement • De-risks potential variances in scope through price control period.	• Stakeholders may become dissatisfied with our lack of capacity to deliver what they want. • Obligatory change could utilise whole pot of money which pushes back potential customer enhancements.

We propose that allowances for these activities be fixed upfront. We will develop an open process to manage the fixed allowances that best delivers value for customers and consumers. We also recognise that we should be held to account to deliver the commitments we make against this stakeholder priority. We will continue to work to identify relevant and proportional metric. These metrics may be both quantitative and qualitative.

7. Our proposed costs for RIIO-2

The calculation and invoicing of customers' energy balancing, capacity and commodity charges are delivered by Xoserve either directly or through automated processes via the Gemini system. Operational costs of Xoserve are included in this priority. Capital investments in new systems are included in the chapter 25 because a primary driver is the change required to facilitate future markets and whole system ambitions.

Our direct operational costs remain consistent with RIIO-1 with the demands of change offset by our continued focus on efficiency.

There are several capital investments in our IT system that we expect to make during RIIO-2. These can be split into asset health-type upgrades to maintain our existing capabilities and those that will support us in continuing to meet the needs of our customers and the wider industry. Investment in these systems has been delayed through RIIO-1 whilst we undertook a significant upgrade to our core network control systems. There is therefore technical debt that needs to be addressed through the investments required during RIIO-2. These investments are explained in more detail in the IT Annex A28.03 and are tagged there to this chapter.

Table 26.4 Activity spend "I want all the information I need to run my business and to understand what you do and why"

Activity Spend (£m in 18/19 prices)	2022	2023	2024	2025	2026	Total RIIO-2	Annualised RIIO-2	Annualised RIIO-1
People	6.8	6.9	6.8	6.7	6.6	33.8	6.8	6.4
Systems	5.6	7.0	5.8	6.3	4.9	29.7	5.9	4.5
Grand Total	12.4	13.9	12.6	13.1	11.5	63.5	12.7	11.0

Business plan data templates

Our business plan is accompanied by a set of spreadsheet business plan data templates (BPDT) in a format required by Ofgem. The following table is provided to assist the reader in understanding how our information provision activity costs feed into the BPDTs.

Table 26.5 business plan data template spend "I want all the information I need to run my business and to understand what you do and why"

RRP Category (£m in 18/19 prices)	2022	2023	2024	2025	2026	Total RIIO-2	Annualised RIIO-2	Annualised RIIO-1
Direct costs	6.8	6.9	6.8	6.7	6.6	33.8	6.8	5.0
SO Capex	5.6	7.0	5.8	6.3	4.9	29.7	5.9	4.9
Grand Total	12.4	13.9	12.6	13.1	11.5	63.5	12.7	**9.8**

8. Next steps

We will continue to work to identify relevant and proportional metrics to make delivery of our commitments visible. These metrics may be both quantitative and qualitative.

27 - I want to connect to the transmission system

What is this stakeholder priority about?

This priority is about what we do to connect, modify or disconnect new and existing sources of gas supply and demand as customers' requirements change. Our connections service is essential to the effective working of the competitive wholesale energy market. It is an enabler for decarbonisation of the gas and electricity systems and it can support the connection of new biomethane sources.

What have you told us?

You have told us you want it to be quicker and cheaper to connect and for us to be more transparent in our processes. You want our connections service to enable decarbonisation, decentralisation and future energy systems transition.

During RIIO-2 we will:

- continue to support the liquidity of the energy market by providing an efficient process for connection and capacity applications
- make best use of the existing network and put a simpler process in place to substitute unused capacity
- deliver more capacity where necessary, informed by robust options analysis
- embed the improvements resulting from our Customer Low Cost Connections (CLoCC) project into business as usual, enabling standard connections for less than £1m in under 12 months
- support the UK Clean Growth strategy, decarbonising the energy systems, helping them to transition and exploring new ways to meet the requirements of a changing customer base.
- be more responsive to the needs of customers, improving our customer satisfaction scores

Our proposed spending in RIIO-2 is £12m of base revenue to run the connections and capacity processes, including customer service improvements, through enhanced digital tools. Figure 27.1 also shows our indicative capex forecast of [redacted] in the RIIO-2 period for south Wales network reinforcement triggered by a new customer requirement. This is not to be included in our base revenue. Our cost recovery would be subject to an uncertainty mechanism if the customer progresses with this scheme. The impact on customer charges would be determined by prevailing code and charging rules, not by the RIIO framework.

1. What is this stakeholder priority about?

Our network connects supplies from nine gas importation facilities to nearly 100 offtakes for distribution networks, power stations and interconnectors, as well as eight storage sites. Four of the importation terminals provided over 80% of total GB gas supply in 2017/18.

This stakeholder priority is about what we do to connect, modify or disconnect new and existing sources of gas supply and demand as customers' requirements change. As well as the physical connections, we manage the processes customers use to reserve capacity to flow gas onto or off the network. If there isn't enough existing network capability, load-related reinforcement of the network may be necessary to provide additional capacity.

Sometimes, we also divert parts of our network to make way for other national and local infrastructure developments – for example road, rail and housing developments. The costs are met by the relevant developers.

2. Our activities and current performance

Our connections performance is a current RIIO-1 output measure monitored by Ofgem. We publish quarterly reports about our connections performance on our website[107].

Connections and capacity processes

Our connection obligations are set out in the uniform network code (UNC). It's the number and type of connection and capacity applications we receive that drives our volume of work, rather than the volume of connected supply or demand. The level of connection activity is inherently uncertain and dependent upon changing customer and energy market requirements.

The costs of our connections, diversions and capacity reservation work are paid by the relevant customers on a cost pass through (no-profit) basis. If firm customer commitments trigger deeper network reinforcement, our costs for the work would be met by a separate revenue driver[108] mechanism agreed with Ofgem.

Facilitating energy markets and decarbonisation

Our connections service provides essential 'liquidity' for the competitive wholesale gas market to work effectively, allowing market participants to bring the cheapest sources of gas supply into the GB market through different entry points. Most of our exit direct connections to date have been for gas-fuelled power stations and these help the electricity market to operate competitively.

Our connections service is a key enabler for decarbonisation, decentralisation and future energy systems transition. For example, we have facilitated the almost complete switch from coal to gas as the fuel of choice for flexible electricity generation; the carbon intensity of electricity generated from gas is roughly half that of electricity from coal[109]. Looking ahead, we are ready to make new gas projects possible including biomethane and shale gas entry connections and compressed natural gas vehicle refuelling exit connections.

Innovation through project customer low cost connections (CLoCC)

You told us that our costs and timescales can be a blocker to connecting to our network, particularly for smaller, non-traditional gas producers and consumers. In response, we initiated CLoCC[110] a gas national innovation competition (NIC) project undertaken alongside three small and medium-sized enterprises (SMEs).

CLoCC fundamentally challenged every aspect of our connection process, aiming to provide new connection options suitable for the needs of our

107 https://www.nationalgridgas.com/connections/applying-connection

108 Special Conditions 5F/5G of the gas transporter licence by which NGGT allowed revenue may be adjusted for provision of incremental entry/exit capacity.

109 https://www.parliament.uk/documents/post/postpn_383-carbon-footprint-electricity-generation.pdf

110 http://projectclocc.com/

changing customer base. The project concluded in 2018 having met its goals of enabling small and medium connections for less than £1m and in less than 12 months from initial enquiry to 'gas on'.

We've made key improvements in the following three areas:

1. **A new online gas connection application portal.** It allows potential customers to identify candidate connection points through a map-based interface and to be provided with capacity availability and immediate cost estimates. There's 24/7 access to check and track application progress.
2. New pre-approved and pre-appraised **standard design connections.** Suitability of above ground installation (AGI) sites for accommodating standardised connections has been pre-screened and implemented in the software platform.
3. **Improved commercial terms**, implemented through code modifications where necessary. Upfront application fees are reduced from £109k to £13k for simple connections and we've created a quicker route through capacity reservation for pre-screened, green light connection locations.

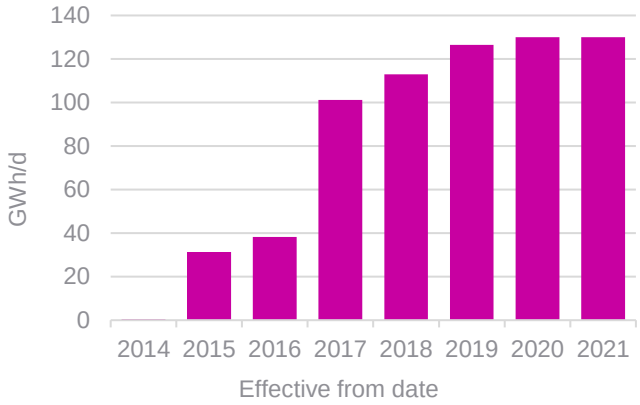
Optimising use of the existing system

As we moved into the RIIO-1 period there was significant uncertainty regarding the supply and demand mix covering storage, liquefied natural gas (LNG) imports and potential new CCGT power stations. Given the uncertainty about load-related investment, the regulatory framework included uncertainty mechanisms to adjust our base revenue when circumstances change. Our RIIO-1 base revenue did include the Avonmouth pipeline output (designed to help manage the consequences of the Avonmouth LNG storage facility closure). Through working collaboratively with key stakeholders, we determined this was not required and we returned the relevant allowance of £215m (2017/18 prices) to consumers.

When we assess applications we decide on the most efficient way to meet customers' needs. Where we can, we meet customer capacity requirements by substituting capacity from one point on the system to another, and this ensures we make best use of the existing system. It avoids the cost and time that could be involved in deeper system reinforcement to provide more capacity.

During the RIIO-1 period (up to 2018) we managed all changing customer requirements without needing investment in incremental capacity. We have accommodated the equivalent of several large power stations through substitution.

Figure 27.2 cumulative use of substitution to meet entry and exit requirements during RIIO-1



New incremental capacity

However, substitution will not always provide a solution to meeting customer capacity requirements – there are areas of the network where physical system reinforcement would be required. On 15 March 2019 we published notice, in accordance with the uniform network code, that a planning and advanced reservation of capacity agreement (PARCA) application in south Wales had progressed to Phase 2. Network entry capacity has been reserved for 163GWh/d of funded incremental obligated entry capacity at Milford Haven aggregated system entry point. The indicative registration date is 1 January 2026.

If this scheme proceeds, we expect physical reinforcement of the network in south Wales will be necessary and this gives rise to the spike in costs in figure 27.1. This might include upgrading existing pipelines or building new ones, installing new compressor units/sites, modifying Above Ground Installations or a combination of all these. The capital costs of the options we are exploring range from [redacted] straddling the RIIO-1, 2 and 3 periods. We are now undertaking detailed desktop studies and cost benefit assessments to narrow down the options and costs. By March 2020 we'll produce a strategic options report as the basis for stakeholder consultation about any land use planning approval (Development Consent Order) that may be required.

Diversions

We work with various third parties building projects like road, rail or housing developments that are close to our gas network infrastructure. Where necessary, we divert our pipelines so that their projects can go ahead without compromising the safety of the gas transmission system.

We co-ordinate our work with third party developers and other affected utilities to minimise the costs and operational impact of these diversions. So far in the RIIO-1 period we have diverted pipelines at a cost of £23m but this doesn't impose a net cost on transmission system customers because it is funded by the relevant third-party developer on a cost pass through basis.

3. What are our stakeholders telling us?

The primary stakeholders for this topic are our customers – people and entities who pay us for the products and services we provide. This includes gas distribution networks, shippers and directly-connected customers including gas storage sites and gas-fuelled power stations. We have established relationships with them through various forums spanning operational matters, code changes, connection applications and management of the various industry commercial agreements involved.

Through changes we have made during RIIO-1 to become more customer-focused we are listening more intently than ever before to our customers' needs (see customer journey and customer satisfaction sections below). Key initiatives like Project CLoCC have involved additional close engagement and collaboration, resulting in positive changes to our working practices.

In light of the business as usual engagement focus we determined that, for the preparation of our RIIO-2 business plan, it was not appropriate to instigate any special, new or different enhanced engagement. Our stakeholder user group supported this approach, noting that the ongoing costs of our connection service are only a small proportion of our overall operating expenditure, that no significant changes are being proposed, and bearing in mind the in-flight commitments we have made to be more responsive to our customers.

Customer journeys

We interact with customers through the complete lifecycle of their projects from initial enquiry, application, commissioning, operation and disconnection to decommissioning. Our customer journey work has been focused on transforming the experience customers have through their lifecycle with National Grid. Our ambition is to meet and exceed our customers' expectations so, to do this, we have engaged with our customers to understand their pain points, thoughts and views on the service we provide.

Typical feedback we have received is that customers value that we are listening and would like us to keep making improvements:

> *"You have taken steps to increase customer engagement, and have improved the connections process, but could do more in terms of explaining the connection and capacity process."* [redacted]

> *"Transparency should be the umbrella over this priority."* [redacted]

Our focus on improving customer experience has delivered (amongst other things):

- a central set of customer experience principles and standards – generated through customer insight to drive consistent best practice performance – from capability to journey redesign
- a customer experience governance board and Net Promoter Score[111] programme to drive cultural changes at all levels of our organisation
- the development of a customer relationship management system that, moving forward, will enable a consistent experience, drive efficiency and support our goal of delivering a personalised customer experience.

Easier to connect

Customers told us connections take too long and progress is not always transparent. We also heard that our existing technical specifications and connection costs present barriers for new entrants – particularly those developing smaller-scale 'green gas' projects. Examples of stakeholder feedback included:

"Workshops involving potential connectors should continue…Getting together with, and providing an open environment to, customers and experts to seek ideas to address certain barriers. Such as dealing with varying gas quality and thermal value as supply sources change." [redacted]

[111] NPS is an index ranging from -100 to +100 that measures the willingness of customers to recommend a company's products or services to others.

"The end customer will want to connect even where there is not currently the means for them to do so. National Grid should make gas more accessible." [redacted]

In response, we are implementing a host of improvements spearheaded by Project CloCC. We are making it possible for standard design connections to be delivered at a cost of less than £1m in under 12 months. Initiatives like our new online connections portal will be accessible to all users of the network whether large or small and the portal will make it easy for customers to check the status of their applications 24/7.

In February 2019, we published a stakeholder playback consultation[112] explaining our business plan direction of travel and asking for further input. We know from the feedback we received that, despite the changes we've just described, some customers still feel the process for bespoke connections (i.e. those not able to use standard designs) is unacceptably long. We will continue to explore what improvements, new products or services we could offer as we move into RIIO-2.

Energy system transition

Some stakeholders have said that, because of future uncertainties, we should be adaptable to change and keep options open around how the network is used by customers:

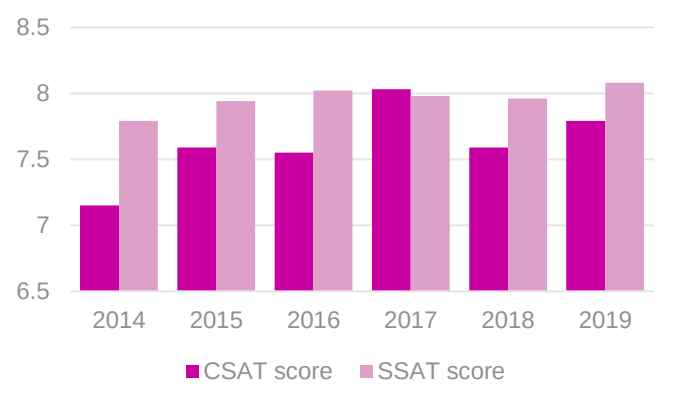
"the RIIO-2 framework needs to allow for differing levels of work on the network to be both determined and undertaken during the RIIO-2 price control period" [redacted]

We support this statement. The existing/revised uncertainty mechanism proposed for incremental capacity and customer service improvements is a key tool that will allow us to be responsive to change.

Customer satisfaction

We are incentivised by Ofgem to improve our customer and stakeholder satisfaction. Our customer satisfaction rating has increased from 7.1 at the start of RIIO-1 to 7.9 currently in 2018/19.

Figure 27.3 Gas transmission customer and stakeholder satisfaction scores



4. Our proposals for RIIO-2 and how they will benefit consumers

Customer focus

We will improve our service for customers by being more responsive to their needs, aiming to raise our measured customer satisfaction scores. We will do this by listening to customer feedback and tackling pinch points in the customer journey, and we'll start using a customer relationship management tool to enhance our ability to provide a joined-up service across our multi-disciplinary teams.

Market facilitation

We will support the energy market's liquidity by providing an efficient connection and capacity applications process in accordance with our code obligations. We will meet or beat the timescales set out in the Uniform Network Code for delivery of connection and capacity offers to customers.

Optimising use of the existing system

We will make best use of existing assets by substituting capacity where possible rather than by building more transmission capacity, and we propose that the process for regulatory approval of capacity substitution should be made simpler. Where necessary we will deliver more capacity, providing transparency about our analysis of network capability and informed by clear, robust options analysis.

Embedding innovation

We will support the UK Clean Growth Strategy, moving towards decarbonisation and the energy systems transition by continually looking for new ways to meet the requirements of a changing customer base. We will act upon learning from

[112] https://www.nationalgridgas.com/document/125911/download

projects currently underway to consider the impact of higher hydrogen content gas on the network.

We will make our network more accessible to new entrants such as shale gas and biomethane entry customers and gas-powered vehicle refuelling station exit customers. We will embed the improvements of Project CLoCC into business as usual, making standard design connections possible for less than £1m in under 12 months. Key improvements include:

- a web portal to streamline the application to offer process for all connections
- application fees (for small and medium customers) reduced from £109k to £13k
- a quicker route through capacity reservation for pre-screened green light connection locations
- acceptance of higher oxygen content gas from biomethane producers
- standardised connection designs and immediate connection cost quotations.

Outputs

Connections

Our connections priority maps to Ofgem's output category 'meet the needs of consumers and network users'. Ofgem have decided to retain our existing RIIO-1 licence obligation relating to connections – specifically to comply with the connections process requirements of the Uniform Network Code. Our performance against this output is monitored through quarterly reporting published on our website.

Customer satisfaction

We will continue to be incentivised by Ofgem to improve our customer satisfaction scores. These output measures have driven improvements through RIIO-1 and we recognise there is further scope to raise our performance.

Extra capacity

If capacity reinforcement is triggered (such as the indicative reinforcement to increase entry capacity at Milford Haven in south Wales) our delivery of this work will become an important output. We'll use notices to tell the industry how we're handling the process, which alternative infrastructure options we're considering and what our preferred solutions are. For example, we'll consult openly with potentially affected communities about any proposed new cross-country pipelines in line with good practice for land use planning approval.

How do our RIIO-2 proposals benefit consumers?

Our connections proposals deliver benefits for industrial and domestic consumers:

Consumer Priorities	How does our plan support this?
"I want to use energy as and when I want"	Our plan supports security of GB gas supply because: - we make it easier for new sources of gas like shale and biomethane to connect to our system - diverse domestic and international sources of gas can access our network efficiently; we are part of a global gas market. The effectiveness of our processes has an impact upon the attractiveness of GB as a destination for the economic supply and consumption of gas
"I want you to facilitate delivery of a sustainable energy system"	Our plan supports a sustainable lower carbon future because: - we make it easier for lower carbon biogas to enter our system e.g. off-the-shelf standardised connection designs. This assists decarbonisation of the whole energy system with minimal disruption to consumers - we make it viable for gas-powered vehicle refuelling stations to connect to our network. These vehicles play an important role in decarbonising the heavy goods transport sector alongside electric vehicles for domestic use - lower connection costs open up new locations where offtake connections were not previously seen as economically viable
"I want an affordable energy bill"	Our plan supports an affordable energy bill because: - we provide a better service to new and existing customers, promoting a faster route to market e.g. web portal - where possible we provide capacity without building new assets. This keeps costs down and avoids uncertainty about the enduring value of new assets in decades to come - keeping costs down helps GB retain a buoyant energy-intensive industry sector in turn supporting employment

5. How will we deliver?

As the energy market decentralises we have seen a surge in connection requests from smaller customers, many of whom are new to the sector with less knowledge of the gas system and the industry's ways of working. These new entrants expect easy to use digital tools to help them connect to the network and existing customers are also coming to expect easy and instant access to information that helps them run their businesses.

The changes we are implementing because of Project CLoCC are spearheading how we are being more responsive to all customer needs. We have started to deploy our new gas connection application portal and this will benefit all customers regardless of size and type. Throughout RIIO-2 we will continue to invest in the portal, related internal systems and other aspects of our website to improve our customer self-service capability and provide customers with unified, timely and continuous access to relevant information.

New functionality[113] introduced by these tools makes us more efficient, cutting down paperwork, reducing administration and saving time. For example:

- automatic generation of key files and standard contracts with customer data
- three types of customer journey; standard connection design, bespoke and PARCA
- email notification to customers and NGGT employees about changes in application status
- customers can self-serve downloading/uploading offers and acceptances
- ability to raise and track invoices.

Our second key enabler for improved delivery is the implementation of our Customer Relationship Management (CRM) system. This system will underpin how we manage our customer connection process across its entire lifecycle. CRM is the most efficient and effective way to manage customer data, our processes for interacting with customers and our identification of opportunities or issues. Following deployment in 2018 we've begun to digitise parts of that journey but, to ensure we can offer an end to end simple, tailored and flexible service to customers, we will need to invest to bring more aspects of our customer interactions into the CRM system's remit.

Customer choice - competition

Some customers have told us they would like the opportunity to deliver their own local connection works, rather than relying upon NGGT to connect them to our system. We are currently supporting 'self-connect' trial and this will provide valuable learning about the changes in process, roles, responsibilities and commercial arrangements that would be necessary to offer a self-connect option more widely.

6. Risk and uncertainty

Our future workload is uncertain because so much of our activity is driven by the number and complexity of the connection and capacity applications that we receive from customers. We assess workload by tracking the enquiries that we have received and monitoring market trends including outputs from the Future Energy Scenarios process.

Through Project CLoCC we already know there is increased interest from customers who want to connect. This confirms that the time and cost savings we've identified for the application process make connection to the network a viable option for new kinds of customer. By January 2019 we had received interest from 12 different customers enquiring about 25 potential connection sites. Four of these customers have confirmed that they will be applying for a standard design connection as the innovation project is implemented.

Considering the inherent uncertainty around future work requirements, we're proposing that only a small proportion of our costs are included in our base revenue. Expenditure for other activities will only be incurred if customer activity triggers a requirement for the work, and it will either be customer-funded on a case-by-case basis or handled by regulatory uncertainty mechanisms established by Ofgem. This is in consumers' interests because it means that, wherever possible, we will only incur costs based upon firm customer commitments. See summary Table 27.4.

[113] For further information see Project CLoCC Close Down Report

Table 27.4 proposed uncertainty mechanisms

UM name	Type	Business plan proposal – what the UM addresses	Frequency
3. **Incremental capacity**	Reopener	Potential costs associated with release of incremental capacity are unknown. Revised incremental capacity reopener for RIIO-2.	Case-by-case basis
4. **Pipeline diversions**	Reopener	Allows recovery of pipeline diversion costs to the extent that they cannot be reasonably recovered from parties requesting the diversion.	Annual

7. Our proposed costs for RIIO-2

Our estimated costs for RIIO-2 reflect a balance between the increase in workload we are seeing, our increased spending on information systems like the connections portal and CRM tool to improve customer service, and the efficiency benefits we expect to achieve from working smarter – for example, using the customer portal. We have assumed that we can flex resources across internal teams to meet peaks and troughs in workload, with zero net cost for customer-funded work. Please refer to Chapter 31 for a full list of our planning assumptions.

Costs not accounted for through the uncertainty mechanisms set out in table 27.4 are shown below.

Table 27.5 Areas of spend "I want to connect to the transmission system" with no related UM

Activity	Base revenue requested?	Comment
System operator activities	Yes £1.2m p.a.	Operating costs for the customer account management, connections contract and network analysis teams who manage our portfolio of commercial agreements with customers. Also includes supply point administration (3% of Xoserve costs)
Customer service (IT)	Yes £1.2m p.a.	Investment for more responsive customer service including: website, connections portal and customer relationship management system
Local connection works	No	Zero net cost forecast for RIIO-2 because actual costs incurred are recharged to customers on a cost pass-through basis

Our proposed total expenditure related to the connections activities we've described in this priority is summarised in the following tables.

Table 27.6. summary of connections costs

Activity spend (£m in 18/19 prices)	2022	2023	2024	2025	2026	Total RIIO-2	Annualised RIIO-2	Annualised RIIO-1
System operator activities	1.2	1.2	1.2	1.2	1.2	5.9	1.2	1.2
Customer service (IT)	1.1	1.4	1.6	0.8	0.9	5.8	1.2	1.0
Pipeline Diversions								
Local connection works								
Incremental capacity (UM)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Total spend	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Note to table 27.6: Diversions and local connection works have a zero net cost forecast for RIIO-2 because actual costs incurred are recharged to customers on a cost pass-through basis

The key changes we have made to the connections part of our business plan since our February 2019 stakeholder playback consultation[114] are:

[114] https://www.nationalgridgas.com/document/125911/download

- Inclusion of indicative new network reinforcement costs for incremental capacity load-related work (uncertainty mechanism costs triggered by a customer application reaching PARCA phase 2 in March 2019)
- Inclusion of supply point administration and customer service improvement IT costs (granularity of cost data which had not previously been separated and mapped to the connections area of our plan).

Business plan data templates

Our business plan is accompanied by a set of spreadsheet BPDT in a format required by Ofgem. The following table provides a summary of how our base revenue and uncertainty mechanism proposed spend flows into our RIIO-2 BPDT.

Table 27.7 summary of connection costs – BPDT split

RRP category (£m in 18/19 prices)	2022	2023	2024	2025	2026	Total RIIO-2	Annualised RIIO-2	Annualised RIIO-1
Direct costs	1.2	1.2	1.2	1.2	1.2	5.9	1.2	1.1
Load-related (UM)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Non-load related	0	0	0	0	0	0	0	0
Non-operational capex	1.1	1.4	1.6	0.8	0.9	5.8	1.2	1.0
Grand total	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Notes to table 27.7

- Direct cost includes the team and people to carry out activities
- Load-related includes the indicative cost of system reinforcement for new incremental capacity
- Non-load related includes Net Zero forecast for customer funded connections and diversions
- Non-operational capex includes customer service improvements (IT)

8. Next steps

We will work with Ofgem to implement the proposed RIIO-2 framework changes that are relevant to this topic including:

- simplification of the regulatory approval process for substituting capacity
- design of the incremental capacity uncertainty mechanism
- we will propose bespoke outputs for stakeholder engagement
- work with the independent stakeholder user group to determine which customers future satisfaction surveys should target and the design and content of future surveys.

We will clarify the situation for customers wishing to connect higher hydrogen content gas sources to the network. This will be informed by learning from several hydrogen projects currently underway with partners. For further information see chapter 25.

Part 5
How we deliver our stakeholders' priorities

28. Our plan is efficient and affordable, providing value for money

What is this stakeholder priority about?

One of our key priorities is keeping energy affordable. We strive to keep our impact on domestic and industrial consumer bills low and we work with our customers to keep energy affordable. We have a strong cost focused culture but are fully aware of the requirement to balance this with the service we deliver. The current RIIO framework gives us a strong incentive to deliver our outcomes as efficiently as possible but we can't cut costs at the expense of long-term consumer outcomes. We've shown how we continually balance this challenge during RIIO-1 by overspending our allowances for asset health investment as we believe this is the right thing to do to maintain a safe and reliable network today and into the future.

What have you told us?

We must help to keep energy affordable for domestic and industrial consumers and this is one of our priorities. We work hard to keep our impact on bills low – the services we provide adds less than £10 to the average annual domestic energy bill.

Being more efficient to deliver value for money

To deliver our proposals as cost-effectively as possible we have challenged ourselves to drive efficiencies across our activities. We have done this by:

- building in the future benefits of our stretching UK efficiency programme, **saving £150m** over the full RIIO-2 period
- making an ambitious commitment to further **reduce our operating costs by £22m**. This represents a further 5.6% improvement in our operating productivity by the end of RIIO-2. This is nearly three times the government's forecast of UK productivity growth. The outcome of our total operational cost efficiencies will mean our RIIO-2 costs are 13% lower by the end of RIIO-2 than they are today
- building in the benefits of our past successful engineering and asset management innovations to include a 4% efficiency on our direct capital investments, **saving £80m.**

In addition to the efficiency improvements and commitments we have applied, we have challenged ourselves to focus on the most effective and efficient activities that will deliver the network capability needs of our stakeholders. We have proposed a plan on future compressors against RIIO-2 and RIIO-3 that will result in 16 compressors being decommissioned or derogated at a cost that's significantly lower than replacing these units. This has the potential to save consumers over £300m in RIIO-2 and £263m in RIIO-3.

Overall, we are reducing the costs of delivering your priorities by £552m. This will keep our impact on the household gas bill at or below RIIO-1 level.

Our wider impact

We are conscious that undertaking our activities effectively has a more far-reaching impact on consumer bills than the cost of our activities alone. By facilitating the effective functioning of the gas market, we have a positive impact on the wholesale energy cost for all stakeholders. [redacted] This concluded that even with perfect foresight and not taking account of unexpected short-term shock, failure to maintain the existing capability of the NTS could have significant impacts on GB consumers, adding up to £877m per year to electricity wholesale prices by 2035.

This chapter demonstrates the value for money and deliverability of the entire business plan. It also discusses costs not mapped separately to other stakeholder priorities, including business support cost and non-controllable costs. This is our first draft business plan. We will continue to gather and review benchmarking and efficiency evidence. We will include any impacts or additional evidence in the next version of our plan.

The total controllable cost of delivering the key stakeholder priorities in this draft plan is £3.1bn including real price effects. We also incur non-controllable costs such as licence fees and business rates which are outside of our control. As in RIIO-1 we propose these be passed through. Our current forecast of these costs included across the whole plan is £851m.

1. What is this stakeholder priority about?

One of our key priorities is keeping energy affordable. We strive to keep our impact on domestic and industrial consumer bills low and we work with our customers to keep energy affordable.

In a time of rising energy bills, it is vital that we play our part in keeping costs down for all consumers, especially those who are in fuel poverty. Overall, we will continue to focus on carrying out our activities as efficiently as possible for the benefit of end consumers.

We develop, maintain, and operate an economic and efficient network. The essential role that we play enables diverse sources of gas to enter the GB wholesale market and allows market participants to optimise their commercial operations. This enables competition in the supply of gas in GB. This keeps energy costs to consumers as low as possible.

2. Our activities and current performance

We have a strong track record of delivering more for consumers.

We have delivered value for money for consumers through the outputs we have delivered. We have maintained high safety performance from our assets and have world class levels of safety for our people and contractors. We are very proud of this.

We have sought innovation opportunities to deliver the greatest value for consumers and applied them across our business activities – we do this throughout our activities, but specifically for network innovation allowance expenditure to date we have delivered four times the benefit for every £1 invested.

The innovative catalytic converter solution at Aylesbury meets emission limits, is significantly cheaper than replacing the unit, quicker to implement and has resulted in £41m returned to consumers in RIIO-1

We have also pro-actively influenced the emissions legislation that our compressors need to comply with. Within the medium combustion plant directive, the time derogation for gas driven compressors was originally 2025. This would have resulted in significant overlap with investments associated with the earlier large combustion plant derogation of 2023.

Through direct liaison with UK government, using our network of industry contacts within the EU and [redacted] we were able to lobby EU stakeholders. These actions resulted in successful influencing of the draft Directive

Crucially we secured a longer derogation for gas compressors that are required to ensure the safety and security of a national gas transmission system. These have been given a further five years, until 2030, to comply with the requirements.

Incentives drive stronger outcomes

We support the core RIIO principle of incentivisation. Across our total spend in RIIO-2 we will be incentivised to continually look for ways to deliver outputs more efficiently and at lower costs. Whenever we find a better way we will share the cost reduction with energy consumers. By maximising our business performance and finding innovative and efficient ways to deliver, bill payers will automatically benefit because of incentivisation.

In RIIO-1 we have completed transformation programmes to improve capability and drive efficiency in our activities. For example, investing in our data and our data analysis capabilities so we can build a modern asset management capability. We have set up a project to deliver better asset management. It is about enabling the business, removing some of the problem handovers, making data, information and decision-making more central. Through unified planning we'll be more agile when workload volumes change, more efficient through project lifecycles and it will be easier to optimise work and minimise disruption to our stakeholders.
We have driven value for money during RIIO-1 through greater competition in contracting to achieve lower tender prices and greater innovation in both procurement and delivery. It has been necessary to develop our own capability in contract and project management excellence so that we are well-positioned to realise the contracting efficiencies in the delivery phase of our projects.

We have worked hard to streamline our activities by developing twenty mandatory standards. They set guidelines for the business by defining the minimum requirements that are expected in working for National Grid. These standards allow us to focus on the way we deliver for our customers. They allow us to be clearer on what's important and enables everyone to challenge the things that get in the way.

Outputs and costs are linked to ensure accountability for outcomes

Over the last decade we have seen more uncertainties affecting our activities. During RIIO-1 uncertainty has been driven by emerging legislative requirements and a better understanding of the condition of our assets.

Uncertainty mechanisms have been in place to adjust our allowed revenue during the period to reflect uncertainty of directed requirements, solutions and associated costs. This manages the risk to consumers by ensuring we are undertaking expenditure when the right level of certainty and cost justification is reached.

An example was the Avonmouth pipeline output designed to help manage the consequences of the Avonmouth LNG storage facility closure. Working collaboratively with key stakeholders we found this was not necessary and we returned the relevant allowance to consumers.

Decisions we make now will affect the outputs and the costs of the network for many years and we have had to balance current and future consumer requirements in coming to our plan. These decisions cover the spending we are proposing in RIIO-2, the recovery of historic costs and the financial framework used to calculate our revenue.

The returns delivered by many networks in the RIIO-1 period have been heavily scrutinised over the last few years. Our returns have not been to the same level because we have been spending over allowances. We do, however, recognise that there are economic reasons why the base return due to shareholders (called the 'cost of equity') should be lower in the RIIO-2 period.

We have delivered a service that our stakeholders value

Reliability has been maintained, playing our role in allowing consumers to use gas as and when they want. This has not been easy given some of the challenges we have faced. Including the trend of our customers using the network in different and more flexible ways and the periods of extreme weather conditions we have experienced.

We have delivered timely customer connections, flexing the network to avoid the need for deeper reinforcement. And we have exceeded our targets for customer and stakeholder satisfaction, although we acknowledge we have more to do in this area.

We contribute 1.6% to the average household energy bill

In RIIO-1 our costs contribute around £10 (1.6%) of the average annual household bill of £569. We have delivered value for money for all consumers through the outputs we have delivered.

3. What are our stakeholders telling us?

You tell us that we have a part to play in keeping energy affordable for domestic and commercial consumers. You expect us to manage costs and risk in the interest of our direct customers and wider consumers.

We invest to make sure that our network provides the service that our stakeholders need and expect. Stakeholders see us as the experts managing the gas transmission system. You are also clear that we must do this economically and efficiently. More broadly, stakeholders want us to build both transparency and trust.

Direct stakeholder feedback:

"All the consumer cares about is the impact on their bill and security of supply" [redacted]

"I couldn't believe how, to be honest, how low your percentage was, you know, if somebody had asked me I'd have said that actually it would have been a lot higher, 20%, sort of 20%, but actually it's very low in comparison to what you do really." [redacted]

Consumers care about keeping their energy bill affordable. They see energy networks as dependable. This reflects well on how we have managed risk on consumers' behalf in the past. We must continue to do so in the future.

4. Our proposals for RIIO-2

The total controllable cost of delivering the key stakeholder priorities in this draft plan is £3.1bn including real price effects. This is the overall totex for RIIO-2, including our business support costs. They are described in this chapter and appear as costs against this stakeholder priority.

The total RIIO-2 spend for this area, is £326m, with an annualised spend of £65m compared to an annualised spend of £79m in RIIO-1. This equates to around 11% of our total business plan.

Stakeholder Priority	Forecast cost
I want the gas transmission system to be safe	£72m
I want to take gas on and off the transmission system where and when I want	£1441m
I want you to protect the transmission system from cyber and external threats	£617m
I want you to care for the environment and communities	£361m
I want you to facilitate the whole energy system of the future – Innovating to meet the challenges of an uncertain future	£103m
I want all the information I need to run my business, and to understand what you do and why	£64m
I want to connect to the transmission system	£12m
I want you to be efficient and affordable	
Business support	£326m
Real Price Effects	£144m
Grand Total	**£3140m**

Capex £1983m*	**Opex** £1012m*
• **Market tested** • **Benchmarked**	• **Pay benchmarked** • **IT benchmarked** • **Business support benchmarked**

***excluding real price effects**

We have tested stakeholder willingness to pay

As we build our business plan, we are making sure it delivers what consumers need at a price they are willing to pay. To do this we are using a mixture of methodologies. We have been speaking with organisations with previous consumer experience to help build our approach and we have asked our independent stakeholder user group and Citizens Advice to challenge our proposals at appropriate points in the process.

Working with the other transmission networks[115] we've appointed consultancy firms, [redacted] to deliver a joint study into willingness to pay (WTP). Their research took place in early 2019 and has been incorporated in our July 2019 submission. Within this research, we covered the topics of risk of supply interruptions, improving the environment around transmission sites, supporting local communities, investing in innovation projects to create future benefits for consumers and supporting consumers in fuel poverty.

The nature of the willingness to pay methodology means that some topics are not appropriate for this type of research. For example, anything safety-related tends to generate an inflated willingness to pay value, which can also impact results for other topics. It is also not appropriate for topics where there is already an established value, such as carbon pricing.

Willingness to pay research has some other drawbacks, including that it can sometimes produce high valuations across a range of service levels. We mitigated this as far as possible by providing context within the study. By focusing on more than one topic, respondents were able to think more holistically about the impact on their bills, and how they trade off against priorities. Willingness to pay is useful in providing information on a range of consumer values for changes in service levels but is not designed for testing the overall acceptability of a business plan. We are using other ways to check consumer acceptability of our plans.

Findings

Domestic customers:

- On average, are willing to pay for improvements in all attributes presented to them
- Are willing to pay less for improvements to highest level of service

Non-domestic consumers:

- Are willing to pay, on average, for most attributes presented to them

A full report on our willingness to pay research can be found in annex A28.01

We have not used these findings to set the size of our plan – their magnitude is greater than our proposed costs and they are a sole data point. Instead, we have used them as an indication of where we may or may not have consumer support, and for topics where there are options, as an indication of priorities. They will also be triangulated with the output of other research and stakeholder engagement.

Following our July 2019 draft submission, we will be carrying out two additional pieces of nationally-representative quantitative research with the specific aim of testing the acceptability of what we're proposing.

Our capital costs are efficient

Our capital costs are the costs we spend on our assets. Whether building new ones or replacing or extending the lives of old ones. The capital costs in this draft business plan will be £80m less than if we delivered them in RIIO-1. This is because we are committing to a 4% efficiency during RIIO-2.

We are efficient as we enter RIIO-2

We use market testing and benchmarking evidence to demonstrate the efficiency of our costs.

100% of our asset health capital expenditure during RIIO-1 was subject to competitive tendering. We utilise this form of competition to extract value from our supply chain. We follow a competitive tender process for any external spend over £100,000 and so 82% of all external expenditure during RIIO-1 has gone through a competitive process. We continue to develop these processes to extract as much value as possible from the supply chain. This ensures and

[115] National Grid Electricity Transmission, Scottish Hydro Electric Transmission, Scottish Power Transmission

validates that we are delivering our outputs at the best value to consumers.

Competition could also be introduced to specific new, large and separable investment projects as has been developed in the Electricity Transmission sector. We will work with Ofgem to determine any changes required. We have identified that the proposed project at our Bacton terminal meets the criteria of competition as defined by Ofgem in their May 2019 decision document.

Benchmarking

We undertake benchmarking and best practice sharing activities across a wide range of our business activities. We do this to identify best practices and where we need to find further business improvements. We focus innovation in these areas to unlock potential benefits or improvements.

We invest time and effort to understand how other businesses perform and how we can adopt approaches that will allow us to drive benefits for consumers.

We participate in various industry associations which allows us access to joint research, innovation projects, benchmarking studies and direct relationships with other similar organisations. We also engage external benchmarking consultancies to further bolster understanding of our cost base.

We are in a unique position of being the only gas transmission business in Great Britain. This means for asset management costs we need to take a different benchmarking approach than that followed by gas distribution networks, where they can look across the four separate network owners. Our approach covers;

- How we build our asset health costs which allows comparisons from previous schemes
- Benchmarking across European transmission system operators for specific spend areas
- Implementing strategic sourcing approach and using various contracting and procurement strategies
- Wider benchmarking initiatives and bespoke activities to identify comparators, such as project management review of our Feeder 9 project and external challenge group reviewing our future asset management project to learn from best practice.

Gas transmission benchmarking initiative (GTBI)

This is a long-standing collaboration of European TSOs, started in 2004, with voluntary participation designed for co-operation and performance comparison. Over the past 14 years, 13 different transmission companies have participated. Our participation is unbroken over that time frame and we are a highly-regarded member of the collaboration. The aims of GTBI are to improve companies' overall performance and identify best practices in gas transmission activities. One activity of the GTBI is a confidential annual cost and performance comparison involving only member companies.

We will stay efficient throughout RIIO-2

We are committing to a four percent efficiency across the capital cost of our draft business plan. This will keep us efficient throughout RIIO-2 for the benefit of energy consumers. We will achieve this through rigorous use of our investment process to ensure efficiency through the lifecycle of our projects. And by extracting value from the supply chain with our contracting strategy.

Our investment process locks in efficiency

All capital investments follow our governance process. This assures that we manage capital investment in line with the delegated authority provided by our board to the gas transmission investment committee. The purpose of the governance process is to assure that investments deliver the best value, fit for purpose solutions to identified problems or opportunities, which meet the needs of ourselves, customers and stakeholders. It manages and defines the project lifecycle from inception through to closure for all gas transmission investments in the regulated business.

It includes six stages with 'gated' progress to ensure minimum requirements are met for each phase, formalises the delegation of authority for gate keepers and sets out mandatory questions to be completed before onwards progression.

It defines the requirements of an investment needs case, which will include cost benefit analysis as required. The needs case is confirmed at every stage before project delivery. We have increasing cost certainty as we move through the stage gates. We appoint FEED contractor at stage 4.3 and a mains works contractor at stage 4.4 in figure 28.1.

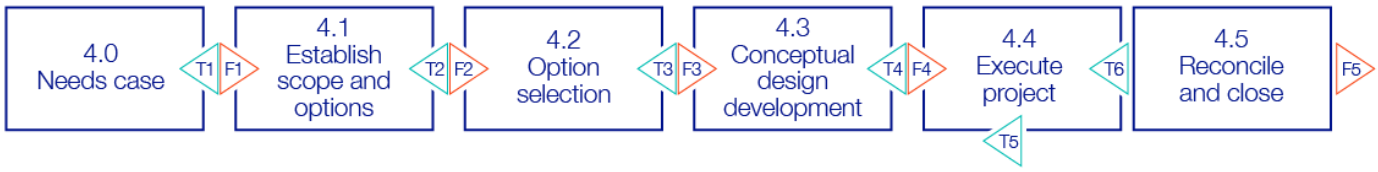
It also sets out the option evaluation and selection process to ensure all reasonable options are considered. These can include do nothing and commercial options in addition to build options.

Our investment process is interlinked with our Governance Code which provides the means for financial approval and commits the investment to time, scope and cost parameters.

There are three possible drivers and routes of entry into the investment process:

- network capability and legislation-driven
- asset health driven
- customer driven (change in need or load related).

Figure 28.1 our investment process



Our delivery model and contracting strategy extracts value from the supply chain

We know that leveraging market forces and utilising native competition will help us get the best deal for consumers from our supply chain. To ensure we maximise this potential we have identified that the following principles are key to our contract and delivery models:

- **Collaboration** - more collaboration with our supply chain to drive greater value and innovation in construction
- **Capable owner** – provide greater transparency about upcoming work, working closely with the supply chain to deliver value over the whole asset life
- **Long term supplier relationships** – select and retain capable, flexible suppliers who deliver what they promise.
- **Simplify tendering** – streamlined tendering process to reduce tendering timescales and costs to the supply chain
- **Early supplier involvement** – two-stage contracts for large projects to allow greater opportunities to increase innovation, simplify the tendering process and reduce whole life costs
- **NEC4** –adopt the New Engineering Contract (NEC4) forms with minimal amendments, to ensure a collaborative approach to contracting with appropriate allocation of project risk
- **Construction supply chain payment charter (CSCPC)** – adopt CSCPC standards, and ensure these principles are cascaded through all levels of the supply chain
- **Providing trusted tier 2 support** – enable our supply chain to utilise our frameworks to purchase equipment and services from experienced suppliers
- **Value from equipment** – procure fit for purpose plant and equipment from global suppliers to enable delivery of our works more economically
- **High performing delivery teams** – we will continue to develop the capability of our teams to ensure effective collaboration, working to become recognised as ‘best in class’ in infrastructure project delivery and contract management
- **Digital strategy** – a digital strategy and framework to maximise the use and benefit of the new technology

In line with ongoing pre-process planning activities the current view of our procurement strategy for the RIIO-2 is as follows:

- **Emissions compliance (compressors)** –Retain the use of the Original Equipment Manufacturer (OEM) Framework established in RIIO-1 and implement an Engineering, Procurement and Construction (EPC) Framework, awarding multiple sites wherever possible.
- **Asset health** – Increased use of our Pipelines Maintenance Centre (PMC) for initial asset condition assessment and repair where possible. Opportunity to commit to a portfolio of works using a more collaborative commercial model with the supply chain (Strategic Partnership/Enterprise) to drive value engineering, planning optimisation and innovation through outperformance of unit costs via an appropriate incentivisation model.
- **Cyber (control and protection)** – Expected increase in the programme of work. Opportunity to commit to a portfolio of works using a more collaborative commercial model with the supply chain (Strategic Partnership/Enterprise) to drive value engineering, planning optimisation and innovation through outperformance of unit costs via an appropriate incentivisation model.
- **Pipelines** – Key is agility to react to customer demands. Use of framework with competitive tendering
- **Physical security** – Likely framework for calling off smaller projects.

Information Technology is at the heart of our business

Information Technology (IT) underpins the safe and reliable operation of our transmission business. Our IT applications and the IT infrastructure that supports those systems are fundamental to the running of our operations and keeping our IT systems maintained and updated is critical to ensuring that we continue to deliver efficiently and reliably. Like any organisation, our employees expect to be able to use technology to support their day job, in line with their use outside of work. However, as a transmission business our reliance on IT is greater than other utility businesses. Our role in managing whole system means we have greater and more complex data handling requirements and are at higher risk of the growing cyber threat. Through RIIO-1 we have invested over and above our allowances for IT infrastructure to help ensure our people can work more collaboratively, and to extend our cyber monitoring.

At the start of RIIO-1, we responded to the challenge from Ofgem to reassess our IT asset health policies by extending the technical lives of our IT infrastructure assets, accepting higher levels of risk whilst maintaining levels of availability. However, as we continued through RIIO-1 our employees fed back that IT was becoming a significant blocker to their effectiveness at work. Over the same period, the escalating threat of cyber-attack on our IT systems meant that we had to look again at how we managed our infrastructure so that we could proactively monitor and remediate cyber threats. Considering this, we have revised our IT asset health policies, which have been reviewed by independent IT experts Gartner, who confirmed that they are in line with industry practice.

We have recently implemented a series of investments in new systems to support our HR, purchasing and financial transactional processes, in response to analysis that showed that we had more manual process steps than “world class” functions. These investments will support better controls and lower costs of function as we start the RIIO-2 period.

Our IT investment portfolio for the RIIO-2 period continues the work we have begun in RIIO-1 to bring our IT infrastructure assets in line with asset health policies. Giving our people have the right tools and equipment to work effectively and allowing cyber monitoring to extend across our IT assets and data.

The cost of our plan for the RIIO-2 period is £77m, including £23m of investment costs to support future application implementations and upgrades on behalf of our business support functions. These costs are in addition to the IT expenditure driven by the gas transmission business and to keep our networks cyber resilient, which we have included in our key stakeholder priority chapters. Our IT investment plan can be found in annex A28.03.

Our IT investments are in line with external benchmarks

We have submitted our IT investment plans, including those investments relating to gas transmission applications, for independent review by Gartner – a recognised IT benchmarking organisation. They found that the mix of investment areas, the individual project costs and our project rate cards were all in line with their expectations, formed from their knowledge of IT investments made by other utility companies.

Our operating costs are efficient

Our operating costs (opex) are the costs we incur on a daily basis to maintain and operate our business, as such they contribute to almost all of the stakeholder priorities in our RIIO-2 plan with only business support opex not included elsewhere in this submission. Collectively they make up 30% of our totex expenditure for the RIIO-2 period and because they relate to the day to day running of our business and occur year after year it is particularly important that we can demonstrate that these costs are efficient.

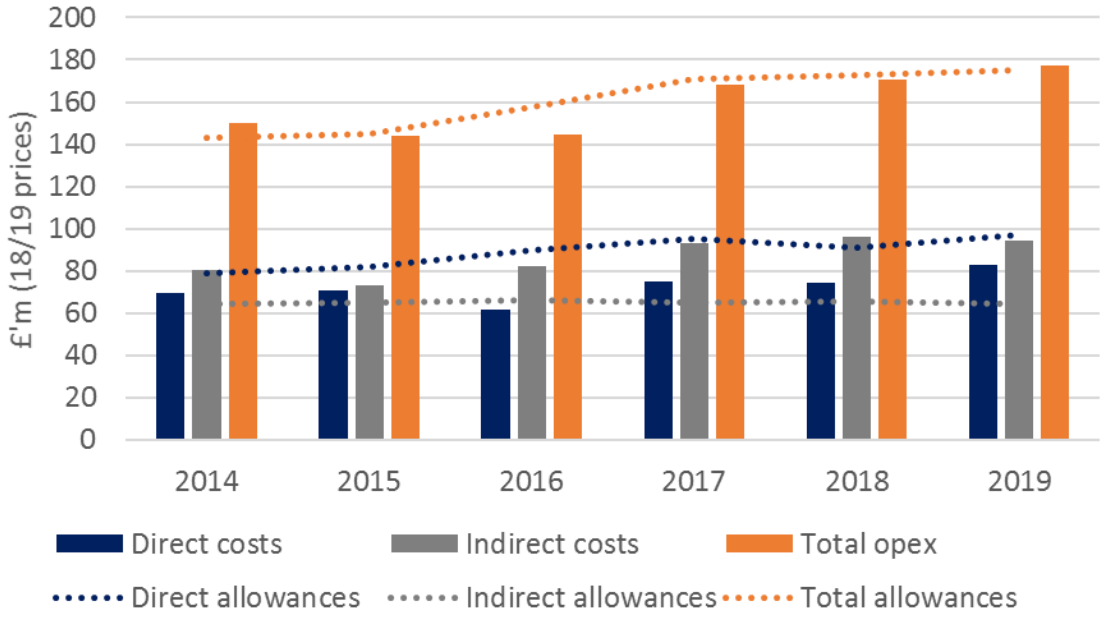
Our plan for RIIO-2 shows that the costs of the activities we do today will be 13% lower by the end of the RIIO-2 period. However, we will have to do more than ever to keep our assets resilient and protected from increased external cyber threat in the RIIO-2 period.

Our RIIO-2 plan learns from our experiences in RIIO-1

We have delivered opex efficiencies in our asset maintenance activities throughout the RIIO-1 period without compromising on delivering outputs. We have, however, cumulatively overspent our allowances due in part to low business support allowances, which were set with reference to overly simplistic benchmarks.

The graph below shows our opex trajectory over the RIIO-1 period (including forecast to the end of RIIO-1), split between direct and indirect costs and allowances.

Figure 28.2 RIIO-1 opex costs and allowances



Ofgem ask us to split our opex costs into direct and indirect categories, with direct expenditure relating to activities that directly impact our assets such as maintenance and the indirect category including both business support and closely-associated indirect (CAI) opex. Business support represents the costs of support functions such as HR and Finance, with CAI costs including more network-specific support costs such as those related to planning network changes and IT support costs for our asset management systems. The running costs of the Gas Control Suite and associated applications used by the system operator are also classified as business support costs. From a business plan data table perspective, the business support and direct expenditure categories are shown separately, however the CAI opex is included in the table along with capitalised internal resource.

As we entered the RIIO-1 period, we were facing growing maintenance requirements from an ageing asset base as well as a shortage of adequately trained workers. The level of opex allowances received for the RIIO-1 period did not fund these upward pressures and consequently gave us a dual challenge of delivering the increasing workload whilst reducing our costs.

Against this backdrop, we reset our operating model at the start of the RIIO-1 period and restructured our business to realign accountabilities, introducing performance excellence (lean) capabilities and optimising our support functions for additional operational workload. This allowed us to mitigate some of the upward pressures in workload and reduce our workforce by over 100 roles.

As we started to deliver our asset health programme in RIIO-1 we found that we needed to get a greater understanding of our asset condition and take more interventions than anticipated. We invested in asset and asset condition data management systems, as well as the resources and capability to analyse and assess the data we collected. This enabled more informed decision making around asset interventions, reducing capex costs.

From an indirect opex perspective, IT costs increased because of the IT systems we invested in to support our asset condition data. Additionally as we developed our capability in identifying and managing the increasing cyber threat to our operations. We also needed to increase the scope of our financial control activities to respond to increasing compliance requirements and focus. The benchmarks that set our allowances did not take these increased activities into account and we were not able to contain these costs within our allowances. We take these lessons and others into our business plan.

Our opex costs are in line with or better than external benchmarks

In line with our position as the only gas transmission business in Great Britain, we need to use a variety of approaches to assess the efficiency of our opex costs.

In areas where there is high comparability, such as across our shared support functions, or employee

pay, we regularly use external benchmarking data to assess our cost and identify areas for improvement. Where there is less comparability, such as our asset maintenance and running costs, benchmarking our costs is more challenging. Our membership of GTBI enables us to share and learn from the best practice in how we run and maintain the Gas Transmission network, keeping our costs efficient.

In preparing our business plan for RIIO-2 we assessed our opex costs against available benchmarking data to assess the efficiency of our opex plan.

Our employees' pay is in line with other companies in our sector

We test our pay deals against our peer group and regularly benchmark our employee remuneration to ensure it remains in line with the market. Our annual pay awards are benchmarked against those of network companies and other competitors in the skills market. We ensure that any deal we put in place with our trade unions or annual pay rise for managers is in line with our peers so that we do not fall out of step with the market but equally so that we do not become a higher than market payer.

From a broader benchmark perspective, with the latest review completed in 2018 by [redacted] (a people and organisational consultancy). We adopt a single pay framework across our UK regulated businesses. This means that all of our employees' (both direct and support function) costs have been recently benchmarked. In summary, total cash remuneration was in line with median pay for a comparator of 130 entities in the Utilities, Oil & Gas and Chemical sectors.

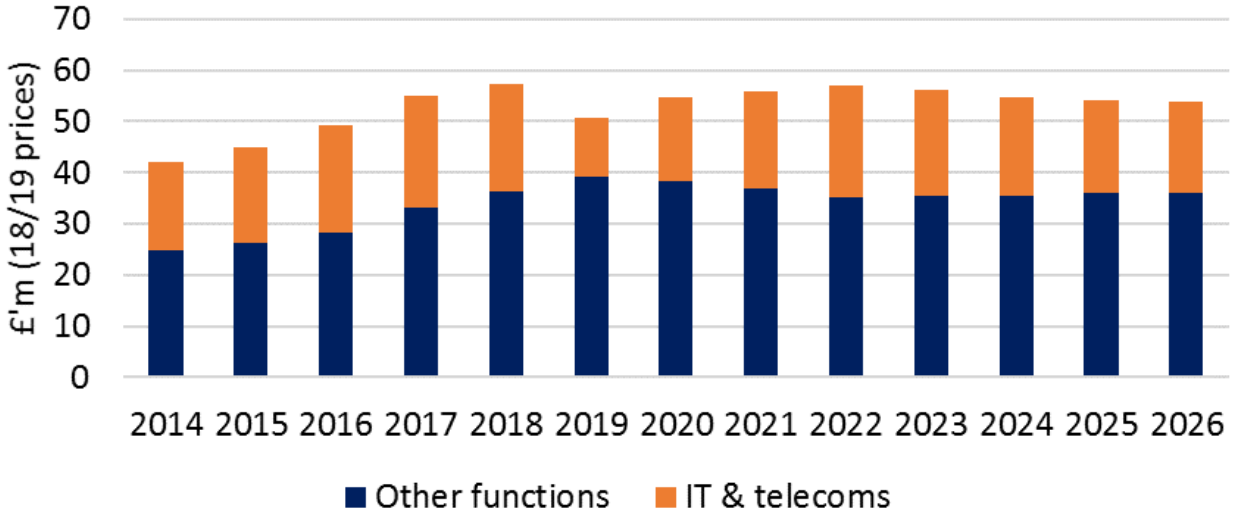
Our business support costs are efficient

Our business support functions provide services such as IT, property management, HR and finance to all the National Grid businesses. They help with the delivery of our core activities, for example by procuring materials, helping us to find and retain our people, and managing IT systems. Our support functions also perform key business activities such as financial control, health and safety and legal compliance.

We operate a shared services model for these functions, where a single function provides services across the National Grid group of businesses. Each business takes a proportion of the shared costs and in doing so benefits from economy of scale efficiencies.

Figure 28.3 shows Gas Transmission's share of the business support costs for the RIIO-1 and RIIO-2 periods. The chart shows that business support opex is broadly flat for the RIIO-2 period, with IT costs growing in the first part of the period as new IT systems become operational and require ongoing support, then reducing as we target efficiencies in line with our opex efficiency ambition of 1.1% per annum.

Figure 28.3 our business support opex for the RIIO-1 and RIIO-2 periods



Benchmarking of our business support costs provides some information about the level of efficiency of our costs, however this approach does not wholly determine the efficient cost of the activities our support functions undertake to support our transmission business. For example, our IT spend as

a percentage of revenue or number of IT users in the business will be higher than many companies. Our IT systems are integral to our operations, and because we face a higher cyber threat due to our role as a gas transmission business. In setting the RIIO-1 price control Ofgem recognised this and provided network companies with the opportunity to submit evidence to support where costs differ from benchmark averages. A pure benchmarking approach to determining efficient costs does not consider the different extents in which businesses invest in support functions in order to drive lower cost in other cost areas. We are forecasting our total opex costs to be broadly in line with allowances by the end of RIIO-1, however this will be through spending higher levels of indirect opex to make efficiencies in our direct opex. Nevertheless, in preparing our plan we wanted to understand how the business support costs in our RIIO-2 business plan compared with those of similar-sized companies.

We asked The Hackett Group, a global business benchmarking organisation, to compare the costs of our support functions with those of similar-sized companies. We provided Hackett with the costs of shared services functions supporting our electricity transmission, gas transmission and electricity system operator businesses. Using Ofgem's business support function definitions, Hackett identified comparable activity categories within their database. We asked Hackett to compare our costs to as many non-regulated companies from the group Ofgem had used for RIIO-1 business support benchmarking for which Hackett still had current data, 19 companies from across multiple sectors formed the comparison group. Hackett performed the comparison to peer group using a single metric for each business support area, such as costs as a percentage of revenue, or cost per full-time equivalent (FTE). Although this is a simplistic approach that averages out key differences (for example, how embedded IT is into an organisation's operations), it provides a reasonable foundation to start analysing and adjusting for more complex areas of our support costs.

Where Hackett identified differences between our costs and those of the comparison group, we asked them to perform more detailed comparisons on an activity-by-activity basis so that we could understand what explained the differences. For our IT costs, we engaged Gartner (an industry-recognised specialist in IT benchmarking) to perform this further analysis, comparing our costs for each of the key activities (e.g. application support, networks, storage, end-user computing) with those of other companies in their database, adjusting for workload (i.e. number of applications, number of services, number of users).

Hackett found that our procurement costs were in line with the upper quartile of their comparison group. So too are the costs for property management after adjusting for our additional Critical National Infrastructure related activities (for example, operating our gas and electricity control centres on a 24-hour basis, and the enhanced physical security measures needed to protect our sites).

Other areas had more differences to benchmark. After adjusting for £2m of employee costs that are held in our HR budget on behalf of the business, our HR costs were lower than peer median but higher than peer upper quartile. We know we must work harder in the energy sector to create an inclusive working environment, and our HR function supports these actions. Our Finance, Audit and Regulation function costs are lower than peer average, but higher than upper quartile companies. Some of this difference is because we were comparing to non-regulated businesses, and the benchmark must be adjusted for additional costs of regulation activities. We also maintain strong financial controls which enable us to operate at the right levels and underpin our strong efficiency. We have seen more focus on our control environment over the RIIO-1 period which has meant we have had to work harder in this area, we also undertake controls work in line with Sarbanes-Oxley requirements (i.e. additional controls around financial information that companies who are listed in the US must comply with). This focus adds more costs of compliance – but better governance and assurance – than companies that do not have requirements that are so stringent.

Our CEO and group management costs are lower than peer median but higher than upper quartile. There appeared to be some outlier cost companies within the upper quartile as costs dropped significantly. We are working to understand the data better, particularly as this function groups together different activities (such as legal support, employee and external communications, and the executive manager of the company) that will vary widely with the nature of business risk each company faces.

On a cost per end user basis, Hackett found our IT costs to be higher than those of similar sized organisations. This is consistent with the extent to which we use and are reliant on IT systems to operate and monitor the gas transmission system which is independent of the number of IT users in our organisation.

Gartner's more detailed analysis found that, after adjusting for levels of workload, our IT costs were in

line with peers whilst delivering higher levels of system availability. In some areas, such as our WAN network and servers, our costs were best in class efficiency defined by Gartner as within the 50th and 25th centiles of cost. In other areas, Gartner found we spend more than our peers on maintaining our networks (LAN) and in supporting applications and end users. The proposed IT infrastructure investment plan for RIIO-2 will support us in achieving best in class efficiency across our IT costs, as well as improving cyber security and will bring our IT costs to upper quartile efficiency by the end of the RIIO-2 period.
We are continuing our work to understand how our costs compare to external benchmarking data and we will use this work to inform our submission as our draft plan evolves.

Our insurance costs are 23% lower than commercial market premiums

We insure our businesses through our captive insurance company, wherever it is efficient to do so. Under this arrangement, insurance is provided by a licenced insurance company owned by the group, set up specifically to underwrite insurable risks of our business operations. We periodically use external consultants to review the premiums considered achievable in the commercial market for our risks, to compare these against the premiums charged and forecast by the captive. We last did this in 2019, using Aon Global Risk Consulting and RKH Specialty, who estimated the commercial market premiums would be over 23% more than our proposed premiums for RIIO-2. This equates to around £6m of savings to consumers for the RIIO-2 period.

Our embedded opex efficiencies make us fit for the RIIO-2 period

Building on the experiences and capabilities we developed in the first half of RIIO-1, we have recently reshaped our business in readiness for the changing needs of our customers over the next five years. We have undertaken an ambitious, bottom up review of our business which enables us to bring in new skills and capabilities and reduce costs to our customers. We have identified a suite of co-ordinated initiatives which will deliver the savings including realigning processes using lean techniques, replacing our financial systems to improve and streamline controls and introducing more flexible field force arrangements.

The resulting re-shaped organisation and cost base make us fit for delivery in the RIIO-2 period. Our pay is comparable with peer companies and savings bring our business support costs in line with or better than benchmarks. We are forecasting to deliver annual opex savings of £30m by March 2021, which will flow into all years of RIIO-2 making a total saving of £150m.

On top of these savings, we are challenging ourselves to find more efficiencies in RIIO-2. We have embedded 1.1% per annum of productivity into our underlying opex cost base. This is nearly three times the current UK trend for productivity and a reduction of £22m across RIIO-2 This means overall our underlying opex cost base will reduce by 13% between 2018 and the end of the RIIO-2 period.

We will have to manage key cost drivers in our plan

We expect the opex pressures we have experienced in the RIIO-1 period to continue into RIIO-2, and they will offset the forecast underlying savings. The three main drivers relate to:

- Our ageing asset base. We forecast an additional £4m opex as we flex our organisation to deliver our RIIO-2 asset health plan and ensure we have the right skills and capabilities to deliver our work now and in the future. Most of these costs will be capitalised but there is some opex impact related to training and other non-capitalisable activities. We are also forecasting an increase of £3m in our insurance costs because of bigger insurance premiums across the infrastructure sector in response to recent wildfires and other major events. Our captive insurance approach means that our premiums are still 23% lower than if we had sought insurance through a commercial arrangement.

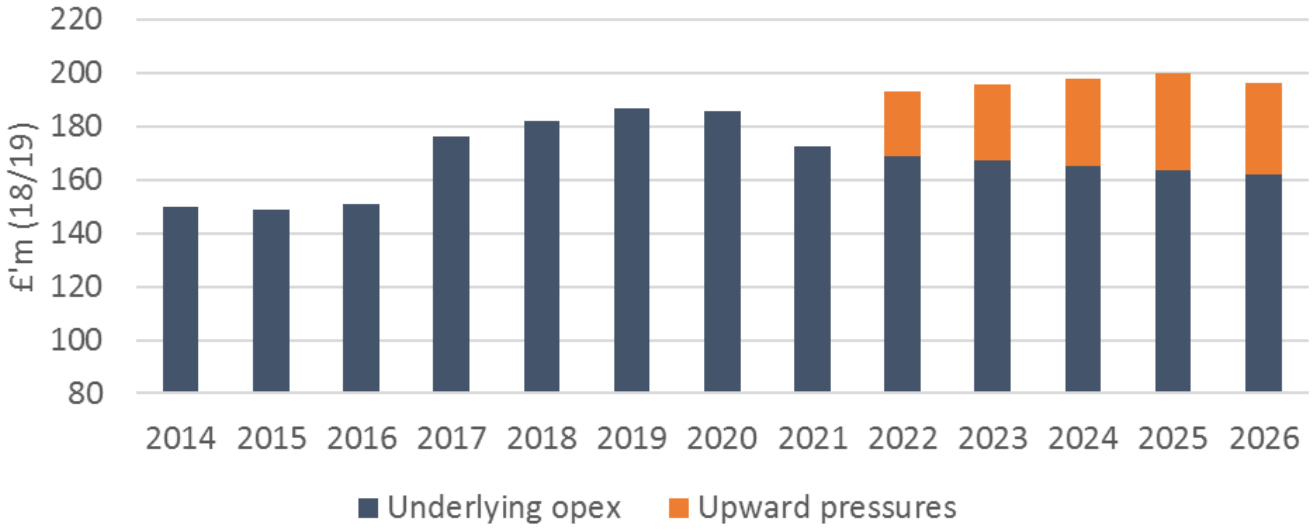
- Maintaining cyber resilience. We need to respond to the emerging threat around deliberate cyber and physical interference with our operational assets. We have invested in cyber resilience during RIIO-1 but there is more to do as we enter RIIO-2. Government bodies are guiding our requirement which will call for both investment and ongoing operating costs. Our additional base RIIO-2 opex in this area is [redacted] per annum and this will be subject to uncertainty mechanisms, so that our response is not constrained by funding and we will only spend what is required by external compliance bodies.

- The related impact on IT support costs. We are investing in new systems to grow capability in our business and reduce cyber threat. Our IT

infrastructure modernisation programme, set up in response to the increasing threat of cyber-attack, offers us opportunities to rationalise our IT architecture to lower running costs in the future. We are targeting IT cost savings of £6m a year by the end of RIIO-2, which more than offsets the increased running costs of our new systems. However, we expect to take up cloud-based IT solutions which add opex costs but reduce capex costs and deliver more scalability and flexibility. Overall, our IT opex costs will increase by £2m in total from the start to the end of RIIO-2.

Figure 28.4 shows the profile of our opex costs over the RIIO-1 and RIIO-2 period. The costs of the activities we do today will be 13% lower by the end of RIIO-2 due to us targeting an efficiency level that is almost three times that of the UK economy over the RIIO-2 period. However, we will have to work harder than before to keep our assets maintained and resilient against the increasing external cyber threat.

Figure 28.4 total opex profile RIIO-1 and RIIO-2



We will be subject to above inflation impacts on our plan

Real Price Effects (RPEs) occur where input prices are anticipated to move differently to the inflation measure which our allowances adjust by annually. This is because the mix of goods and services in the inflation calculation differ to the good and services we purchase. The main areas where this applies are labour costs and the materials we use in our capital works

Independent forecasts and long-term trends highlight that both labour costs and capex material costs are forecast to grow at a quicker rate than inflation over the RIIO-2 period. We will therefore be exposed to above-inflation RPEs in our plan. Whilst both are anticipated to grow, the level of control we have differs, as does the potential volatility in the annual price movements.

Our staff costs track the directional trend of the relevant indices but do not fluctuate with short-term changes due to our long-term pay deals and longer-term approach to workforce resilience. The underlying indices are also less volatile than those related to commodities. Following the RIIO principle of aligning risk to the party best placed to manage it, we are therefore proposing a fixed allowance for labour RPEs based on independent forecasts of 0.3% above RPI (1.3% above CPIH).

In comparison, we have limited ability to control how capex material prices impact our cost base. Changes in input prices will be factored into all goods we purchase, and the related indices aligned to these costs are inherently more volatile than labour, with for example 20% annual cost swings in the last ten years. Although these impacts can be partially mitigated through contracting strategy, we cannot

control the risk and underlying cost trend. We are therefore proposing an index approach for capex materials which will ensure our customers pay no more or no less than the relevant indices for these costs.

5. How will we deliver?

The planned increase in work on the network has required us to think very differently about how we manage system access whilst ensuring we can deliver the service our customers need. It is important that the RIIO-2 incentive arrangements on maintenance, capacity constraints and customer satisfaction are aligned to minimise the impact our work can have on our customers.

The application of innovation projects developed in RIIO-1 such as GRAID and Shallow Dig as discussed earlier and other projects such as composite pipe supports and 3D Modelling (BIM) will be critical to successful and efficient delivery of our programmes of work. We will also continue to develop our campaign approach to work delivery alongside our procurement contract approach to drive successful and efficient delivery of work.

We have developed our plan over a 10-year period to accommodate network outages in RIIO-2 and RIIO-3. However, we have demonstrated that we can manage the network outages required by this plan while minimising constraints and costs for our customers. Bringing workload forward or deferring into RIIO-3 is likely to influence the capability of the network during that period.

The building blocks of our outage plan are:

- pipeline inspection outages – we have defined when we need to internally inspect our pipelines (between five and 15 years). Remediation outages are scheduled following inspection and our plan is designed to deliver as many works as possible during outages for pipeline inspections, to avoid any more down-time.

- prioritising delivery of legislative work – to manage external threats and reduce the emissions at our compressor sites we have prioritised the associated outages over the 10-year period. Deadlines for these programmes mean we need to ensure we meet the compliance date. These activities have then been scheduled alongside our asset health plans.

- non-routine maintenance – over time we will need to carry out non-routine maintenance that requires outages. We can't plan for this but our plan provides flexibility to schedule additional outages.

To ensure we deliver the plan as currently expected we will rely on our people, processes and practices.

People

Our most important assets are our people. Workforce resilience is about having a workforce with the right number of people with the right skills, the right, healthy mindset and work-life balance, and the right representation to reflect the society we serve.

We are forecasting significant levels of retirement and increased non-retirement attrition over the RIIO-2 period and the following 10 years. At the same time, entrants to science, technology, engineering and maths (STEM) careers, from which we would expect to replace our workforce, are becoming increasingly scarce. In response, and to ensure that the people we bring in represent the diversity of the communities we serve, we are committing to expand our HR activities in supporting STEM engagement, inclusion and diversity and the wellbeing of all our people.

We already have in place many things to help ensure the resilience of our workforce. Through RIIO-1 we have seen employee engagement levels in line with high performing companies and have higher proportions of key diversity metrics in our critical workforce relative to the UK engineering sector.
We are proposing to maintain the resilience of our critical roles within a range of 105-115% coverage (that is the per centage of people who could perform in a critical role with a six-month handover). By doing this we can maintain the resilience of our networks, contribute to the UK STEM talent pool and protect consumers from having to fund premium labour costs in the future. We will track our progress on developing the diversity of our critical role workforce by reporting key diversity metrics for this workforce within our annual regulatory reports.

We are a socially responsible employer. We passionately believe that having an inclusive and diverse workforce and culture is the right thing to do to ensure everyone can thrive. In 2018 we were ranked among the top 50 employers for social mobility by the Social Mobility Foundation[117].

[117] http://ournationalgrid.com/uk/we-are-ranked-in-top-50-for-social-mobility/

During RIIO-1 we have significantly increased our black, Asian and minority ethnic (BAME) diversity to 14.4% across our employees. We have done this by running internal initiatives including reverse mentoring, employee resource groups and a development programme for diverse leaders. For the second year running, we made Business in the Community's (BITC) Best UK Employers for Race Top 70 list[118] and were also a finalist in BITC's Race Equality Awards.

We have increased the total proportion of our female employees across all roles by 3.6 per centage points in the last four years from 22.6% to 26.2. We have also secured a place in The Times Top 50 Employers for Women[119]. We have increased the population of female employees by running several initiatives including female-focused training programmes (Spring Board and Spring Forward), our UK women's network, Women in National Grid (WiNG), and ensuring that our roles attract female staff by targeting organisations such as the Women's Engineering Society. In line with other UK employers of over 250 people, from 2017 we reported our gender pay gap. Our latest data shows that our median pay gap is 0.4%

Further detail can be found in the sustainable workforce planning annex A28.02.

6. Risk and uncertainty

There is some risk around the level of external cost that we face which are outside of our control. We are proposing to pass through these costs which cover things like licence fees and business rates.

To manage the risk of above inflation cost impact we are proposing an index approach for capital materials which will ensure our customers pay no more or no less than the relevant indices for these costs.

[118] https://race.bitc.org.uk/awards-benchmarking/best-employers-race-2018-0

[119] http://ournationalgrid.com/uk/were-named-in-top-50-employers-for-women-list/

7. Our proposed costs for RIIO-2

This chapter demonstrates the value for money and deliverability of the entire business plan. The costs shown here are not mapped separately to other stakeholder priorities, including business support cost and non-controllable costs.

Non-controllable costs such as licence fees and business rates are outside of our control. As in RIIO-1 we propose these be passed through. Our current forecast of these costs not shown in other chapters is £752m.

Table 28.5 activity spend 'I want you to be efficient and affordable'

Activity Spend (£m in 18/19 prices)	2022	2023	2024	2025	2026	Total RIIO-2	Annualised RIIO-2	Annualised RIIO-1
Total controllable costs	88.2	89.8	85.0	81.5	83.7	428.2	85.6	78.5
Total non-controllable costs	170.0	171.4	143.6	133.2	133.7	751.9	150.4	183.2
Total Spend	258.2	261.2	228.6	214.7	217.4	1180.1	236.0	261.7
Capex efficiency commitment	**-11.6**	**-13.2**	**-16.1**	**-17.1**	**-21.9**	**-79.9**	**-16.0**	
Productivity efficiency commitment	**-1.8**	**-3.1**	**-4.4**	**-5.7**	**-7.0**	**-22.0**	**-4.4**	

Business Plan Data Templates

Our business plan is accompanied by a set of spreadsheet business plan data templates (BPDT) in a format required by Ofgem. The following table shows how our business support costs feed into the BPDTs.

Table 28.6 business plan data template spend 'I want you to be efficient and affordable'

RRP Category (£m in 18/19 prices)	2022	2023	2024	2025	2026	Total RIIO-2	Annualised RIIIO-2	Annualised RIIO-1
Business support	63.7	62.8	61.9	62.0	61.7	312.2	62.4	57.9
Closely Associated Indirects	1.7	1.7	1.8	1.8	1.8	8.8	1.8	4.8
Direct costs	0.2	0.2	0.2	1.0	0.2	1.9	0.4	6.0
Load Related	0.1	0.1	0.2	0.1	0.0	0.5	0.1	0.8
Non-load related	-11.6	-13.2	-16.1	-17.1	-21.9	-79.9	-16.0	0.0
Non-operational capex	20.6	21.9	16.5	10.9	13.0	82.9	16.6	10.3
Total Non-Controllable Costs	170.0	171.4	143.6	133.2	133.7	751.9	150.4	182.1
Grand Total	**244.8**	**244.9**	**208.1**	**191.9**	**188.5**	**1078.2**	**215.6**	**261.7**

8. Next steps

We are continuing with our consumer engagement programme, including acceptability testing and 'slider' research on consumers' views on the trade-offs in our plan.

We are still reviewing the benchmarking and efficiency evidence we have collected. The results and the implications for our plan could change. The forecasts for real price effects (RPEs) may change. We will carry out acceptability testing for this plan.

29. Summary of our outputs and incentives

This chapter provides a summary of the outputs and uncertainty mechanisms which form part of the gas transmission price control package. They are supported by Annexes A29.01-A29.03 setting out these proposals in further detail. These are evolving areas and we will be engaging with you as we further develop our proposals in these areas for future iterations of the business plan.

Price Control Deliverables (PCDs)

Detail on each of the proposed price control deliverables can be found in annex A29.01. A summary of these PCDs is below.

PCD name	Business plan proposal - what the PCD measures	Related UM	Supporting info
1. **Cyber resilience**	Delivery of cyber security enhancements to reduce the risk of events which could have a severe impact on GB consumers.	UM_1	National Grid UK Cyber Security Strategy (Annex A23.01) Gas Transmission and Gas System Operator NIS Self-Assessments (Annexes A23.03 and A23.04) Gas Transmission and Gas System Operator draft NIS Improvement Plans (Annexes A23.05 and A23.06) Justification Paper –NGGT Cyber Resilience (Information Technology) (Annex A23.02) Operational Technology and Cyber Resilience Justification Paper (Annex A23.07)
2. **Physical security**	Delivery of physical security enhancements to reduce the risk of events which could have a severe impact on GB consumers.	UM_2	Enhanced Physical Site Security Asset Health Justification Report (Annex A23.08) Enhanced Physical Site Security Major Project Justification Report (Annex A23.09)
3. **NARMs (PCD/ODI)**	Relative target to measure delivery of our asset health investments with justified over and under delivery.	-	Justification report and CBA (Annex's A22.08- A22.23)

PCD name	Business plan proposal - what the PCD measures	Related UM	Supporting info
4. **Compressor emissions**	Deliver compressor emissions compliance at Wormington in RIIO-2 and begin work to deliver compliance at King's Lynn, Peterborough and St. Fergus in RIIO-3	UM_5	Compressor Emissions Compliance Strategy (Annex A24.05) Wormington Justification report & CBA (Annex A24.10 & A24.11) Huntingdon Justification report & CBA (Annex's A24.14 & A24.15) King's Lynn Justification report & CBA (Annex A24.18 & A24.19) Peterborough Justification report & CBA (Annex A24.12 & A24.13) St. Fergus Justification report & CBA (Annex A24.16 & A24.17)
5. **Redundant assets**	Address redundant assets across 77 sites, assets and asset groups	-	Justification report (Annex A24.08)
6. **Kings Lynn Subsidence**	Address subsidence at King's Lynn compressor site	-	Justification report & CBA (Annex 22.04 & A22.05)
7. **Bacton terminal site redevelopment**	Delivery of Bacton terminal site redevelopment	-	Justification report & CBA (Annex A22.02 & A22.03)
8. **Environmental action plan (new potential PCD/ODI)**	A requirement from Ofgem's May decision, across all sectors, was the delivery of an environmental action plan (EAP) and annual environmental report. This is new for gas transmission. We have included an initial draft EAP in our submission. This is in early stage development, is due to be updated as per Ofgem's revised guidance, and stakeholder views will be sought.	-	Draft Environmental Action Plan (Annex A24.01)

Licence Obligations

A summary of the licence obligations is below.

Licence Obligation name	Business plan proposal – purpose of LO
1. **Maintain 1 in 20 demand capability**	To ensure NGGT efficiently manages the network to be able to meet a 1 in 20 peak demand severe weather event.
2. **Network capability assessment**	To ensure NGGT delivers an NTS that has the physical capability to efficiently meet the needs of NTS users now and in the future.
3. **Connections**	To incentivise NGGT to make connection offers in a timely manner.
4. **Emergency response & enquiry service**	To ensure customers have a reliable emergency response phone line service in the event of an emergency**.**
5. **Annual environmental report (including business carbon footprint (BCF) reporting)**	To increase the transparency of NGGT's environmental performance.

Uncertainty mechanisms (UM)

Detail on each of the proposed uncertainty mechanisms can be found in annex A29.02.

A summary of these is below.

UM name	Type	Business plan proposal – what the UM addresses	Frequency
1. **Cyber resilience**	Reopener Upfront allowance & totex incentive sharing applies for known work with defined outputs.	There is some uncertainty above our baseline scope and costs for cyber resilience work in RIIO-2. An ongoing adjustment mechanism avoids security works being over or underfunded in RIIO-2.	Process undertaken annually May or may not result in any required changes
2. Physical security	Reopener Upfront allowance & totex incentive sharing applies for known work with defined outputs.	Scope and cost of physical security work that is in consumer interests in RIIO-2. An ongoing adjustment mechanism to avoid us being over or underfunded for physical security works in RIIO-2.	Process undertaken annually May or may not result in any required changes
3. **Incremental capacity**	Reopener	Potential costs associated with release of incremental capacity are unknown. Revised incremental capacity reopener for RIIO-2.	Case-by-case basis
4. **Pipeline diversions**	Reopener	Allows recovery of pipeline diversion costs to the extent that they cannot be reasonably recovered from parties requesting the diversion.	Annual
5. **Compressor emissions**	Reopener Upfront allowance & Totex incentive sharing applies for known work with defined outputs.	Reopener for costs relating to compliance with emissions directives.	Year 2 of price control True up at end of period

UM name	Type	Business plan proposal – what the UM addresses	Frequency
6. Quarry & loss development	Reopener Upfront allowance & Totex incentive sharing applies for known work with defined outputs.	Reopener to deal with unpredictable loss of development and mineralisation costs.	Year 2 of price control True up at end of period
7. New threat vector	Reopener	Bespoke UM proposal relating to new threat vectors - "unknown unknowns". Concept to be developed further through future iterations.	Only triggered in exceptional circumstances so that we can respond to stakeholder requirements.
8. **Whole systems**	Coordinated Adjustment Mechanism	Not yet defined (Ofgem potential option in May decision). Further discussion required with Ofgem	To be defined
9. **Policing cost associated with Counter-Terrorism Act 2008**	Pass through	Policing costs cannot be controlled by NGGT or predicted, therefore treated as pass-through.	Annual
10. **Conveyance of gas for independent systems**	Pass through	Costs relate to government policy and cannot be controlled by NGGT, therefore treated as pass-through.	Annual
11. Gas Transporter's share of Xoserve costs	Pass through	This only relate to our share of costs for central data service provider (CDSP) services.	Annual

Incentives

Detail on our proposed incentives can be found in annex A29.03.

A summary of these is below.

Incentive name	Type	Business plan proposal
1. **Stakeholder engagement incentive**	ODI reputational with bespoke outputs	Consider bespoke outputs for stakeholder engagement in line with Ofgem's proposal.
2. **Customer satisfaction survey**	ODI financial	Retain amended incentive in line with Ofgem's proposals.
3. **Quality of demand forecast – day ahead and**	ODI financial	Retain schemes Incentive set with appropriate rewards and penalties to meet the needs of

Incentive name	Type	Business plan proposal
2-5 day schemes (D1/D2-5)		consumers, recognising that demand forecasting is becoming increasingly challenging. Metrics to be agreed with Ofgem.
4. **Maintenance – use of days and changes schemes**	ODI financial	Retain existing schemes and expand to cover the wider range of maintenance activities supported by stakeholder feedback. Incentive set with appropriate rewards and penalties to meet the needs of consumers, recognising that the volume of planned maintenance is likely to be significantly higher in RIIO-2. Metrics to be agreed with Ofgem.
5. **Entry and exit capacity constraint management**	ODI financial	Retain scheme, scheme design to be reviewed after completion of network capability review. Consider changes to scheme to address high impact/low probability nature of scheme. Metrics to be agreed with Ofgem.
6. **Residual balancing**	ODI financial	Retain scheme. Incentive set with appropriate rewards and penalties to meet the needs of consumers, recognising the impact of a changing energy landscape. Propose options to amend linepack component of scheme to better drive the right behaviour during seasonal transitions between winter and summer. Metrics to be agreed with Ofgem.
7. NTS shrinkage	ODI financial	Retain scheme with potential improvements to drive further consumer savings for RIIO-2. Incentive set with appropriate rewards and penalties to meet the needs of consumers.
8. **Environmental action plan**	Potential ODI or PCD	A requirement from Ofgem's May decision, across all sectors, was the delivery of an environmental action plan and annual environmental report. This is new for gas transmission. We have included an initial draft EAP in our submission. This is in early stage development, is due to be updated as per Ofgem's revised guidance, and stakeholder views will be sought.
9. Linepack services	Potential ODI	Develop and consult on options and consider interactions with existing incentives (e.g. residual balancing and constraint management).
10. **GHG emissions (venting)**	ODI financial	Retain scheme with incentive set with appropriate rewards and penalties to meet the needs of consumers. Include upside to encourage further performance improvements. Potentially develop further as part of broader environmental incentive package.
11. **Connections**	ODI financial	Explore options with stakeholders about whether an incentive on the connections process can deliver benefits for consumer.

30. Our plan is financeable

Key messages

Our plan is financeable on a notional company basis.

We agree there is evidence for lower base returns in RIIO-2, but we do not agree it is to the extent that is being proposed by Ofgem.

Our working assumption of 5.5% provides a fair, equitable return which is lower than RIIO-1, reflecting the nature of transmission and allocates risks to the parties best placed to manage them.

The financial package we propose provides the financial capacity required to incentivise networks to innovate so we can deliver stakeholders' needs in an uncertain landscape to facilitate energy transition.

It will also allow us to continue with optimal investments in the technologies that will be key to realising the UK's clean growth ambitions and stakeholder needs such as decarbonisation of heat.

Introduction

We have worked with our stakeholders to build a business plan that reflects their expectations and delivers the services they want. This will involve major programmes of infrastructure investment which will be funded through a combination of debt and equity, at the most efficient proportions. The financial package we are proposing provides the funding and incentives required to compensate investors for the risks held for investing in our business. At the same time our financial package will make sure that our allowed revenues and return are no higher than necessary so that we keep costs low for consumers.

We provide a full and detailed analysis of our financial package in annex A30.01. In this chapter, we provide a summary of our proposals with the focus on:

- an outline and justification of the financial parameters we have assumed in our draft business plan
- the results of our financeability assessment, testing both our package and Ofgem's working assumptions
- the impact on the average household bill of our draft plan and the methodology we have used to calculate it.

Our activities and current performance

We are in a period where the energy system is undergoing major transformation. We are making new and different decisions so that our networks enable the move towards a low carbon economy and do not become an obstacle to delivery. There is however real uncertainty about what needs to be done and when. Networks need to be responsive and proactive to changes in how the network is used which inherently means assuming more risk, the impacts of which we are already seeing.

Transformation was anticipated in the design of the RIIO-1 framework which has adapted well to protect consumers as the energy system has changed. A range of re-openers have adjusted our allowances for specific categories of uncertain costs. RIIO-1 has also provided strong incentives for us to manage risks effectively and to deliver improved service levels. RIIO was introduced to make regulated energy networks move away from simply delivering as cheaply as possible. The RIIO framework has driven progressive behaviours where companies are incentivised to innovate, think large scale and discover what is possible. However, despite these efforts, we have been affected by the emergence of asset management risks, which have not out-turned in our favour. These are the primary drivers behind an expected c10%[120] underperformance in the RIIO-1 period.

We use return on regulated equity (RoRE) to assess how our networks are performing financially under the price control compared to the assumed return used in setting allowed revenues. Based on RRP18 data, our performance is:

[120] Based on RRP18

Table 30.1 RIIO-1 RoRE based in real terms

Allowed return + IQI	6.7%
Totex incentives	(0.6%)
Other incentives	0.3%
Operational RoRE	6.4%
Financing & tax performance	0.6%
Total RoRE	7%

We acknowledge there are gaps and imperfections in the current framework which have led to the perception of windfall gains and losses leading to concerns over the legitimacy of returns levels. It is appropriate therefore for Ofgem to reconsider optimal risk allocation and close these gaps in the design of the next price control, whilst maintaining its core principles which focus on incentivisation, innovation and outputs.

An incentive-based framework which encourages longer-term decision making is best aligned to the changing nature of network services and will facilitate responses to asks which cannot yet be defined. In determining our financial package for RIIO-2 we have made sure it provides sufficient funding to continue driving investment, innovation and future efficiencies which will support stakeholder-led outcomes and lead to sustainably low bills.

Principles for RIIO-2

An appropriately balanced financial framework is key to current and future consumers being fairly charged for the network they use and the services they receive. Careful assessment and calibration of the framework enables a balance to be struck between consumers benefitting from sustainably low bills and incentivising continued investment in long-term assets which will provide benefits over many years.

To ensure this balance we have developed the following principles to guide our approach in delivering the most value for consumers:

Strong incentives: *high quality services delivered at the lowest cost to consumers*
An effective incentive framework ensures delivery of services at the price and levels consumers are willing to pay by aligning their interests with those of investors. Networks are encouraged to seek out lower costs, through the potential to share benefits, whilst still being held to account for delivering the outcomes they have committed to with clear consequences of non-delivery.

Transparent performance: *Be clear how and where networks have delivered for the consumer*
Commitment to, and a clear understanding of what the network is expected to deliver are key in strengthening accountability. This in turn will allow outcomes to be measured and monitored against targets set at the start of the price control providing the transparency which is important for maintaining consumer confidence.

Balanced risk and reward: *risks best managed by networks are not passed to consumers*
The financial framework needs to balance risk and reward fairly between consumers and network companies.

Reducing risks for networks can reduce the cost of capital, and therefore short-term consumer bills. However, limited risk for networks also creates little incentive or financial capacity to control costs because of the limited opportunity to be retained from any reductions. This will ultimately drive higher long-term consumer bills. To avoid this the framework needs to allow a return which reflects market conditions and the risk landscape. This will provide the financial capacity needed for the networks to be incentivised to take the additional risks required to facilitate energy transition.

Regulatory commitment and stable regime: *will keep financing costs low for consumers*
Our costs of borrowing will depend on how our credit rating is assessed. If our credit rating deteriorates, then borrowing costs will go up. Furthermore, it is reasonable for equity investors to expect returns which are broadly stable over time so that returns which were considered appropriate at the time of investment would still be considered appropriate now and in the future. Unpredictability increases risk perception placing upward pressure on the cost of capital. Only by maintaining a consistent approach will the financial framework allow network companies to attract the required investment while keeping bills low for consumers.

In this chapter, we explain how by following these principles, we have developed a draft business plan that delivers a sustainable consumer bill reduction, in the RIIO-2 price control period.

Overview of the plan

Our draft plan indicates the scale of investment in RIIO-2 has annual totex ranges from a low of £480m to a high of £680m, totalling £3.1bn[121] across the 5-year price control. We expect that funding for new expenditure will come primarily from revenues, new debt and re-invested equity return. At these levels of expenditure, we do not expect any equity injections to be required but it is important that the expected level of investment is considered in setting the allowed cost of capital. Ofgem has previously recognised that a greater level of equity investment would tend to support a higher cost of capital.

Proposed financial package

This section sets out our proposal for our cost of capital and its components, including the cost of debt, the cost of equity and gearing. It also sets out our assumptions around tax, capitalisation and regulatory depreciation. Together these make up our financial package; a package which will retain and attract the required investment for the next price control.

For the purposes of this business plan we have followed Ofgem working assumptions wherever possible. We support immediate transition to a CPIH indexed price control but given our fundamental concerns with the policies set out in Ofgem's sector specific decision, we have also used our own assumptions where there is strong rationale to suggest estimates should be different. We have tested the robustness of our package, details of which we go into in the financeability section of the chapter.

Where appropriate we provide a summary of both our proposals and Ofgem's working assumptions. We quote figures on an RPI-stripped basis (i.e. after adjusting for inflation impacts) for comparability with previous price controls.

Allowed debt funding

The cost of debt allowance is set to remunerate companies for incurred debt costs appropriate for a notional efficient network company. We support Ofgem's proposal to maintain adoption of a full indexation mechanism. Their working assumption is based on the RIIO-1 approach albeit with a slight extension to the trailing average period to better align with the sector profile of debt issued, with a 11-15-year trombone being proposed.

We consider a more appropriate trailing average period is 20 years. Companies across the energy sectors have issued debt with broadly the same average tenor of around 20 years. This gives a basis for the use of a 20-year trailing average index which we then uplift by 15bps to allow for debt issuance costs, costs of carry and liquidity provision costs.

Table 30.2 cost of debt assumptions

RPI stripped		
Year	**Ofgem**	**National Grid**
2022	0.97%	2.05%
2023	0.90%	1.88%
2024	0.85%	1.72%
2025	0.82%	1.59%
2026	0.80%	1.46%
RIIO-2 average	0.87%	1.74%

Allowed equity return

The cost of equity is an estimation of the return that equity investors expect for the risks that they take when investing in gas transmission. Value is created for investors through dividends and asset growth funded by the cost of equity allowance. In line with Ofgem's approach, we set the cost of equity based on the capital asset pricing model (CAPM) to reflect investor expectations by combining three parameters; total market returns, risk-free rate and the equity beta. Here we summarise the rationale behind each of our parameter values, with a more detailed explanation of our approach set out in annex A30.01 and our responses to Ofgem's consultation documents.

Total market return (TMR)

The TMR is an estimation of the return that investors expect for taking the market-average level of risk. There is a range of evidence that can be used to estimate future TMR (historical returns, forward looking approaches, investment fund forecasts), we agree with Ofgem that using historical data is the best forecast for TMR. Despite this, Ofgem's method represents a decrease of ~25% since RIIO-1 which is inconsistent with our observations of investor expectations and the expected returns range implied by long run historical data and the stability of TMR.

[121] Including real price effects

We support due weight being given to information in published sources such as the Dimson, Staunton and Marsh dataset from Credit Suisse, not only because it is a convenient and recognised source, but because it contains carefully researched and consistent equity values. We also support comparing values to cross-checks provided these are based on reasonable assumptions and are valid comparisons. Using this approach, all methods imply a range that is at least 6.2% to 7.2% relative to RPI.

Risk free rate

In theory, the risk-free rate is the return for taking zero risk. In practice, the best proxy for a riskless UK investment is the return that investors expect from holding UK government debt (because the UK government is very unlikely to default). We have used Ofgem's working assumption on the basis that the risk-free rate will reflect market rates within the price control.

Equity beta

The equity beta measures undiversifiable risk for which investors expect additional returns. In the context of RIIO-2, it represents the amount of risk that network owners cannot diversify away, or which is specific to the political and regulatory regimes in which the networks operate. Ofgem's approach has led to a working assumption for equity beta which implies a significant reduction in the assumed risk for transmission networks from RIIO-1 and is below the PR19 value for the water industry. This is contrary to regulatory precedent which shows transmission having higher risk.

Transmission networks are more interlinked making works more complex to deliver. There is also higher risk driven by the uncertainty from the energy transition and the influence of political factors impacting the timing and scale of investment. This combined with greater cyber risk because of reliance on digital assets and technological developments leading to changing customer usage of our networks, means a risk profile which supports a beta at least in line with RIIO-1. This is consistent with observed data which does not support a reduction. We include further detail in annex A30.01.

It should also be noted that CAPM does not capture all the risks faced by networks that investors will consider when assessing the level of returns that they require, e.g. political and regulatory risk, so this range may still understate the value of allowed return which should be set.

We propose an equity beta of at least 0.91 for a notional gearing of 60%. However, we recognise that giving due weight to other evidence such as decomposing National Grid plc's group asset beta into a UK and US beta and relevant European comparators, could credibly lead to a higher range of 0.95 to 1.125. Whilst we have not included at this stage, we will continue to review this additional evidence and consider for future business plan submissions.

Cross checks

We agree that cost of equity should be cross-checked against comparator data. Recognising the level of subjectivity involved in estimating the input parameters of the CAPM model there is value in sense-checking the results against those from alternative methodologies. Several direct and reliable cross-checks are available which we have considered appropriate.

These are:

- Dividend Growth Model estimates for individual listed utilities.

An alternative to CAPM, for calculating the cost of equity, is the Dividend Growth Model (DGM) which is widely used in US regulatory settlements. Considering the same sample of listed companies[122] used to determine observed beta values, DGM values suggest that the allowed equity return needs to be some way above 8.6% nominal (equivalent to 5.6% real assuming 3% RPI).

- Asset risk premium to debt risk premium differential

Oxera Consulting[123] propose a further cross-check that draws on evidence from debt markets to ensure that allowed returns set by the regulator for equity are commensurate with the risk associated with operating and owning the associated assets. The premium for equity risk should be higher than the debt premium given the lower priority of equity in terms of claims on cashflow. If this differential is too

[122] National Grid, Pennon, United Utilities, Severn Trent

[123] "Review of RIIO-2 finance issues: Asset risk premium, debt risk premium and debt betas", Oxera, March 2019 on behalf of the ENA

low, it would indicate an uplift is required to one or more of the CAPM parameters.

- Regulatory precedent

Investors value certainty of their future return on investment to the extent that they expect a price control process to follow regulatory commitment and established principles. Ofgem's assumptions seem inconsistent with past regulatory precedent, both Ofgem's own and the CMA. Furthermore, it does not seem credible that the reduction in allowed return can properly reflect any changes in the underlying network risks or market environment.

We find that these cross-checks and review of the available evidence, support our cost of equity range of 5.5% to 6.7%.

Outperformance wedge

Ofgem proposes to make a downward adjustment of 50bps to the allowed equity return to reflect its expectations that companies will outperform the targets that it sets, which is both conceptually and practically flawed. Conceptually the adjustment does not recognise and appreciate the consumer benefits which have been achieved through incentives-based regulation. Instead it is likely to undermine the behaviours that drive efficiency by creating an ex-post adjustment to claw back performance. Practically, the adjustment is equivalent to an arbitrary c15% reduction in allowances which cannot be justified with so little evidence.

On this basis, we make no adjustment for an outperformance wedge.

Table 30.3 summarises both the financial parameter values we have used to derive our cost of equity assumption and Ofgem's proposals based on a notional gearing of 60%.

Table 30.3 cost of equity assumptions

RPI stripped	Ofgem			National Grid		
	Low	High	BP assumption	Low	High	BP assumption
Total market return (TMR)	5.25%	5.75%		6.20%	7.20%	
Risk Free Rate	-1.78%	-1.78%		-1.78%	-1.78%	
Equity Beta	0.66	0.85		0.91	0.94	
Cross Checks	0.14%	-0.02%				
Cost of Equity	3.00%	4.60%	3.80%	5.48%	6.67%	5.50%
Outperformance Wedge			-0.5%			0%
Cost of Equity			3.30%			5.50%

Ofgem's proposals for allowed equity return are 3% to 4.6% RPI stripped with a working assumption of 3.8% for a notional gearing of 60%. A 50bps outperformance wedge is then applied to reduce the working assumption to 3.3%. This is significantly lower than RIIO-1 and whilst we agree that there is evidence for lower base returns, we do not agree it is to the extent that is being proposed.

Instead we propose a cost of equity of at least 5.5%, which we use as a basis for our financeability assessment. This is a fair, equitable return which is lower than RIIO-1, reflecting the nature of transmission and provides the financial capacity required to drive the stretching outcomes stakeholders prioritise, like decarbonised heat.

Regulatory depreciation and asset lives

Under RIIO, the regulatory asset value (RAV) represents the balance of unrecovered investment and is repaid to us over a period aligned to the average expected economic life of the asset base. This is referred to as regulatory depreciation. We agree with the principles set out by Ofgem that the

depreciation charge should reflect the benefits consumers derive from the network services they receive. Setting an appropriate profile of regulatory depreciation is therefore key in ensuring the interests of existing and future consumers are fairly balanced.

With a changing platform and a much more uncertain outlook for the gas network, an increasing RAV set against the potential decline in customer base would result in increased RAV stranding risk and a sharp increase in charges to future customers to recover the investment. The regulatory asset life and regulatory depreciation profile require revisiting to assess the combination required to balance existing and future customer charges whilst reducing the risk of stranded investment.

We have carried out an initial high-level review and our preliminary indications at this stage are that both a reduction in the 45-year asset life assumed for RIIO-1, and a weighting of the depreciation profile towards earlier years through adoption of a sum of digits approach are required to match consumer benefit to charge and to manage the stranding risk.

Clearly this will have an impact and increase the consumer bill in the short term, but this is balanced by the risk of having stranded assets and prevents future generations from being impacted by the potential of larger consumer bill hikes as we seek to recover the RAV over a shorter period.

Capitalisation rates

This parameter refers to the level of company expenditure paid for by consumers over time ('slow money'), rather than immediately ('fast money'). This will be calculated with reference to the baseline expenditure projections over the price control period and reflect the proportions of capital and operating expenditure which we propose to fix for the period.

Based on current plans, this results in 66% of totex being treated as slow money and 34% as fast.

Taxation

Allowances to pay corporation tax are calculated on a notional basis as a proxy for efficient costs. It is expected that these allowances will be broadly equal over time to payments made to HMRC.

The RIIO-1 notional allowance approach has been an effective mechanism and propose its continuation for funding in RIIO-2. We adopt this assumption in our business plans, but with an adjustment to include incentives to allow closer approximation to the actual charge.

Stakeholder feedback

Our proposals have been informed by our primary financial stakeholders, investors, who we have engaged with about the financial package, including the technical aspects.

Their views have been gathered through an extensive investor engagement programme, which includes:

- an annual investor survey compiled by KPMG Makinson Cowell during August 2018. The survey comprised detailed interviews on a range of topics including those related to the RIIO framework
- the views expressed by shareholders in the c500 meetings we have conducted in the past year, the seminar on our UK business in September 2018 and during several site visits in both the UK and US
- city views based on analyst reports and feedback received from both debt and equity investors
- market reaction to regulatory announcements through share price analysis

This engagement has identified that:

- our shareholders assess that the risk of investing in UK regulated utilities has increased significantly compared to earlier in the RIIO-1 regulatory period and there has also been a significant increase in political and regulatory news which has triggered share price falls in the current regulatory period, relative to previous regulatory periods;
- investors are concerned that the level of return proposed in the RIIO-2 working assumptions does not reflect our underlying business risks;
- as investors are focused on future cash flows they want to understand the potential impact on the cash generation of the UK regulated businesses in the RIIO-2 period and the consequences for balance sheet strength and returns to shareholders; and
- our investors will make comparisons with other regulated sectors both in the UK and internationally as part of assessing the relative attractiveness of the final RIIO-2 outcome.

We have also undertaken initial engagement with a wider stakeholder base including customers and

Citizens Advice who are interested in the absolute level of our charges as well as their predictability and volatility. We have developed educational materials designed to make clearer the services consumers are paying for[124]. We appreciate that energy bills are complex and have worked with stakeholders to make the financial factors affecting bills more accessible to consumers.

This feedback has been considered when determining our financial package which ensures that returns are set at level which continues to retain and attract investment without changing the risk profile of our investors who value long term growth of the business.

We will continue to engage with stakeholders and test our and Ofgem's financial proposals against their expectations and priorities, particularly in the context of the consumer bill and ensuring stakeholders understand what it is they are getting for their money. The results of this process will inform our submission.

Financeability assessment

Approach to financial assessment

Our network is financeable if we can maintain an investment grade credit rating because it provides adequate resilience in the event of economic downturn and outturn of downside risk. We have tested to see what effect our decisions will have on our credit rating. We also recognise Ofgem's duty to have regard to ensuring we are financeable by allowing us to recover revenues that are sufficient to pay interest and dividends to our finance providers. If the allowed return, depreciation profile and capitalisation policy are set appropriately and there is consistency in future determinations, the notional company should be financeable.

We have adopted the following approach to assess the financeability:

Focus the assessment on a notional company

The onus for ensuring financeability of the actual companies lies with networks. However, the regulator has a duty to have regard to the need to secure that the price control is set at a level which would allow an efficient notional company to finance its licenced activities. The methodology which is adopted therefore needs to be robust, replicable and relevant for both of these company views.

Whilst the parameters and particulars of actual companies may be of some interest to the extent that they inform estimates for a 'notional efficient company', the financial parameters (such as cost of debt, gearing, cost of equity, and financial metrics) should be estimated for the notional efficient company. The financeability of the actual company can only be assured on a sustainable basis if supported by a package which delivers a financeable notional company.

Target a strong credit rating consistently across the financial package

We have assessed our credit rating against a target rating of A- and BBB+, consistent with both the cost of debt indices and the regulatory approach in the RIIO-1 period. We consider these credit rating levels remain appropriate into RIIO-2 because they ensure the right balance between the financial resilience of the network and consumer bill impacts, particularly given the uncertainties related to the political landscape, increased competition and the likelihood of lower returns in the RIIO-2 period.

Consider a range of financial ratios for both debt and equity investors across several future price control periods.

We have primarily followed Moody's rating methodology for regulated electricity and gas networks which considers both credit metrics and qualitative factors. Ofgem has favoured this approach in the past, which we support. We have applied the Moody's approach flexibly to allow our assessment to be in line with how Moody's themselves apply the methodology.

This involves:

- putting an additional focus on the core metrics: adjusted interest cover ratio (AICR) and net debt/RAV
- stress testing the qualitative factors, in the light of the evolving political and regulatory landscape, given they can materially influence rating outcomes.

A financeability assessment also requires consideration of the requirements of the equity investor. Shareholders see energy networks as

[124] https://www.nationalgridgas.com/about-us/breaking-down-your-bill

income stocks and invest in National Grid with an expectation of receiving a consistent and reasonable dividend yield, which the business' earnings need to be able and to support. At this stage, we will focus on the financial ratios and RAV growth and carry out initial assessment of trends but will, as part of next steps, combine with RoRE performance ranges to inform the overall investor proposition.

We do not expect to achieve all the ratios in every year. We have highlighted where sustained downward trends give rise to financeability concerns. We have considered these trends across several price controls (up to and including RIIO-5) to assess the long-term sustainability of the financial package. This helps us to avoid short-term fixes to address immediate cashflow issues that might create financeability problems in the future.

Financeability is not just a consideration of short-term liquidity ratios but considers the long-term sustainability of the company's financial position which is important in safeguarding future investment.

Results of financeability assessment

We have explained our financial package assumptions which underpin the financeability assessment. The modelling results presented in this section are also based on the following:

- an immediate transition to CPIH, CPIH inflation assumed to be 2% p.a.
- 25% inflation linked debt throughout the RIIO-2 period with RPI debt switched to CPIH
- a dividend yield of 5%
- qualitative factors consistent with Moody's most recent publication with exception of scale/complexity which we have reduced in line with nature of the RIIO-2 plan, which together contribute 60% of the overall weighting.

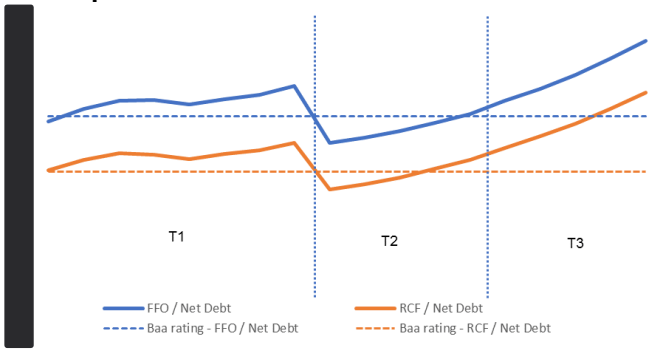
Table 30.4 Moody's qualitative factors and ratings

Stability and predictability of regulatory regime	Aaa
Asset ownership model	Aa
Cost and investment recovery	A
Revenue risk	Aa
Scale /complexity of capital programme	Baa
Financial policy	Baa

Our initial analysis shows that the current investment plan would be financeable under our financial package and assumptions at notional grade. The AICR and FFO/net debt ratios show deterioration into RIIO-2 which can be attributed to the drop in the cost of equity and re-setting of the gearing levels to align to 60% at the start of the price control, after which the ratios become stable for the remainder of the period.

However, risks remain around the RCF/net debt and FFO/net debt metrics which fall below investment grade thresholds within the RIIO-2 period. Our proposal to reduce asset lives to 25 years and adopt a sum of digits depreciation profile from RIIO-2 onwards is a contributing factor for the improvements observed in RIIO-3.

Figure 30.5 key debt metrics using National Grid assumptions



Turning to equity metrics, at this stage we focus on our investment proposition. Which is to generate shareholder value through both dividends and asset growth by investing in essential assets. We assume a dividend yield of 5% on notional equity, which is in line with RIIO assumptions and consistent with the water company submissions for PR19 which range from 3% to 5%. It is also similar to asset growth across the period, which is c4% per annum, as there is an expectation from investors that asset growth should be translated into earnings growth. At this level, dividend is sufficiently covered over the RIIO-2 period but we see a decline in the metrics which are a proxy for price/earnings ratios which are likely to present challenges going forwards.

We have focussed on the financeability of the notional company at this stage. However, based on a preliminary view of the actual company which reflects our actual gearing levels and financing costs, we expect a marginal improvement in the results of our financeability assessment. For later submissions, we will continue to build the detailed underlying data and justification of our business plan, which along with the release of Ofgem's financial model will enable us to explore the financeability of the actual company in more detail.

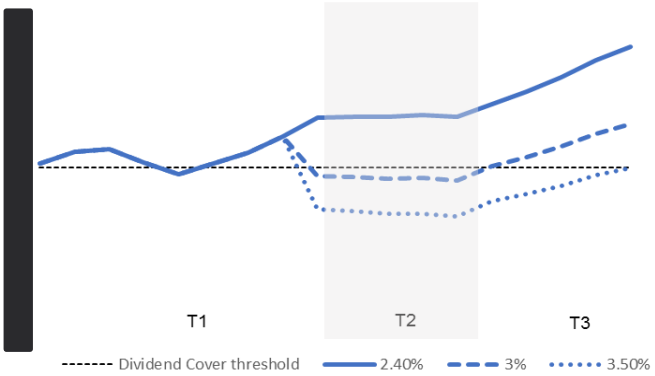
We have also run our analysis using Ofgem's financial package (which includes depreciation set on a straight-line basis with a 45-year asset life) and the following assumptions:

- an immediate transition to CPIH, CPIH inflation assumed to be 2% p.a.
- 25% inflation linked debt throughout the RIIO-2 period with RPI debt switched to CPIH
- a dividend yield of 2.4% (as used by Ofgem in their May decision document)
- qualitative factors in line with Moody's most recent publication which together contribute 60% of the overall weighting

The notional company should be financeable without the need to rely on assumed outperformance. Therefore, we have not assessed financeability using a 0.5% outperformance adjustment to the base allowed return. Taking this into account, our analysis shows we are not financeable. The equity investor offering under this framework sees dividends reduced significantly below investor expectations.

Ofgem assumes a 2.4% yield which does not align with stable dividend growth and is less than the dividend proposition set out by quoted water companies in their PR19 submissions and represents a falling investor return against inflation. There is a critical sensitivity around dividend yield assumptions and switching to just 3.5%, which remains below investor expectations, causes a deterioration in dividend cover well below the 1.5 level needed to sustain the dividend yield.

Figure 30.6 dividend cover using Ofgem assumptions



Furthermore, a 3.5% dividend yield would lead to a deterioration in the debt investor proposition. Under this assumption, the Moody's rating grid falls below the Baa1 credit rating during the RIIO-2 period, resulting in an investment grade inconsistent with the index used to set cost of debt allowances.

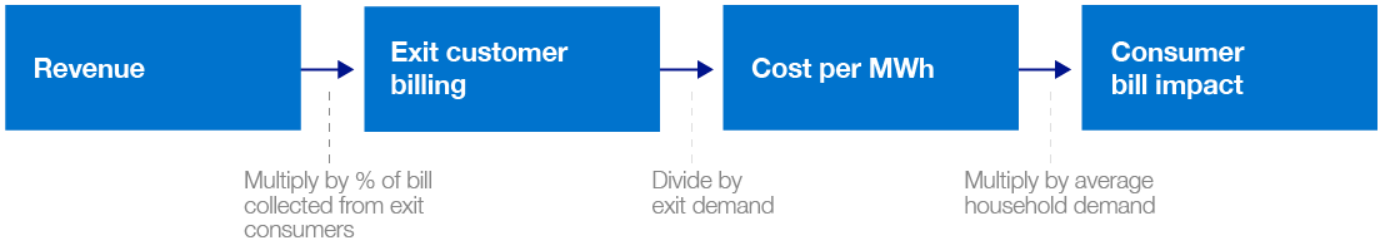
The impact of lower allowed returns is being partially mitigated by accelerating cash flows from future periods through the transition to CPIH. Whilst improving the short term financeability of the notional company, this should not be used as justification for a setting an allowed return which is too low, as based on our analysis, a continuation of an RPI indexed price control would not be financeable beyond RIIO-2.

Ofgem's proposals which accelerate cashflow to mitigate low returns and reduce the value of the investment proposition will provide protection to debt investors, but only by shifting material risk to equity investors. This risks the likelihood that RIIO-2 will provide a fair return to shareholders. Setting a low return and curtailing the level of dividend creates a mis-alignment which the risk investors bear, which ultimately decreases the attractiveness of investment in the sector.

Consumer bill impacts

We have set out an efficient financial package that funds the investment we need to make for consumers in RIIO-2. In this section, we set out the effect this will have on consumer bills and the methodology we used to calculate it. The revenue that we are allowed to recover under the price control is paid by all network customers in Great Britain (households, businesses and generators). The process for recovering revenue is complex. We have therefore used a simple top down approach that follows the methodology described by Ofgem with four steps:

Figure 30.7 Methodology for calculating gas bill impacts



This approach is based on the charging methodology and inputs from 2018-19, so our forward-looking estimates do not include potential future changes to these variables. Based on our RIIO-1 averages, National Grid direct charges account for c2% of the average household gas bill, this is around £9 a year.

Using the methodology described, our business plan leads to a flat to declining consumer bill over the RIIO-2 period. However, we must caveat this position as without a working Ofgem financial model and the detailed plan and package still to be finalised, this view could change for later submissions.

We have engaged with stakeholders to ensure that they understand the consumer bill implications. We have explained how the bill impacts reflect value for the network they use and the services they receive while being fair to current and future generations. We are confident that our proposed financial package is efficient and in terms of costs to consumers, delivers best value in the long-term.

Customer bill impacts

It is not just domestic consumer bills which will be impacted by our plan. We have built this plan with the help of our customers and have incorporated their views in our proposals. The impact of our plan on their charges will however differ depending on their location, the type of contract they have with us and their level of energy demand. When we have engaged with our customers on how we can help them understand their bill impacts for RIIO-2 they have told us that we should give them visibility of our revenue trends over time. This will allow them to calculate their own specific bill impacts based on their circumstances. Ofgem have not finalised the financial model which will calculate revenue for RIIO-2 but using the figures set out in this plan, we estimate that our underlying revenue in RIIO-2 will be broadly flat compared to the average level in RIIO-1. There will be annual fluctuation from the underlying trend due to regulatory framework items such as uncertainty mechanisms and true ups. We are proposing changes to the framework which will reduce this fluctuation so for this draft plan we have focused on explaining the underlying revenue trends. We will engage further with our customers on these plans and our framework proposals to test their acceptability

Next steps

It is important to carry out sensitivity testing to assess the resilience of financial ratios under different scenarios to justify that our financing package is not just efficient, but also robust. The scenarios which we will consider in more detail when assessing the financeability of the notional company include:

- totex ranges developed from an assessment of the business risk borne by the network across the RIIO-2 price control;
- potential market scenarios, such as alternative interest and inflation rate forecasts;
- the impact of totex and incentive underperformance based on our assessment of potential outcomes and business risk; and
- interaction with other proposed financial mechanisms, such as the returns adjustment mechanism.

Based on a range of plausible outcomes we will evaluate the subsequent impact on both our cashflow and returns using RoRE analysis. This will allow us to test the risk and reward balance to ensure the ranges are deliverable and offer a fair balance for investors. We will also test there is sufficient financial capacity such that the incentives package is unlikely to lead to financial distress when coupled with adverse macro-economic shocks.

Chapter 31. Assumptions

Based on what our stakeholders have told us, we have used a set of assumptions to build and underpin the proposals we are putting forward. Below is the list of assumptions we have used for our business plan:

Assumption No.	Chapter	Topic	Planning assumption	Comments
001	ALL	Framework	Our business plan is underpinned by our current commercial framework and regime. If this framework/regime was to change, this could fundamentally change our overall plan.	We are assuming the commercial framework remains the same.
002	ALL	Brexit	The form of Brexit has a neutral impact on our activities and costs.	There are uncertainties about our post-Brexit trading arrangements that could impact RIIO-2 activity, such as industry code change workload.
003	ALL	Uncertainty mechanisms	In-period adjustment mechanisms would be appropriate to cope with changes in workload triggered by events outside our control. This might include incremental capacity requirements triggered by customers, and government response to security threats.	We think this is better for consumers than attempting to include uncertain work into the price control allowance. Various Uncertainty Mechanisms have been used in RIIO-1. We have made proposals for future uncertainty mechanisms in chapter 29
004	ALL	Mapping costs to stakeholder priorities	Costs are mapped to stakeholder priorities based on strongest relationship. This is the first time we have categorised cost data in this way to improve transparency of how costs relate to stakeholder priorities.	Some activities have at least secondary relevance for multiple priorities.
005	11.Context	Gas transmission network- Future	Our view, shared by most stakeholders, is that there is a long-term future for gas and the gas transmission network to at least 2045.	This assumption is informed by the Future of Gas project and other internal analysis and external commentary.
006	11.Context	Gas transmission network - Value to society	The gas transmission network provides wider benefits to society. For example, it supports decarbonisation by flexing with gas-fired power stations to balance intermittent renewables. We should factor in these wider benefits when planning the development of the network.	

Assumption No.	Chapter	Topic	Planning assumption	Comments
007	11.Context	Keeping options open	The gas transmission network is playing an important role in supporting decarbonisation. We should preserve a gas transmission network that keeps options open as insurance amid uncertainty about the way ahead for decarbonisation.	To expand the evidence base informing decisions, we have undertaken external analysis on the value of the gas transmission network in enabling energy prices to remain affordable. The output of this is being considered through our network capability work.
008	11.Context 22.Gas on/off 24.Environment	Supply and demand	We will anchor our analysis of network capability using the supply and demand scenarios and sensitivities in the Future Energy Scenarios (FES) 2018. These were used as the basis for work on the common scenario upon which this plan is based.	We will review the impact of 2019 FES before the December submission
009	14. Network capability	Network capability	This business plan is based on our current understanding of stakeholders' network capability requirements. We are planning further stakeholder engagement on network capability. Future versions of our business plan may change to reflect feedback from stakeholders.	
010	22.Gas on/off	Gas transmission network - Access and capability	There is uncertainty over how customers will use the system in future, particularly the timing and location of where gas comes on and off the system. An appropriate balance needs to be struck between competing priorities of a low-cost network and customers' ability to move gas on and off the system unconstrained.	The physical size of our network and the commercial framework affects our ability to offer relatively unconstrained flow of gas over a wide and variable range of supply patterns. We will explore stakeholders' views on the costs and consequences of other options. This might include decommissioning certain assets, adding resilience elsewhere or exploring market- based solutions.
011	22.Gas on/off	Ageing assets	We should target an appropriate level of asset health investment to mitigate the reliability risks from an ageing asset base.	We are using improved decision support tools and monetised risk modelling. We have consulted with stakeholders on the costs and consequences of different targets for service

Assumption No.	Chapter	Topic	Planning assumption	Comments
				risk. E.g. keep the same or improve reliability by 10%.
012	22.Gas on/off 24.Environment	Asset health/PCD/ risk removal	A proportion of the planned asset health risk to be removed during RIIO-2 is delivered as a result of other investment drivers (e.g. emissions and cyber) If these drivers were to no longer exist, then the asset health driver is likely to remain. This may result in costs moving between drivers in our business plan.	
013	21.Safety 22.Gas on/off	No reduction in reliability or safety	Interventions for ageing assets can bring simultaneous reliability and safety benefits. A future pathway for asset health that resulted in a reduction in safety would not be supported by HSE.	For the purposes of our RIIO-2 plan we discount as non-credible any Asset Health plan that would intentionally reduce safety.
014	21.Safety 22.Gas On/off	Network capability must not reduce safety	Any consideration of changing (reducing) the network capability must not compromise National Grid compliance with GSMR, in particular the obligation to minimise the risk of a gas supply emergency and cover 1 in 50 risk (as well as 1 in 20 risk).	This requirement has been emphasised in feedback from HSE. We will have regard to this in addressing Ofgem's proposals for network capability. See Chapter 'I want to take Gas on/off where and when I want'
015	21.Safety	Gas transmission network - Pipelines & AGI	Customer requirements in RIIO-2 are unlikely to alter the size of our core network in terms of pipeline route km and number of above-ground installations.	This expectation drives a base level of activity such as pipeline in line inspections and surveillance for third-party interference.
016	21.Safety	Network emergency co-ordination	National Grid continues to perform the role of Network Emergency Co-ordinator.	The costs for the NEC role will be factored into our RIIO-2 plan.
017	21.Safety	Safety upkeep of operational sites	All sites are to be brought up to a similar standard (for building integrity and welfare provision) that can last 20-30 years and that is fair and equal to all NGT employees.	This policy together with site survey/condition data drives our prioritised programme of safety upkeep work.
018	21.Safety	Legislation driven safety work is sacrosanct	There is a level of work which must be undertaken to comply with statutory legislation e.g. prescribed maximum periods between pressure systems inspections.	The need for this work to be included in our business plan has been treated as sacrosanct: (i) NARMS monetised risk decision support tool is not used for this work, (ii) we have not

Assumption No.	Chapter	Topic	Planning assumption	Comments
				sought wider stakeholder views on the level of activity we undertaken because it is not open to choice, optionality or influence, (iii) our key stakeholder is HSE with whom we work closely to ensure expectations are met.
019	21.Safety	Goal Setting Safety Legislation	The permissive safety regime in which we operate means the standards expected of us are continually increasing. We must always seek continual improvement. This requirement has been emphasised in feedback from HSE.	It follows that it is not an option to "do less". We can only seek more efficient means to achieve a safety outcome that is equivalent or better than the existing means of compliance. Furthermore, where new technology becomes available that might enable risks to be reduced below previous levels, there is an expectation that we evaluate adopting such technology even if it means an increase in costs.
020	21.Safety 24.Environment 23.Cyber	Legislation	We assume no material changes in key industry legislation and best practice for compliance, including safety (COMAH, GS(M)R etc.), environmental (MCPD) and cyber (NIS Regulation).	Such key legislation drives our level of activity and costs, particularly in areas of safety. We have assumed we can use the NARMs justified over-delivery mechanism.
021	24.Environment	Gas transmission network - compressors	We will need a programme of work on our gas compressors during RIIO-2 and beyond to comply with mandatory emissions legislation deadlines.	We will develop a strategy with input from our stakeholders and considering the potential future patterns of use of the network.
022	24.Environment	Planning legislation	The requirements of Planning Act do not change during RIIO-2 period.	
023	24.Environment	Decommissioning/ redundant assets	Any decommissioned assets will be removed and made safe.	
024	24.Environment	Compressors	IED investments as per the May 2018 and June 2019 reopeners will go ahead.	Peterborough, Huntingdon, St. Fergus and Hatton
025	24.Environment	Compressors	Delivery of work to achieve MCP compliance will commence in 2021/2022.	

Assumption No.	Chapter	Topic	Planning assumption	Comments
026	24.Environment	Compressors	There will be investment required in RIIO-2 for new units to be delivered post RIIO-2.	
027	24.Environment	Compressors	For operational purposes, Best Available Techniques principles will apply to determine preferred running order of units on site.	
028	24.Environment	Compressors	When carrying out network analysis, adequate levels of reliability for compressors which are not being modified as part of emissions compliance work are met.	
029	24.Environment	Compressors	Where units are derogated under MCP legislation due to low running hours, there will be an ongoing review of those units.	
030	27.Connections	Number of connections	Our initial assumption is that we can flex resources to process a variable number of customer connection needs that might arise in the period.	There is uncertainty about the level of customer activity that will come forward, for example from new entrants developing green gas schemes.
031	27.Connections	Incremental capacity	No 'anticipatory' incremental network investment would be included in our base revenue, ahead of firm customer commitment. Learning from RIIO-1 is not to include allowances in base revenue until schemes confirmed.	We propose that a revenue adjustment mechanism be included. If triggered our allowed revenue could be adjusted appropriately. We have provided an indicative capex estimate for RIIO-2 network reinforcement in south Wales if the customer progresses with this scheme.
032	23.External threats	External threats	We shall protect the system from cyber and physical threats in line with government requirements. The level of threat is per today's security services classification: threat from international terrorism = SEVERE, [redacted]	The level of work required in RIIO-2 could be higher if the threat changes or the interpretation of required mitigations changes.
033	23.External threats	Physical security	The sites at which enhanced physical security measures are required remain as prescribed by BEIS.	Government and security services' advice will be reviewed and changed periodically.

Assumption No.	Chapter	Topic	Planning assumption	Comments
034	23. External threats	Scope of work	We have consciously included our asset replacement costs for operational technology and enhanced physical security in chapter 23 rather than in chapter 22 Gas on/off,	We have done this for stakeholder transparency so that all costs for threats are presented in the same part of our plan. Protection from threats is the primary driver and we expect specific RIIO-2 outputs to be attached to this work, separate to the NARMS asset health outputs.
035	26.Information provision	Market information	The information we provide to the market will continue to play a crucial role in the healthy running of the wholesale energy markets.	We will explore with stakeholders the type of information that is most valuable in making sure the wholesale gas and electricity markets run in the optimal way.
036	28.Efficient and affordable	Price control allowed revenue	Where the scope of our RIIO-2 work is clear and we are best-placed to manage risks on behalf of consumers, we assume funding will be included in our base revenue.	This principle represents established practice under the existing RIIO framework. National Grid is incentivised to manage efficient delivery on behalf of consumers.
037	28.Efficient and affordable	Efficiencies	The efficiencies we have achieved throughout RIIO-1 will form the basis of our costs in RIIO-2.	We will work towards committing to additional efficiencies during the RIIO-2 period that we believe we can achieve when we submit our final business plan.
038	30.Finance	Finance parameters	Finance parameters (cost of debt, inflation indices etc.) have not yet been determined for RIIO-2. These parameters, together with our spending plans, will both influence the component of our costs which translates into future consumer bills.	These finance parameters will be reviewed with Ofgem during 2019 and we will update our assumptions accordingly for our next versions of our business plan.
039	ALL	Finance parameters	The price base off all costs and cash amounts are in 18/19 price base	This is the price base required by Ofgem for the RIIO-2 submission

Chapter 32. Glossary

A

Achilles UVDC
A community for the UK utilities industry. Members use the Achilles supplier pre-qualification system to manage risk in their supply chain and to make sure they comply with EU regulations.

As Low As Reasonably Practical (ALARP)
A term often used in the regulation and management of safety-critical and safety-involved systems.

AGI
Above Ground Installation.

B

Base revenue
The amount of revenue we are allowed to recover as set up front at the beginning of the price control.

Building Information Modelling (BIM)
A process to help engineering and building firms to improve sustainability in their construction projects.

Business Carbon Footprint
A measure of NGGT's environmental footprint, in tonnes of CO_2 emitted.

BEIS
Department for Business, Energy and Industrial Strategy.

C

Capacity constraint management
This is an incentive that aims to incentivise an efficient overall cost of System Operator constraint management actions through efficient system operation and optimisation of strategies, and encourage balanced risk versus reward decisions in the release of additional capacity.

Capital expenditure (capex)
Expenditure on investment in long-term assets, such as compressors.

Captivate project
This is an innovation project to prove the concept of carbon mineralisation from boiler house emissions at our Stallingborough site, building a fully containerised emissions capture demonstrator.

Carbon capture usage and storage
Carbon capture usage and storage uses established technologies to capture, transport and store carbon dioxide emissions from large point sources, such as power stations

Carbon Disclosure Project
A not-for-profit organisation that runs a global disclosure system that helps businesses, organisations, cities and regions to measure and manage their environmental impact.

Centre for the Protection of National Infrastructure (CPNI)
The UK government authority that is responsible for providing security advice to businesses operating key national infrastructure, helping to reduce the infrastructure's vulnerability to terrorism and other threats.

Clean Growth Strategy
The UK government strategy for decarbonising all sectors of the UK economy during the 2020s.

(Project) CLoCC
Customer Low Cost Connections. A project seeking to improve the experience of small and medium-sized customers (like bio-methane producers) connecting to the gas transmission system.

Control of Major Accident Hazards (COMAH)
The Control of Major Accident Hazards (COMAH) Regulations ensuring that businesses take all necessary measures to prevent major accidents involving dangerous substances and limit the consequences to people and the environment of any major accidents which do occur.

Committee on Climate Change
An independent organisation providing advice to the UK government on building a low carbon economy and preparing for climate change.

Compressor Emissions Compliance Strategy (CECS)
The CECS details decision-making processes and plans for complying with the Industrial Emissions Directive and the Medium Combustion Plant Directive through RIIO-2 and beyond to the MCPD compliance date, 1st January 2030.

Construction Industry Research and Information Association (CIRIA)
A neutral, independent body fostering innovation and improvement in the construction industry.

Consumer Price Index (CPIH)
CPIH is a new metric that builds on the widely-used consumer price inflation (CPI) measure: CPIH includes owner occupiers' housing costs.

Critical National Infrastructure (CNI)
Assets that the government has identified as essential for society and the economy to function normally. In the UK there are 13 national infrastructure sectors including defence, emergency services, energy, food, transport and water.

D

Decarbonisation
The Climate Change Act 2008 requires the UK to reduce emissions of greenhouse gases from heat by at least 80% by 2050. The government's approach to decarbonisation of heat focuses on innovation, both to find new ways to reduce demand for heat and to support deployment of low carbon heating options.

Decommissioning
A state where the isolated plant has been disconnected, purged of all process fluids (Methane, odourant, condensate etc.) and is not pressurised. Useful spares are also removed where it is determined that this is beneficial, or parts are removed and sold to third parties. Following these steps all assets are removed from site and the site returned back to ground level. This includes below ground assets if decommissioning a full site

Depreciation
Depreciation is a measure of the consumption, use or wearing out of an asset over the period of its economic life.

Digitalisation
Leveraging digitisation to improve business processes, for example by making it easy to find, use and share digital information.

Digitisation
The process of converting information from a physical format into a digital one.

Disconnected
A state where there is a physical air gap separation between energy sources and assets. This includes the disconnection from gas at all pressure tiers and disconnection of all electrical and control equipment.

E

Energy Act 2008
Legislation introduced by the UK government to reduce CO_2 emissions from energy generation and ensure secure, clean and affordable energy for UK customers and consumers. It aims to drive rapid deployment of renewables and it created a regulatory framework enabling private sector investment in carbon capture and storage projects.

Energy Data Taskforce
Launched by the government and our regulator Ofgem, the taskforce advises on how to unlock value from energy systems data to support innovation, foster competition and offer consumers better value for money.

Energy Networks Association (ENA)
A body representing gas and electricity transmission and distribution network operators in the UK and Ireland.

ENA Gas Futures Group (GFG)
The GFG is exploring the role that gas and the gas networks should play in the future energy system and considering potential alternative options for the UK's future energy provision.

ENA Gas Innovation Governance Group (GIGG)
A group of representatives from the gas distribution and transmission network companies, exploring technological, operational and commercial innovation projects to identify which will be most useful in meeting the future needs of gas networks.

Energy and Utility Procurement Skills Accord
A set of five commitments to ensure that responsible procurement practices are used to drive investment in skills development in the energy and utilities sector to help address skills shortages.

Equity Beta
Measures the covariance of the returns on a stock with the market return. The weaker this covariance, the lower the return that investors would require on that stock.

European Network of Transmission System Operators for Gas (ENTSOG)
Set up in 2009 by 31 transmission system operators in 21 EU countries, ENTSOG is intended to improve cooperation and develop a pan-European transmission system that provides secure, affordable and clean energy for EU businesses and consumers.

European Union Emissions Trading Scheme (EU ETS)
A scheme allowing participating companies to buy or sell emissions allowances and help EU member states to limit or cut GHG emissions at least cost.

EU third energy package
The package came into force in 2009, aiming to improve the way the EU's internal energy market works, to resolve structural issues and to improve service, choice and value for energy customers.

Ex-ante
Refers to a value or parameter established upfront (e.g. at the price control review to be used in the price control period ahead).

F

Future Energy Scenarios (FES)
An annual industry-wide consultation process encompassing questionnaires, workshops, meetings and seminars to seek feedback on latest scenarios and shape future scenario work. The Future Energy Scenarios document is produced annually by National Grid and contains our latest scenarios.

Future of Gas
A project to develop insights into future market requirements for gas, and to set out GB's options for the role of gas as it works towards the 2050 carbon reduction targets.

G

Gas day
The standard time period for gas demand is a gas day. This is because gas travels at 25mph through the network. Gas landed in Scotland would take 23 hours to travel to the furthest point on the network in Cornwall. The gas day starts and ends at 5am when gas demand tends to be lowest.

Gas Distribution Network (GDN)
An administrative unit responsible for the operation and maintenance of the local transmission system and <7barg distribution networks within a defined geographical boundary.

Gas Distribution Network (GDN) offtake
The point at which natural gas exits the NTS into the distribution network.

Gas Future Operability Planning (GFOP)
GFOP is our way of describing how the ever-evolving energy landscape may impact gas network operability, with the aim of setting the direction for solutions that benefit all market participants.

Gas National Control Centre (GNCC)
Our GNCC runs GB's gas NTS and ensures that correct gas pressures, flow rates, temperatures and gas quality are maintained.

Gas Safety (Management) Regulations (GSMR)
Regulations applying to conveyance of natural gas (methane) through pipes to domestic and other consumers.

Gas Ten Year Statement (GTYS)
Published annually by us to give you a better understanding of how we intend to operate and make plans for the gas network over the next decade.

Gas Transporter Licence
The licence National Grid and gas distribution networks hold as gas transporters.

Gearing
A ratio measuring the extent to which a company is financed through borrowing. Ofgem calculates

gearing as a percentage of net debt relative to the RAV.

GRAID
Gas Robotic Agile Inspection Device. This was a project undertaken through the network innovation competition (NIC). It is aim was to design and develop a remotely operable robot that can be inserted into live, high pressure 100 bar(g), mild steel pipework systems to undertake both visual and physical inspection of the otherwise inaccessible buried sections of the system.

Grid for Good Programme
Our social mobility project designed to connect people in need with support services and networks. We're trialling it first in Birmingham.

I

Inclusive Economy Partnership (IEP)
A partnership of businesses, civil organisations and government departments to support communities to feel part of society and to contribute to the economy.

Indexation
The adjustment of an economic variable so that the variable rises or falls in accordance with index movements (e.g. inflation indices, bond indices).

Interconnector
A pipeline used to link gas systems across borders between UK and Europe.

Isolated
A state where the plant is separated from every source of energy in such way that the separation is secure. This would normally entail, as a minimum, the closing of necessary valves to satisfy HSE guidance HSG253 isolation recommendations.

J

Joint Office of Gas Transporters
This body administers the Uniform Network Code (UNC), which sets out common transportation arrangements for Britain's gas industry.

L

Licence
The document setting out the conditions of the National Grid Gas Plc Gas Transporter Licence in respect of the NTS.

Licence obligations
An obligation on the network companies to meet certain standards of performance. The Gas and Electricity Markets Authority (GEMA) has the power to take appropriate enforcement action in the case of failure to meet these obligations.

Linepack
The stock of gas within the gas transmission system.

Load-related capex
Capital expenditure on new assets to accommodate changes in the level or pattern of gas supply and demand.

Liquified Natural Gas (LNG)
Formed by chilling gas to –161 degrees Celsius so that it occupies 600 times less space than in its gaseous form.

M

Monetised risk
Ofgem defines monetised risk as the total asset risk value based on the required output metric.

Monitoring of Real-time Fugitive Emissions (MoRFE) project
This is a project to better understand leaks from equipment on the network. This project is being funded through the network innovation allowance (NIA) and it will identify and quantify methane emissions, accurately and cost effectively.

N

National Transmission System (NTS)
The high-pressure system consisting of terminals, compressor stations, pipeline systems and offtakes. Designed to operate at pressures up to 85 barg. NTS pipelines transport gas from terminals to NTS offtakes.

Net present value (NPV)
NPV is the discounted sum of future cash flows, whether positive or negative, minus any initial investment.

Network Capability
The ability to accommodate levels of gas flows onto and off the network.

Network entry/network exit agreements
These are an operational agreement detailing the operational terms and conditions for gas to flow which must be signed by both National Grid and the shipper.

Network Innovation Allowance (NIA)
The network innovation allowance provides funding for network licensees to use to fund smaller technical, commercial, or operational innovation projects directly related to the licensees network that have the potential to deliver financial benefits to the licensee and its customers

Network Innovation Competition (NIC)
NIC is an annual opportunity for Gas network companies to compete for funding for the development and demonstration of new technologies, operating and commercial arrangements.

Network output measures (NOMs)
This covers four aspects; network asset condition, network risk, network performance and network capability. The measures enable an evaluation to be made of the overall state of the network.

Network asset risk metric (NARM)
This is a concept to describe the level of risk of the overall network and that of individual assets. For each individual asset that contributes to the overall level of network risk, the monetised risk is determined, which takes into account the condition of the asset and the consequences of failure.

New Engineering Contract 4 (NEC4)
A new form of energy and construction contract, designed to be flexible and easy to use, to improve procurement practices.

NGGT
National Grid Gas Transmission

NIS Regulations
Network and Information Regulations, 2018. The requirements of an EU directive put into UK law. Aims to improve cyber resilience.

Non-load related capex
The replacement or refurbishment of assets which are either at the end of their useful life due to their age or condition or need to be replaced on safety or environmental grounds.

O

One (1) in 20 peak day
1 in 20 peak day demand is the level of daily demand that, in a long series of winters, with connected load held at the levels appropriate to the winter in question, would be exceeded in one out of 20 winters, with each winter counted only once.

Operators of Essential Services (OES)
As defined pursuant to the NIS regulations

Operating expenditure (opex)
The costs of the day-to-day operation of the network such as staff costs, repairs and maintenance expenditure, and overheads.

Outputs
Services, requirements, and deliverables that network companies are funded or incentivised to deliver through the price control.

Output delivery incentives (ODI)
In RIIO-2 these will apply where service quality improvements beyond a level that is funded through base revenues may be in the interests of consumers.

P

Physical Security Upgrade Programme (PSUP)
A national programme to improve physical security at sites designated as critical national infrastructure (CNI). Initiated by the UK government it is now overseen by BEIS.

Pipeline Inspection Gauge (PIG)
This is the tool that gas transmission uses to inspect the condition of the pipelines on the network.

Pipelines Safety Regulations 1996 (PSR)
The Pipelines Safety Regulations 1996 apply to natural gas pipelines in Great Britain and in territorial waters of the UK Continental Shelf. They introduced a range of measures to manage the risk from any failure of iron pipes.

PSSR
The Pressure Systems Safety **Regulations** 2000 cover the safe design and use of pressure systems. The aim of **PSSR** is to prevent serious injury from the hazard of stored energy (pressure) as a result of the failure of a pressure system or one of its component parts.

The Planning and Advanced Reservation of Capacity Agreement (PARCA)
The PARCA is a bi-lateral commercial contract that allows a customer to request NTS entry and/or exit capacity well ahead of when the capacity will be needed.

Price control
The control developed by the regulator, Ofgem to set targets and allowed revenues for network companies.

Price control deliverables (PCDs)
In RIIO-2, PCDs are used to capture those outputs that are directly funded through the price control and where the funding provided is not transferrable to a different output or project.

R

Regulatory Asset Value (RAV)
The value ascribed by Ofgem to the capital employed in the licensee's regulated business.

Redundant
Any equipment or fixed assets which are no longer required (now or in the immediate future) for us to operate the NTS

Reopener
A process undertaken in certain limited circumstances by Ofgem to amend revenue allowances (or parameters that give risk to revenue allowances) within the price control period.

Residual balancing
The residual balancing scheme incentivises us to balance supply and demand on the gas day (see 'gas day' above) and to minimise the impact this has on the market.

RIIO-1 and RIIO-2
Our first and second applicable periods for regulating network companies by a method known as Revenue = Incentives + Innovation + Outputs. The RIIO-1 price control covers the period from 2013 to 2021 and RIIO-2 will run from 2021 to 2026.

S

Service risk framework
The Service Risk Framework describes the expected performance measures for our assets, from our perspective and that of our external stakeholders.

Shrinkage
Term used to describe gas consumed within or lost from a gas transporter's system. It includes leakage from the network, gas used by network operators during transportation (e.g. power to compressors), and gas stolen from the network.

Storage agreements
This is an operational agreement detailing the operational terms and conditions for gas to flow which must be signed by both National Grid and the shipper.

Strategic asset management plan (SAMP)
This document describes our overall management strategy for the network's assets and how our practices, policies and procedures together form an integrated asset management system

System management principles statement
We publish this document in accordance with our obligation. The purpose of the statement is to describe the basis on which National Grid NTS will employ system management services.

System Operator (SO)
Referring to the gas system operator as part of NGGT, the gas transmission system operator in Great Britain. Responsible for entering into contracts with those who want to connect to and/or use the gas transmission system.

T

Task Force for Climate-Related Financial Disclosure (TCFD)
Set up by the Financial Stability Board (an international body to monitor and make recommendations about the global financial system) following the 2009 G20 summit, the TCFD develops voluntary, consistent, climate-related financial risk disclosures that help companies to provide meaningful, easy to understand information to their stakeholders.

Total expenditure (totex)
Totex includes both capital expenditure (capex) and operating expenditure (opex).

Total market return (TMR)
Measure of return that equity investors expect for the market-average level of risk.

Total societal impact (TSI)
The impact that a business's products, services, operations and full range of activities have on society.

Transmission system operator (TSO)
A body responsible for transporting gas or electricity using fixed infrastructure.

U

Uncertainty mechanism (UM)
UMs allow changes to the base revenue during the price control period to reflect significant cost changes that are expected to be outside the company's control.

Uniform Network Code (UNC)
The code that sets out common transportation arrangements for Britain's gas industry (see also the Joint Office of Gas Transporters).

UN Sustainable Development Goals
A range of goals designed to address global challenges relating to poverty, environmental degradation, climate, inequality, peace and justice, and intended to be achieved by 2030.

User group (known as the 'Stakeholder User Group')
For RIIO-2, transmission companies are required to set up a user group. This group will provide Ofgem with a public report on their views and the companies' business plans from the perspective of network users.

W

Warm Homes Fund
National Grid and Affordable Warmth Solutions (AWS) set up this £150m fund to help households that are fuel poor, by incentivising local authorities, social housing bodies and other organisations to install affordable heating solutions in their homes.

Thank you for reading our draft business plan

You have now reached the end of our July 2019 draft business plan.

In this draft business plan, we have explained that we believe our nation should have a clean, reliable energy system to help address the effects of climate change, improve the quality of the air we breathe and support a prosperous economy for future generations.

Our draft business plan covers a crucial five-year period from 2021 to 2026. We have engaged with our stakeholders more extensively than ever before on our draft business plan and built it around our stakeholders' priorities.

This is the first draft of our business plan and we are submitting it to the RIIO-2 challenge group. We welcome comments from the RIIO-2 challenge group and our independent stakeholder user group. We will take them on board for our next draft plan in October 2019.

We also welcome your feedback on our draft plan. You can send your thoughts to charon.balrey@nationalgrid.com

Alternatively, you can put your thoughts in writing and send to: Charon Balrey, National Grid House, Warwick Technology Park, Gallows Hill, Warwick, CV34 6DA.