Our Performance

2022/23

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CEO Foreword

1. Welcome to our second Performance document of the RIIO-T2 price control period. In this report, we will focus on what we have delivered against our allowances in 2022/23. We will also provide context on the backdrop for our performance this year, as well as looking forward to the rest of the RIIO-T2 period to identify key areas of focus for the remainder of the price control.
2. I am pleased to report on a transformative time for National Gas Transmission, following the completed acquisition of a 60% equity stake in the business by the consortium comprising Macquarie Asset Management and British Columbia Investment Management Corporation (31 January 2023).
3. This significant investment is a vote of confidence that National Gas Transmission will play a leading role in the UK's energy transition. It enables us to continue to support the expansion of hydrogen's role in the energy mix to deliver a competitive edge for the UK, and to work with the Government and Ofgem to maintain security of supply over the coming decades.
4. However, as a critical energy network we also encountered some of the greatest challenges we have ever faced, driven by Russia’s illegal invasion of Ukraine and the resulting volatility in the gas markets.
5. Despite this, we have made strong progress on the consumer priorities that underpin our business: delivering reliable energy, affordable energy, and sustainable energy to our consumers.
6. First and foremost, we also want to run a safe business. In 2022/23 we improved our performance on our safety performance indicator of lost time incidents per 100,000 hours, reducing the rate from 0.12 to 0.03.

Reliable Energy

7. The flexibility and reliability of our network keeps homes warm, industry fuelled and the lights on – the safety and reliability of our supply is our first priority. We have achieved 100% reliability in 2022/23 despite a substantial increase in asset maintenance activity as we worked to enhance the resilience of our network still further ahead of a challenging winter.
8. To maintain this high standard throughout last year we carried out enhanced winter preparations even in the high heat of summer: our engineers carried out vital pipeline inspections, digs and maintenance around our networks ranging from Westminster to the North York Moors National Park.

9. Our maintenance programme made us all the more resilient when it came to winter and enabled us to maintain high levels of export through the gas interconnectors to Belgium and the Netherlands. An extraordinary supply and demand pattern, driven by volatility in global gas markets, continued throughout 2022/23. We exported sustained flows of gas into Europe throughout that period via our compressor and terminal network in eastern England – regularly sustaining flows of 75 million cubic metres every day to the gas interconnectors with Belgium and the Netherlands, and accounting for more than 15% of European gas storage by the end of 2022.

10. Unusually large entry and exit flows continued throughout the financial year. A record 26.2 billion cubic metres of liquefied natural gas (LNG) came into Britain's Milford Haven and Isle of Grain terminals: up 53% on the 17.1 billion cubic metres in 2021/22. Meanwhile, 20.3 billion cubic metres flowed out to the Netherlands and Belgium through the two interconnectors from Bacton terminal in Norfolk. The volume of these exports was four times greater than the volume we flowed to Europe in 2021/22 and represented a substantial operational challenge to the way we manage and maintain the transmission network.

11. Playing our part in security of supply is essential to me and my leadership team and so I am grateful that we can continue to work closely with our governmental and regulatory stakeholders, our supply chain and other partners to enhance supply security for British consumers in future winters or emergencies. In October 2022 we completed our annual network emergency exercise 'Exercise Degree' involving hundreds of participants from the industry, government, and regulators. The exercise enabled us to practice responses up to and including a National Gas Supply Emergency, an event that the UK has never seen. In addition, we are working closely with the UK Government and Ofgem on how we ensure gas supply, and the transmission network can be resilient to future challenges.

Sustainable energy

12. National Gas Transmission is at the forefront of leading a transition to clean, fair, and affordable energy. To deliver on our vision, we have a clear strategy for how we will manage and operate our business for long-term sustainable benefit. We are fully committed to ensuring sustainable and ethical practices through continuous evaluation and enhancement of our operations. Our goal is to promote sustainable, inclusive growth for our customers, employees, and broader society. To achieve this, we have implemented a robust improvement program that actively encourages stakeholder participation, challenges our practices, and leverages our business intelligence to gain deeper insights.

13. As a new stand-alone business, National Gas has an ambition to support the reduction of our direct and indirect greenhouse gas emissions to Net Zero by 2040. This is a change to our previous ambition of 2050 which was in place under National Grid Group. We are focused on our wider responsibilities beyond meeting our key performance indicators by acting as a responsible business and doing good in the communities we serve, such as through our social partnerships or our employees volunteering for charities across the UK.

14. We also made great strides in developing a hydrogen future. Our FutureGrid test facility at Spadeadam is planned to complete in November 2023; and last December we submitted plans for the initial phase of a hydrogen backbone in the UK, known as Project Union. We are grateful to Ofgem for approving funding during the spring for this project, which will support further feasibility work over the next 12 months on a proposed 2,000km hydrogen transmission network.

Governance

15. Our new Board was established on 31 January and to support the new Board we have created a new board governance framework, applying the Wates Corporate Governance Principles for large private companies.

16. I strongly believe that National Gas Transmission has the right tools and services available and the right capabilities through our people and supply chain partners, to continue operating safely and delivering reliable energy for all customers – improving energy security in the near term and progressing towards a cleaner energy future.

Jon Butterworth

(CEO, National Gas Transmission)

I. Executive Summary

18. This document describes our financial and operational performance against the consumer priorities we have committed to deliver as part of the RIIO-T2 Price Control.

19. Within the regulatory year the sale of a majority stake in the National Gas Transmission (NGT) and Metering business by National Grid Plc has concluded. This has led to National Gas Transmission and Metering becoming a standalone business.

National Gas Transmission and Metering Business Sale

20. On 18 March 2021, National Grid Plc announced their plans to sell a majority stake in the UK National Gas Transmission and Metering business. On 31 January 2023 National Grid completed the sale of a 60% stake in National Gas Transmission Holdings Limited (including subsidiaries National Gas Transmission and National Gas Metering) to a Macquarie-led consortium, which includes BCI of Canada. National Grid remains a 40% shareholder in the business.

21. Ahead of the transaction, National Gas Transmission was established as a standalone business within National Grid Plc and operated as such awaiting the final regulatory approvals ahead of the transaction. The period operating as a standalone business gave confidence to the effectiveness of the separation. Some elements of the standalone business are operating under a time-limited Transitional Service Agreement (TSA) for which strong Governance arrangements have been established between National Grid Plc and National Gas Transmission to govern the interaction and service provision. The majority of these TSA services relate to our IT infrastructure for which we have a mature IT separation programme to enable a full and timely TSA exit.

22. The transaction on the 31 January 2023 has related to the top-level Governance of the business with the incoming majority shareholders and has not impacted the operational elements of the business which were already standalone and have continued with a clear focus on delivering our RIIO-T2 commitments enabling us to grow our output in year two of RIIO-T2. We continue to forecast to deliver our outputs across the RIIO-T2 price control and are confident that the new board's focus will enable this delivery.

23. The new ownership has not changed National Gas' commitment to acting with Social Conscience. Our new majority shareholders have an ambitious attitude towards environmental responsibility which National Gas Transmission has now adopted. National Gas Transmission held a consumer listening session in December 2021 to support our understanding of consumer views and attitudes. Community and social responsibility questions were addressed in breakout room discussions on the practical approaches National Gas Transmission can take to support the communities it serves, and we have now used these recommendations to formalise our socially responsible business strategy as a standalone business. Following the 2022/23 reporting year, subject to the National Security and Investment Act 2021, the Macquarie Asset Management and British Columbia

Investment Management consortium have increased their holding in National Gas Transmission from 60% to 80%, as of July 2023. National Grid Group retain 20% holdings.

Operational Context

24. The Russian invasion of Ukraine continues to have a significant impact on millions of people across Europe and has led to an unprecedented change in the operations of National Gas Transmission.

25. The conflict has impacted historic European gas supply chains, leading to an increased requirement for alternative sources of gas as European economies sought and seek to replace Russian gas imports. We have responded to these changes in customer requirements reflected in different supply and demand patterns and increased demand, reconfiguring the network to move gas West to East to facilitate European exports, with total gas exports from the UK to Europe increasing by 4-fold from the previous five years up to ~20 bcm/yr in 2022/23.

26. The increase in demand has also had the subsequent impact of increasing compressor running hours by ~55% compared to 2021/22, with run hours increased from 35,602 hours up to 54,781[1] hours in 2022/23, of which the majority of the additional running hours were across the summer months. This created several challenges including managing access to the network for outages for asset health interventions and maintenance as well as the potential for increased GHG emissions. It also highlights the importance of having a flexible network and associated resilience to be able to deal with unpredictable conditions and meet customer's needs.

27. Whilst Great Britain is not reliant on Russian gas for energy security to the same extent as Europe, the resultant reduction of gas across the continent has created uncertainty and volatility for energy markets with gas prices reaching record high levels and supply chains and lead times for equipment substantially increased.

28. The rise in GB gas prices has driven changes in the way our customers use our network, for example in 2022/23 as well as the increase in exports to Europe we experienced suppressed Local Distribution Zones (LDZ) demand which has contributed to a reduction of 6 bcm in LDZ demand compared to 2021/22 as well as changes in industrial demand.

29. Although LDZ and industrial demand reduced, there has been uncharacteristically high demand on electricity interconnectors to Europe throughout the summer and autumn driving additional demand for UK gas powered generation. Europe have used electricity imported from UK interconnectors in lieu of using gas for power generation which has in turn helped them to replenish low storage stocks and provide supplies to customers in the absence of Russian gas.

[1] This also impacted our GHG emissions which is covered in more detail in Section VI.

30. These evolving market conditions continue to present a number of challenges to the operation of our network, but we have continued to assess and adapt to these conditions to meet the needs of our customers.

Consumer Priority Delivery

31. In 2022/23 we have delivered good performance for our customers against our three consumer priority areas. These priority areas focus on the delivery of outcomes that our customers and stakeholders have told us that they value the most. Table 2 (Page 25) summarises our performance against each individual price control deliverable (PCD) and incentive that sit within the consumer priority areas.

32. We were on target with all but three of our outputs that sits within the **meeting the needs of consumer and network user's** priority area. In 2022/23 we continued to build upon the progress we have made in previous years in our customer (CSAT) and stakeholder (SSAT) satisfaction ratings, achieving a score of 8.60 against a target of 7.80 for CSAT and 8.69 against a target of 7.40. The CSAT score represents a small decrease of 0.03 compared to last year's score of 8.63 but is still considerably higher than target, and the SSAT score is an increase of 0.15 from the 2021/22 score of 8.54. This performance has been driven by the continued focus on our annual engagement programme that enables us to engage with customers and stakeholders across all our business priorities, and through the extension of our strategic relationship management and Key Account Management (KAM) approach to ensure we understand our customers at all levels across their organisations.

33. We have also had successes in our maintenance and constraint management incentives where we have continued to look for opportunities to improve our performance and have achieved all of our incentive scheme targets. This has helped to drive added value for our customers and stakeholders by avoiding constraints and giving our customers unrestricted access to the network.

34. It is worth noting that we exceeded our linepack incentive scheme target under the linepack performance measure element of the residual balancing incentive scheme, but we did not achieve our targets on the price element of the scheme. In addition, both the demand forecasting D-1 financial incentive and demand forecasting D2-D5 reputation incentive targets were not met this year despite several initiatives that were implemented to drive performance such as improved demand forecasting capability models for power stations.

35. The global economic and market conditions drove volatile gas prices, market uncertainty and changing customer behaviour which is causing us additional difficulties in meeting our RIIO-T2 incentives and outputs. To mitigate against these challenges, we are introducing several improvements that will support and accelerate delivery in future years of the price control.

36. Despite this challenging backdrop, during 2022/23 we have successfully facilitated the delivery of 100% of gas requirements for our customers and made good progress against our outputs related to the **maintaining a safe and reliable network consumer priority**. This

includes progress against deliverables associated with our Cyber information technology (IT) and Cyber operational technology (OT) programme of works.

37. We have also made good progress with the Bacton terminal site redevelopment project and remain on track to deliver the Final Option Selection Report (FOSR) in February 2024 or earlier[1]. During 2022 we identified two additional needs cases at the site related to dust in gas flows via the Interconnector to Europe, and the risk of over-pressurisation from upstream suppliers at three of the incoming pipelines. These risks were not known about at the time of submitting our RIIO-T2 business plan. We are continuing to engage with Ofgem on how best to proceed with these items.

38. Whilst we have made good progress and built upon the work undertaken in the first year of the price control, for some of our price control deliverables (PCDs) in this consumer priority area, notably asset health and physical security, we have delivered lower volumes of works than anticipated. This has been due to a number of factors including global supply chain challenges influencing availability and procurement of critical materials (for example with regards to asset health, current global economic conditions have increased lead times for valves to 52 weeks), a shortage of skilled labour available in the market and the need to defer some of our 2022/23 programme of works due to high summer flows resulting in reduced access to the network to take outages. Despite these challenges, we have taken positive steps to accelerate delivery, implementing a change to the delivery strategy to increase the portion of the asset health interventions that can be delivered by inhouse resources and expanding our team through the recruitment of additional project engineers, project managers, and work supervisors. This, combined with the strategic planning we undertook in the first year of the price control, means we are overcoming these challenges and continue to ramp up delivery for the remainder of the price control.

39. We recognise the critical role that National Gas must play in helping the UK achieve its ambitious environmental targets set out at COP26. In the second year of RIIO-T2 we have made positive steps in progressing the outputs that contribute to the consumer priority area of **delivering an environmentally sustainable network**. In 2022/23 we have continued to perform well against baseline targets for our environmental incentives and the greenhouse gas emissions (GHG) incentive. Despite an extremely challenging year, with high summer compressor running hours and venting to support export of gas to Europe, our GHG emissions were 2,287 tonnes, exceeding the incentive target. This level of performance has been supported by a number of strategies including system control panel improvements, the continuation of the compressor inhibiting trial, and a new ‘dry cranked’ process that resulted in a saving of circa 300 tonnes of venting.

40. The compressor emissions projects that ensure our assets are compliant with the Industrial Emissions Directive (IED) have all been progressed throughout the year. In 2022/23 we have submitted compressor emissions FOSRs for five sites; Wormington, King’s Lynn, St Fergus and Peterborough and Huntingdon. We received the Final Decision for Wormington in March

[1] Forecast delivery in early winter 2023/24 (subject to Ofgem agreement)

2023. We are expecting the final decisions for the remaining compressor emissions projects in 2023/24 and will continue to have regular engagement with Ofgem to ensure the optimum outcome for our customers and the environment is achieved.

41. We also have compressor emissions projects in physical delivery at Peterborough, Huntingdon, and Hatton. At Hatton, the compressor was delivered to site ahead of schedule in March 2023. The Compressor and Gas Turbine (GT) are now on their foundations following initial installation and alignment works. At Peterborough all monitoring and testing tasks are due to be completed in the next quarter, with finishing touches to the site due to be completed before the end of the year. For Huntingdon, commissioning and operational acceptance of Unit D and E are scheduled for 2023/24, with all remaining project activities (road construction, drainage, lighting and final finishes) and demobilisation due to be completed before the end of the calendar year.

42. For redundant assets, we have physically delivered a further five outputs this year taking our cumulative total to nine outputs physically delivered across the first two years of the price control. Whilst we are making steady progress in this area, we are behind where we would like to be, with the current geopolitical conditions impacting our ability to gain access to the network. We continue to look for opportunities to align redundant asset activities with similar types of work, to deliver our outputs as efficiently as possible and maximise outage availability.

Innovation

43. In 2022/23 we have continued to focus on innovation, with a particular emphasis on projects that can facilitate the UK target of Net Zero by 2050. Our innovation strategy consists of three core RIIO-T2 Innovation themes: 'Fit for the Future', 'Ready for Decarbonisation' and 'Decarbonised Energy System'. Projects within these themes support the business in preparing for Net Zero by examining the suitability of hydrogen as a cleaner alternative to natural gas and identifying what changes may be needed across NGT to facilitate this. We also continue to maintain a core component of our overall innovation portfolio that looks at increasing the efficiency of our day-to-day maintenance and operational activities, by utilising innovative tools and methods, enabling us to deliver the greatest value for consumers.

44. This year 26 NIA projects were sanctioned and of these, 19 projects progressed into delivery with a total spend of £4.0m. Highlights include the New Pipeline AI Route Planning project which utilises an AI-based tool or platform to enable the rapid exploration of pipeline routing options for new pipelines, and the Hydrogen Deblending Feasibility project (Phase 2) which seeks to understand deblending on the NTS with an engineering and market framework focus.

45. With regards to the Strategic Innovation Fund (SIF) work, NGT have progressed Round 1 projects both at Discovery stage (10 projects) and Alpha stage (4 projects), applications for the continuation of two projects to the Beta phase have been submitted and would start

delivery in 2023/24, if successful. Applications for a further five SIF Round 2 Discovery projects were made in November 2022 with three successful at application and due to commence in April 2023. In total, 2022/23 spend was £2.3m (this includes SIF projects in which NGT supported as well as led).

46. A third innovation funding stream from RIIO-T1, the Network Innovation Competition (NIC), awarded NGT £9.7m in November 2020. The funding was for the construct of an offline hydrogen test facility at Spadeadam for hydrogen testing as part of the FutureGrid programme. Over the past year, the FutureGrid offline hydrogen test facility has been constructed and the commissioning process has begun. This is in preparation for testing: firstly 100% natural gas in May 2023, followed by 2%, 5%, 20% and 100% hydrogen tests from June 2023 onwards.

47. All of the projects across the various funding streams tie into an overarching plan to understand transitioning towards hydrogen and net zero. This is in support of our proposals to repurpose part of the transmission network to develop the UK's hydrogen backbone.

48. More information on all our Innovation projects can be found in Chapter VII. Innovation.

Net Zero

49. Our Net Zero strategy has an integral role to play in leading a clean, fair, and affordable energy future for all in the UK. The strategy focuses on facilitating the implementation of a decarbonised energy system while providing energy resilience.

50. In all future energy scenarios, hydrogen as an energy vector has a key role throughout the transition to 2050 and beyond. We are exploring transporting hydrogen as an alternative to natural gas in the NTS to decarbonise heat, power, transport, and industry.

51. The Net Zero and re-opener development (NZARD) together with use-it or lose-it (UIOLI) funding, enables and facilitates early development work on strategic projects. This early work is critical to underpinning Net Zero re-opener projects.

52. In 2022/23 we undertook 13 UIOLI projects, eight of which were completed within year, and spent £2.0m. Five projects have been carried forward into 2023/2024. These projects are discussed in more detail in Chapter VIII. Net Zero.

53. In 2022/23 we submitted four applications under the Net Zero Pre-Construction and Small Projects Reopener mechanism, these included a reopener for Project Union and three projects related to methane emissions.

54. Project Union is our flagship project to create a UK hydrogen backbone, transporting 100% hydrogen, while connecting hydrogen production and storage with end users. Through the phased repurposing of existing gas transmission network infrastructure, the backbone will comprise 1,500 to 2,000km of repurposed assets, representing up to 25% of the UK's current methane transmission network, by the early 2030s.

55. We were awarded £5.6m in funding in addition to a company contribution of £0.6m to complete a phasing strategy for delivery of each section of the hydrogen backbone, pre-FEED

activities for a full UK hydrogen backbone and development of hydrogen market enabling activities.

Financial Performance

56. Overall, our Totex spend in 2022/2023 was £411.4m compared to allowances of £545.5m (in 2018/19 prices). The backdrop of underspend against our allowances is due to several macro and global challenges impacting our delivery of investments including critical material procurement, ability to access the network to take outages together with sourcing and retention of skilled labour in the UK market. Across all of our deliverables we are focused on mitigating these challenges to deliver our RIIO-T2 outputs.

57. Across RIIO-T2 our like-for-like Totex is planned to be £2,250.3m against an allowance of £2,274.3m. This results in a forecasted spend below allowances of £24.0m. Over the RIIO-T2 period we plan to invest circa £1.36bn of Capex across our overall business which will further increase when we agree the final options and cost allowances through the agreed reopener uncertainty mechanisms. We are forecasting to spend above allowances in TO load related Capex, TO non-load related Capex, TO other Capex and SO Capex. This is being offset by lower than forecast spend against TO non-operational Capex, TO Opex and SO Opex.

58. In relation to our portfolio of reopener uncertainty mechanisms set out in our Regulatory Reporting Pack (RRP) table 8.10 Pipeline Log, we anticipate the potential for our Totex to be £3.1bn over RIIO-T2 due to the forecast of investments needed to deliver improvements in resilience, reliability and meeting our environmental emissions obligations. Our approach is to signal these costs in our baseline Totex once we have certainty on scope and more accurate cost information. For example, we included the outcome of Ofgem's decision relating to our Wormington Compressor emissions project within our Totex and allowance forecast for RRP 2022/23.

Consumer Bill Benefit

59. We are acutely aware of the impact that high gas prices can have on consumers across the board, and we are committed to delivering value for money with the services and investments we undertake.

60. Using our indicative calculation, in 2022/23 the portion of the consumer bill attributable to National Gas Transmission was £7.99. This is an increase compared to 2021/22 where the NGT portion of the domestic consumer gas bill was estimated at £7.30. This increase was caused by higher General Non-Transmission revenue in 2022/23 as a result of higher forward gas market prices ahead of the year driving higher expected shrinkage costs.

Key Risks and Looking ahead

61. The continuing conflict in Ukraine has added considerable uncertainty to the global gas market and it is anticipated that the associated risks and issues will continue. Specifically, the GB and European markets and therefore gas price remain sensitive to perceived or actual changes in supply and demand drivers. Examples of this include: the extent of Asian gas

demand growth this year (specifically if China's economy further recovers from Covid), the level of EU storage stocks as we enter/throughout winter, LNG supply availability, new floating storage regasification units (FSRU) coming online in Europe, weather and the levels of European gas demand expected this winter. European gas demand is impacted by numerous factors including whether there is a cold winter and the extent to which renewable and low carbon power generation are available to meet European consumers needs and minimise the use of Gas Power Stations. These factors along with the general balance of LNG supply and associated demand for LNG, impact price and may result in market volatility throughout this reporting year.

62. The volatility within the energy markets and the ripple effect through the broader economy has been shown to impact many areas of our business, from the way we operate our network, the availability of materials and the cost to deliver our portfolio of RIIO-T2 investments. The extent to which we are impacted over the rest of RIIO-T2 could be influenced by how much volatility persists.

63. In 2022/23, supply and demand has been characterised by increased export to Europe to meet shortfalls caused by the curtailment of Russian gas. The resulting higher summer demand and changing flow patterns to a West to East direction, as well as intermittent renewable supply and changing customer behaviour, has highlighted the importance of having assets that are flexible and resilient to adapt to evolving, and often rapidly changing, conditions.

64. We will manage the impacts of these changes as effectively as possible to ensure that we continue to deliver for our customers and ultimately consumers. We are working closely with the Department for Energy Security and Net Zero (DESNZ) and Ofgem, as well as our European counterparts, to mitigate potential future risks. We will also build upon the winter preparedness improvements we initiated in 2022/23, carrying them forward and looking for additional opportunities to enhance our understanding of the energy landscape going forward.

65. Looking ahead, our key area of focus for 2023/24 will remain on delivering our RIIO-T2 consumer priorities through managing our ageing asset base, facilitating the Net Zero energy transition by supporting developments towards a Hydrogen network, responding to the dynamic cyber threat landscape and the efficient delivery of high value reopener projects, such as the Western Gas Network and Asset Health reopeners. These reopener submissions represent a significant area of workload for us as we focus our efforts on creating robust and fully justified submissions that provide Ofgem with the confidence that we are delivering the right solution at the right time. We are also expecting the Ofgem final decisions for a number of the FOSR and reopener submissions that we made during 2022/23, within the next financial year. These decisions will provide greater clarity on the programme of works that we will need to deliver.

66. The strategic planning and surveying work that we undertook in the first year of RIIO-T2 has been instrumental in effectively prioritising workload, identifying bundling opportunities and

optimising resource allocation. We are already witnessing the positive impact these measures have had on our programmes of work, with asset health expenditure increasing from £44.9m in year one to £65.5m in year two. In key areas where we are currently still behind forecast, such as asset health, we have put steps in place to further accelerate delivery. These steps, designed to overcome the challenges in the procurement and labour market, include reorganising our internal structure to complete more inhouse asset health interventions and increasing our capacity by expanding our team of project engineers. We will continue to embed these improvements and look for further opportunities to drive performance throughout the remainder of the price control.

67. The regulatory and policy landscape needs to evolve at pace to support the activities needed to drive a timely transition. We continue our work to support the development of the regulatory framework.

68. Since September of last year, Ofgem has been leading work on the future systems and network regulation (FSNR) which is an important activity to enable an energy system that meets the needs of all energy consumers over the coming years. The gas network will perform a critical role in maintaining the secure energy need of our nation across the transition and beyond. And achieving Net Zero will require a smart combination of all network assets, gas, and electricity alike.

69. Whilst hydrogen is out of scope in the FSNR, there are important interactions with the development of the Hydrogen Transport Business Model which DESNZ is leading. There are significant opportunities to drive value to consumers through leveraging the co-management of natural gas and hydrogen, enabling a balanced position on risk and reward, and keeping costs down for consumers today and tomorrow.

70. The role of a hydrogen network in ensuring security of supply and optimising network infrastructure is key to delivering a decarbonised power network by 2035[2], lowering emissions from industrial clusters in the later 2020s and beyond and providing low carbon energy for transport and potentially heat, enabling the transition to Net Zero.

71. The flexibility and reliability of the gas transmission system in meeting the challenge of supporting the European energy market in the last financial year, further highlights the essential role the network plays in mitigating both foreseen and unforeseen events that can fundamentally impact the way energy is supplied and used. It has raised questions around the right capability and resilience levels of the network going forwards in the medium and long terms to support the UK through the energy transition. DESNZ, through the publication of Powering up Britain[3], have highlighted the need for increased focus in this area through firstly, the need for a medium range Gas Supply Security Assessment to be developed this year. Secondly by reviewing the existing gas infrastructure standards that inform network

[2] CCC. (March 2023). Delivering a reliable decarbonised power system: Delivering-a-reliable-decarbonised-power-system.pdf (theccc.org.uk)
[3] Powering up Britain. https://www.gov.uk/government/publications/powering-up-britain

capability and reliability. This review by UK Government is expected to commence this financial year and will be supported by NGT.

72. There are significant external policy and regulatory developments underway which sit alongside these activities. These include the broader role of the Future System Operator, Regional System Planners and development of a Centralised Strategic Network Plan. There is a significant amount of work to be done to ensure effective and holistic operation across the various developments.

73. Looking ahead, next year we will be focussing on the development of an ambitious and well justified regulatory business plan for our next price control period. We have mobilised a programme of work to deliver our plans to Ofgem, by December 2024. The business plan will be our first with new investors and under our new company name and it will set out the level of investments required for the next regulatory period, which we expect will run from 2026 to 2031. The business plan will continue to be aligned to the needs of our stakeholders and users of the network. The plan will be designed to deliver our stakeholder priorities through managing our ageing assets whilst facilitating Net Zero and the transition to a Hydrogen network. We have multiple working groups in place for various internal stakeholders to come together and share progress and ideas and are excited to move forward with the plan build.

74. Our business plan will consider the implications for the short and longer term needs by developing the hydrogen transmission system of tomorrow. It is anticipated that demand for natural gas will start to decrease as we move towards Net Zero. The period towards the end of the decade will be critical if we are to meet our interim targets and Net Zero by 2050. With hydrogen, we can support the development of renewable sources like wind and solar – providing energy in the depths of winter when sunlight is at a premium and in the height of summer when the wind is not blowing. By using our existing infrastructure and expertise, we are proud to play a leadership role in delivering a clean energy system of the future and realising our Net Zero ambitions. Significant interdependencies exist across methane, hydrogen, and electricity – therefore our business plan will look to optimise across a common planning pathway for all these energy vectors. Including hydrogen requirements within the gas sector will deliver consumer benefits in terms of reducing overall cost and facilitating the necessary pace of the transition to Net Zero. We understand the vital role we can play in decarbonising our own system and providing hydrogen solutions for the UK. This will grow GDP, create skilled jobs and provide export opportunities to meet the economic growth ambition for our country.

75. Lastly, we look forward to continuing our constructive and collaborative relationship with Ofgem. Proactively working to build on the current regulation framework to ensure we deliver the best value for the end consumer, through meeting our regulatory obligations, developing compelling re-openers cases that will ensure the right investments in the NTS to deliver safety, reliable energy to our customers, and by helping to shape the next Price Control.

Performance Summary

76. The table below summarises spend and allowances (baseline and uncertainty mechanisms) for 2022/23 and for the five-year RIIO-T2 period.

77. The table and commentary in this section reference allowances that include Real Price Effects ('RPE'), whereas commentary provided for each individual category of spend in the remainder of this document excludes the impact of RPE.

Activity	**FY23 Totex Spend**	**FY23 Allowance**	**FY23 Cost vs Allowance**	**5 Year Totex Forecast**	**5 Year Allowance**	**5 Year Cost vs Allowance**
	(£m, 18/19 prices)	**(£m, 18/19 prices)**	**(£m, 18/19 prices)**	**(£m, 18/19 prices)**	**(£m, 18/19 prices)**	**(£m, 18/19 prices)**
TO Load Related Capex	10.8	9.8	1.0	99.0	93.3	5.7
TO Non-Load Related Capex	154.5	186.3	(31.8)	846.7	766.7	80.0
TO Non-operational Capex	8.6	27.2	(18.6)	94.5	123.0	(28.5)
TO Other Capex	59.6	94.6	(35.0)	240.9	235.2	5.7
TO Opex	111.9	133.0	(21.1)	542.4	598.3	(55.9)
TO Totex	**345.4**	**450.9**	**(105.5)**	**1,823.5**	**1,816.5**	**7.0**
SO Capex	17.0	31.7	(14.7)	173.9	144.7	29.2
SO Opex	49.0	62.9	(13.9)	252.9	313.1	(60.2)
SO Totex	**66.0**	**94.6**	**(28.6)**	**426.8**	**457.8**	**(31.0)**
Total	**411.4**	**545.5**	**(134.1)**	**2,250.3**	**2,274.3**	**(24.0)**

Table 1 - Summary of 2022/23 and five-year forecast spend and allowances

78. In 2022/23 our Totex spend was £411.4m compared to allowances of £545.5m. Over the five-year RIIO-T2 period, Totex is forecast to be broadly in line with allowances at £2.3bn.

79. Totex forecast and allowances include some spend for uncertainty mechanisms. Spend and allowances for the Western Gas Funded Incremental Capacity and Wormington projects are included in the table above as the needs case has been approved. The 2022/23 Totex spend for asset health work at the St Fergus terminal is also included, but the allowances have not been included at this stage as they are subject to needs case approval. RRP table 8.10 includes a list of all other re-openers we are expecting to submit, which if approved would increase the total Totex spend and allowances over the RIIO-2 period to £3.1bn. A further breakdown of the key variances is detailed below.

TO Totex Overview

80. TO Capital Expenditure for 2022/23 was £233.5m against total allowances of £317.9m. Capital Expenditure for the five-year period is forecast to be £1,281.1m against allowances of £1,218.2m.

81. Load Related Capital Expenditure was £10.8m against allowances of £9.8m in 2022/23. Of this, £6.8m relates to Western Gas Funded Incremental Capacity against £6.8m of allowances under the relevant Uncertainty Mechanism. The underspend versus the 2022/23 forecast is primarily the result of re-phasing the procurement of long-lead time items (pipes and valves) into 2023/24. Cumulatively this spend totals £9.2m. In 2022/23 £1.2m was incurred on unfunded projects, principally the Felindre VSD project, which results in cumulative spend of £5.4m on Entry RIIO-T1 Carryover works in RIIO-T2 and accounts for most of the forecast overspend versus allowances across RIIO-T2.

82. Non-Load Related Capital Expenditure was £154.5m, £31.8m lower than allowances. Cumulative year 1 and year 2 spend is £276.1m, £29.7m lower than allowances. During 2022/23 we have experienced higher than expected difficulty in gaining access to sites due to the role of the NTS in moving gas into Europe and procurement delays, resulting in a re-phasing of work into RIIO-T2 years 3-5. Whilst activity has increased year on year, Asset Health expenditure was £51m below allowances (including RPEs) in 2022/23 and as such, a revised programme of delivery across years 3-5 of RIIO-T2 is being assessed, including the involvement of our Operations and Pipeline Maintenance teams to reduce reliance on external contractors, as summarised in Chapter XI. In aggregate, spend across Bacton Site Redevelopment Feed and Emissions projects is £15.1m lower than allowances, with activity due to be completed in years 3-5 of RIIO-T2. This was partly offset by £2.4m spend on Stopples and Recompression, largely reflecting a partial recovery of prior year underspend.

83. We have incurred £16.1m of expenditure at St Fergus (cumulatively £32.5m) against the relevant Uncertainty Mechanism.

84. A further £35.3m has been incurred on RIIO-T1 Carryover Non-Load Related projects in 2022/23 (cumulative £73.7m). This primarily consists of ongoing expenditure on Peterborough and Huntingdon Compressor works (£66.0m). NGT continue to engage with

Ofgem on how best to provide the required level of network resilience and security of supply at Peterborough and Huntingdon following Ofgem's Proposed Final Preferred Option in respect of proposed investment to comply with MCPD emissions legislation, alongside ongoing consultation surrounding Uncertainty Mechanism investment submissions for other compressor sites.

85. Forecast RIIO-T2 spend on Non-Load Related Capital Expenditure remains broadly in line with allowances, with lower spend on Asset Health of £25.5m offset by additional spend relating to St Fergus Asset Health Uncertainty Mechanism at £32.5m. The £80.0m forecast variance in the table above largely reflects expenditure on RIIO-T1 Non-Load Related Capital Expenditure, principally on Peterborough and Huntingdon compressor works.

86. Non-Operational Capex spend was £8.6m in 2022/23, £18.6m below allowances. Cumulative spend is £40.0m (£32.6m excluding one-off property purchases in 2021/22), £15.3m below allowances. This largely reflects IT programme spend being lower than allowances across the first two years of RIIO-T2, reflecting additional system planning to determine the best and most efficient solution given that projects are closely interwoven with delivering separation from National Grid. Expenditure across the RIIO-T2 period is expected to be broadly in line with allowances as project spend accelerates in years 3 and 4 of RIIO-T2. In 2022/23, a credit of £3.1m has been received against 2021/22 unfunded costs in respect of a new Enterprise Resource Planning ('ERP') system, resulting in cumulative unfunded costs of £1.8m.

87. TO Other Capex expenditure was £59.6m, £35.0m below allowances. The underspend against allowances across Physical Security Resilience, Cyber Resilience IT/OT and Non-Operational Capex reflects additional planning processes being necessary to determine the best and most efficient solution, notably in cyber programmes where the focus on proof of concept and scalability of solutions to meet the NISD EU Directive continues and limitations on outages caused by the impacts on the network caused by the situation in Ukraine. RIIO-T2 forecast spend of £240.9m is £5.7m higher than allowances, primarily reflecting spend carried over from RIIO-T1.

88. TO Opex costs in 2022/23 were £111.9m against allowances of £133.0m. Direct Opex was largely in line with allowances, with lower maintenance costs driven by utilisation of Gas Operations resource, reduced use of agency staff and procurement efficiencies, offset by higher fault maintenance costs caused by higher than expected levels of Linewalking and DSEAR defects costs and Operational Property costs (£3.8m higher than allowances) driven by a significant market-driven increase in own use electricity costs. TO Indirect costs were lower than allowances due to the net result of setting up an independent and efficient operating model on separation from National Grid that is right sized for NGT. TO Opex is expected to be £55.9m lower than allowances across the RIIO-T2 period, reflecting the ongoing impact of the factors noted above.

SO Totex Overview

89. SO capital expenditure in 2022/23 was £17m, £14.7m lower than allowances (cumulative spend of £34.9m versus allowances of £59.7m). This was primarily driven by IT Capex, with this programme of work progressing at a slower rate than was previously forecast. This progress mirrors that described above in the TO non-operational Capex section, where additional time is being taken by the business as it attempts to both optimise the chosen solutions and indirectly drive efficient spend.

90. SO Opex costs were £49.0m in 2022/23, £13.9m lower than allowances. Direct Opex costs were lower than allowances, primarily due to new ways of working and ensuring the SO is correctly resourced across all teams and reducing reliance on agency resource, combined with lower Market subscription and Xoserve costs. SO Indirect costs were also lower than allowances, again impacted by the setting up of an independent and efficient operating model on separation from National Grid that's right sized for NGT and lower CNI spend. SO Opex is expected to be £60.2m lower than allowances across the RIIO-T2 period, reflecting the ongoing impact of the factors noted above.

Table 2 - Outputs and incentive performance

Meeting the needs of consumers and network users				
Our Output	**Description**	**Output Type**	**2022/23 Target**	**2022/23 Performance**
Customer satisfaction	Undertake annual satisfaction survey with our customers	ODI-F	7.8/10	8.60/10.00
Stakeholder satisfaction	Undertake annual satisfaction survey with our stakeholders	ODI-R	7.4/10	8.69/10.00
Quality of Demand Forecast	Deliver accurate day ahead demand forecasting (D-1)	ODI-F	8.48 mcm average forecast error	8.97 mcm average forecast error
	Deliver accurate demand forecasting at the two to five days ahead stage (D2 to D5)	LO	13.70 mcm average forecast error	13.95 mcm average forecast error
Maintenance	Deliver benchmark performance for maintenance outage day (including valve operations)	ODI-F	11 days or less	1 maintenance day called
	Deliver benchmark performance for maintenance outage day (excluding valve operations)	ODI-F	75% of NG driven customer impacting works aligned with customer outages	92% of NG driven customer impacting works aligned with customer outages
	Minimise National Grid driven changes to maintenance planning	ODI-F	9.06 days change	0 changes initiated by NGT
Entry and Exit capacity constraint management	Meet constraint management target	ODI-F	£8.5m	£0 costs
Residual Balancing	Meet residual balancing linepark performance measure (LPM) target	ODI-F	<2.8 mcm average daily change	2.5 mcm average daily change
	Meet residual balancing price performance measure (PPM) target	ODI-F	Difference 1.5% of SAP	Difference 4.0% of SAP
Modernising energy data (digitalisation strategy and action plan)	Set out our approach to using data and digitalisation to deliver benefit for our stakeholders and society	LO	Publish Digitalisation Strategy and action plan	Gas Transmission Digitalisation Strategy published March 2022. Updated Action Plan published June 2023

Maintaining a safe and resilient network				
Our Output	**Description**	**Output Type**	**2022/23 Target**	**2022/23 Performance**
Network Asset Risk Metric (NARM)	Deliver our Baseline Network Risk Outputs (measured as long term risk benefits (LTRB)) as a result of asset health investment into our lead secondary assets using Baseline NARM allowances.	PCD	Deliver our Baseline Network Risk Outputs of R£200.77m (across three risk sub-categories) by the end of RIIO-T2.	Increase in NARMs work delivered in 2022/23 in comparison to 2021/22. On track to deliver 5 year output
Cyber resilience OT	Deliver cyber resilience programme related to Cyber Operational Technology	PCD UIOLI	Deliver Year 2 PCD deliverables	Year 2 cyber programme complete. Delivery of Control Systems impacted by global market conditions
Cyber resilience IT	Deliver cyber resilience programme related to Cyber Information Technology	PCD	Deliver Year 2 PCD deliverables	Year 2 cyber programme complete. Some elements are behind the original schedule but overall NGT expect to complete existing outputs within the RIIO-T2 period
Physical resilience	Deliver physical security upgrades at sites designated as Critical National Infrastructure (CNI).	PCD	Deliver PSUP requirements by 2026	Delivery of 4 out of 9 sites in progress and on track for completion by Q3 2023/24. Remaining 5 sites on track for delivery in 2024/25. On track for 5 year output.
Annual Network Capability Report	Publish annual ANCAR document	LO	Publish report for 2022/23	Published June 2022
Exit Capacity	Run the annual exit capacity process in accordance with the Exit Capacity Planning Guidance (ECPG)	LO	Run annual exit capacity process and submit Exit Capacity Allocation Report	Process ran Apr 2022- Jan 2023. Report published 31st Oct 2022
Asset health non-lead assets	Delivery of agreed AH non-lead assets volumes	PCD		Slower progress on some deliverables as we further refine delivery approach. Some deliverables tracking ahead of total volumes. On track for 5 year output
Bacton terminal site redevelopment	Deliver a Final Options Selection Report (FOSR) and Re-opener submission	PCD	FOSR Delivery date Feb 2022, Reopener date Sep 2023	New FOSR and reopener dates of no later than Feb 2024 and August 2025 respectively, as agreed with Ofgem. All work is on track for FOSR submission in February 2024 or earlier.
King's Lynn subsidence	Delivery of Re-opener submission	PCD	Delivery date 31/03/2022	Output Fully delivered with alternative specification - Close-out Reopener submission delivered. Subsidence needs case driver no longer valid so no request for major project funding at this time

Delivering an environmentally sustainable network				
Our Output	**Description**	**Output Type**	**2022/23 Target**	**2022/23 Performance**
Greenhouse gas emissions (venting)	Meet greenhouse gas emissions venting targets	ODI-F	<2,897 tonnes for 22/23	2,287 tonnes
NTS Shrinkage	Meet our targets for the amount and the cost of the energy we use to run the network	ODI-R	N/A for 2022/23	6,795 GWh £533.8m
Annual Environmental Report	Publish an Annual Environmental Report	LO	Publish Oct 2023	On track for submission Oct 2023
Deliver our Baseline Environmental Incentive targets	Reduce operational transport emissions	ODI-F	12% reduction in operational transport emissions against baseline level of 1748 tCO2e	3% increase in operational transport emissions against baseline to 1797 tCO2e
	Reduce business mileage emissions	ODI-F	3% reduction in business mile emissions against baseline level of 1608 tCO2e	54% decrease in business mile emissions against baseline to 741 tCO2e
	Reduce office and operational waste recycling	ODI-F	52% of office and operational waste recycled	96.8% recycled
	Reduce office waste	ODI-F	3% reduction in office waste against baseline level of 54.6 tonnes	14.7% decrease in office waste against baseline; 47 tonnes recycled
	Reduce office water use	ODI-F	3% reduction in water use against baseline level of 7,380 m3	47% decrease in water use against baseline to 3,910 m3
	Increase the environmental value of non-operational land	ODI-F	1.4% increase in natural capital valuation against baseline level of £32.92m	4.5% increase in natural capital valuation
	Increase the biodiversity net gain on new network projects	ODI-F	N/A	Not triggered in 2022/23
Redundant assets	Decommission 80 redundant assets/asset sites, five customer sites and four compressors	PCD	Delivery date Mar 2026	9 Redundant Asset outputs have been physically delivered in total, pending project close out. 3 outputs are no longer redundant due to an external customer impact, 13 condensate tank outputs are being reassessed to determine the most appropriate intervention due to a change in risk. All remaining outputs are on track to be delivered by year 5.
Incremental Capacity	Needs case submission and FIOC Project Direction submission (Re-opener allowance request) for in-flight Western Gas Network project (Milford Haven PARCA)	Re-opener	Needs Case submission June 2021	Needs Case submitted June 2021 (approved Dec 2021), FIOC Project Direction submission on track for June 2023
Compressor emissions - Wormington	Deliver a Final Options Selection Report, long lead items and Reopener submission for Wormington	PCD	FOSR delivery date May 2022, Reopener date Nov 2024	New FOSR date of Aug 2022, as agreed with Ofgem. FOSR submitted Aug 2022. Reopener remains on track for Nov 2024
Compressor emissions - Kings Lynn	Deliver a Final Options Selection Report, long lead items, and Reopener submission for King's Lynn	PCD	FOSR delivery date Oct 2022, Reopener date Apr 2025	New FOSR date of Jan 2023, as agreed with Ofgem. FOSR submitted Jan 2023. Reopener remains on track for Apr 2025
Compressor emissions - Peterborough and Huntingdon	Deliver a Final Options Selection Report, long lead items and Reopener submission for Peterborough	PCD	FOSR delivery date Dec 2022, Reopener date Jun 2025	New FOSR date of Jan 2023, as agreed with Ofgem. FOSR submitted Jan 2023. Ropener remains on track for Jun 2025
Compressor emissions - St Fergus	Deliver a Final Options Selection Report, long lead items and Reopener submission for St Fergus	PCD	FOSR delivery date Dec 2022, Reopener date Jun 2025	New FOSR date of Jan 2023, as agreed with Ofgem. FOSR submitted Jan 2023. Reopener remains on track for Jun 2025
Hatton	Deliver emissions compliance at Hatton with a new unit scoped and procured to deliver 41MW mechanical output power.	PCD	Delivery date Mar 2025	On track for delivery Mar 2025

Key

Red – Missed an annual output and forecast to miss the remainder of our five-year output commitment

Amber – Missed annual output but on target to progress towards the remainder of our five-year output/successful achievement of annual output and risk of failure of the remainder of our five-year output

Green – Successful achievement of an annual output and on target to meet the remainder of progress towards our five-year output commitment

Blue – Output delivered

II. Operational Context

91. As the sole owner and operator of the Gas Transmission network in Great Britain, National Gas Transmission manages the day-to-day operation of the NTS including the residual balancing of the network, maintaining system pressures, and assuring gas quality. Our performance in 2022/23 is contextualised by the continued evolution of the operational challenges the business has faced during the financial year.

92. The war in Ukraine which started towards the end of the last reporting cycle (February 2022), has had a significant impact within this reporting year and has led to unprecedented change in the operation of National Gas Transmission. Supply chains and lead times for equipment increased, gas prices increased and the operation of gas networks across Europe moved from an East to West to a West to East direction. This was also felt in the UK where gas flowed from across the UK to the East coast where Interconnector and BBL connect the NTS to Europe.

93. Despite this challenging backdrop during 2022/23 we have facilitated the delivery of 100% of gas requirements for our customers. Achieving this level of performance required us to continually adapt to the changing use of the network by our customers. We saw significant changes in the operation and usage of the NTS, including maximising exports to Europe (above obligated levels for much of the summer and autumn) and large gas for power demand swings between days. These changes were influenced by global markets, such as:

- Low storage stock levels in Europe with much reduced Russian gas supplies to Europe impacted the replenishment of storage levels and supply to customers,
- Gas prices at record high levels with significant price differentials between UK and Europe (as detailed in Tables 3,4 and 5)
- High demand on electricity interconnectors to Europe throughout the summer and autumn driving additional demand for UK gas powered generation.

94. Facilitating European exports throughout the summer and into the winter was a challenge to the operation of the NTS. We transported ~20 bcm of gas from UK to Europe, compared to ~4 bcm in previous years. With such a large demand at one single point (Bacton Exit IP), the whole network was configured to move gas in that direction.

95. This increased compressor running hours, by 54% compared to 2021/22, across the fleet to manage the gas flow and the subsequent increase in supply. Compressor run hours increased from 35,602 hours in 2021/22 up to 54,781[4] hours in 2022/23, of which the majority of these additional running hours were across the summer months. The additional compressor hours increased at a higher rate than the associated demand due to having such a large single point of demand at Bacton Exit Interconnection Point (IP). Overall total demand across

[4] These are the highest annual run hours we have experienced since 2017/18. Increased run hours have also impacted our GHG emissions which is covered in more detail in Section VI.

2022/23 increased to 92.8 bcm, including 20 bcm of exports to Europe, compared to 80.7 bcm in 2021/22.

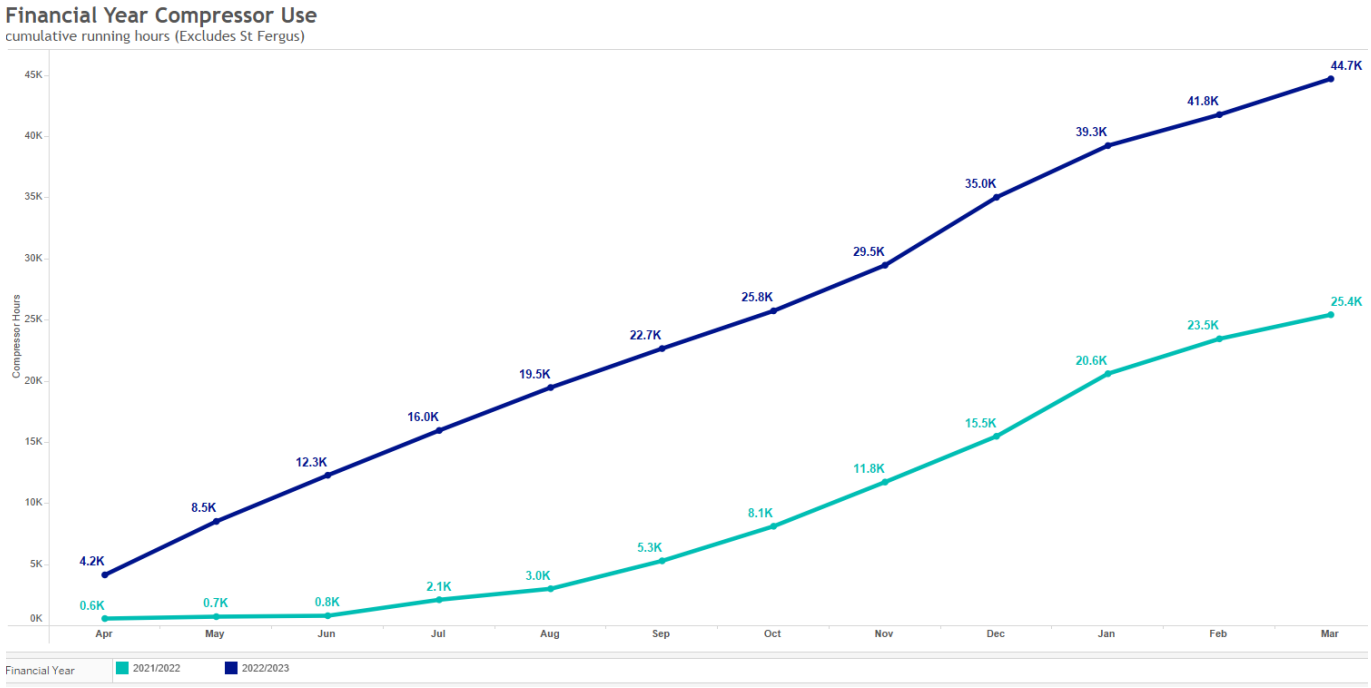


Figure 1 - Compressor Running Hours 2021/22 vs 2022/23

96. Supplies of gas into the UK remain diverse, with UKCS, Norway and LNG making up the bulk of the gas supply into the UK during 2022/23. The largest change was the increase in LNG supply from 16.5 bcm in 2021/22 to 25.5 bcm in 2022/23. UKCS also increased from 29.1 bcm to 32.3 bcm, but Norway remained at similar levels with extra Norwegian gas being supplied directly to Europe. Storage supplies are typically used to respond to on the day imbalances, there was a small increase of 1.1 bcm in storage withdrawal in 2022/23 compared to 2021/22.

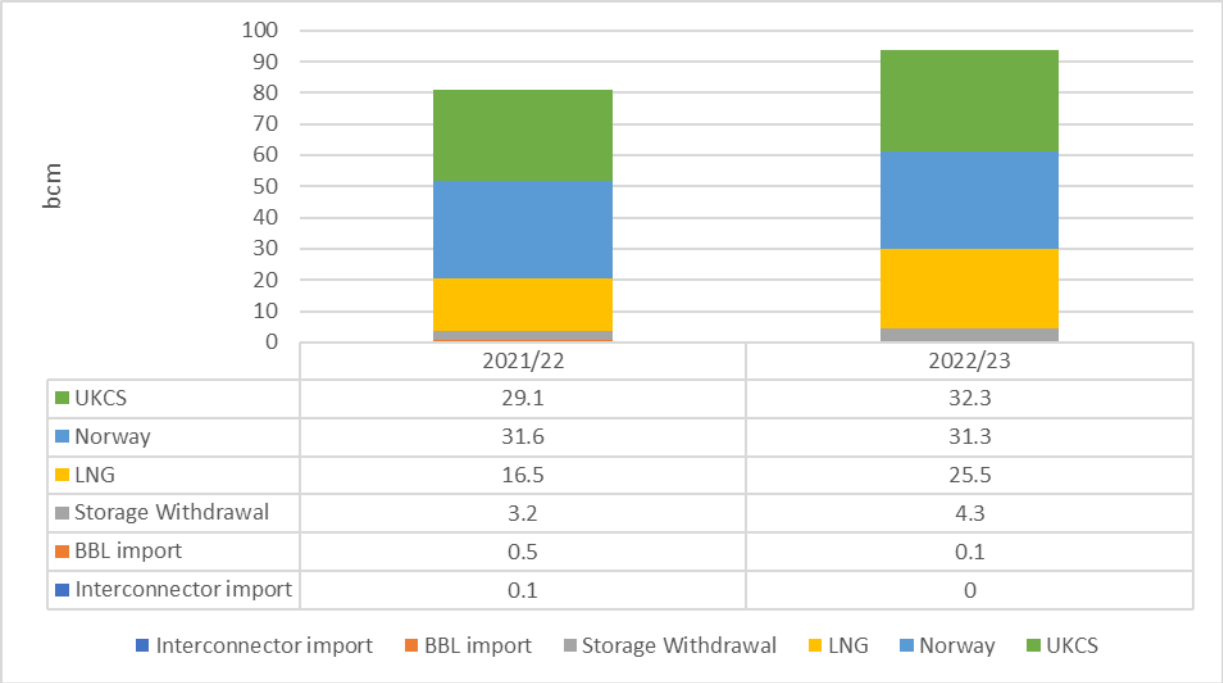


Figure 2 - Total UK Gas Supplies 2021/22 compared to 2022/23 (bcm)

97. Our winter supply position was aligned to our winter outlook which forecasted that UKCS, Norway and LNG would provide the bulk of gas supplies and would be supplemented by storage. LNG responded as expected and we had the highest delivery of LNG since 2011/12, flowing at a sustained level of 130mcm during the Troll from Trondheim cold snap in Dec 2022 (between the 6 and 17 Dec demand was greater than 350mcm). Interconnector flows were exporting to Europe for most of the winter, although they did reduce exports during times of peak UK demand and towards the end of winter, we saw a small amount of gas imported from Europe.

98. The continued impact on the GB gas market from the global events of early 2022 continued into 2022/23. Winter 2022 saw an increase in the System Average Price (SAP) with an average of 158 p/th in 2021/22 and a maximum SAP of 506 p/th, increasing further in 2022/23 to an average of 186 p/th (~20%) with the maximum SAP increasing to 568 p/th (~10%).

SAP – p/therm	2019/20	2020/21	2021/22	2022/23
Average	29	31	158	186
Min	18	9	45	13
Max	43	78	506	568

Table 3 – Average SAP from 2019/20 to 2022/23

Belgium – p/therm	2021/22	2022/23
Average	163.1	227.3
Min	46.5	20.0
Max	512.0	605.0

Table 4 – Average Belgium p/therm from 2021/22 to 2022/23

Dutch – p/therm	2021/22	2022/23
Average	165	280
Min	47.7	59.8
Max	514.6	761.5

Table 5 – Average Dutch p/therm from 2021/22 to 2022/23

99. These high GB gas prices have changed the behaviour of some customers connected to the NTS. Not only have we seen record exports to Europe, but Local Distribution Zones (LDZ) demand has been suppressed by ~12% when weather effects are removed, which contributed to a reduction of 6 bcm in LDZ demand compared to 2021/22. The high gas prices also drove a change in industrial demand, with some significant reductions seen over the past three years. The largest step change was between 2020/21 and 2021/22, with gas usage for industrials reducing on peak days from 21 mcm/d to 12 mcm/d with further reduction in 2022/23 to 8 mcm/d.

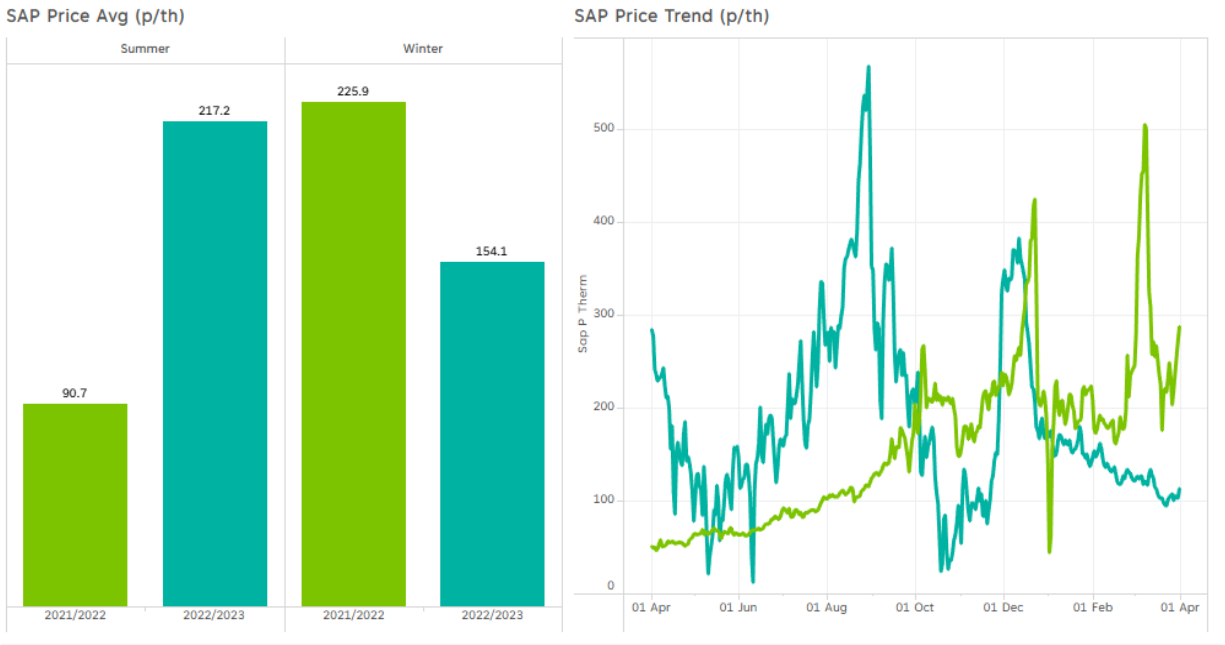
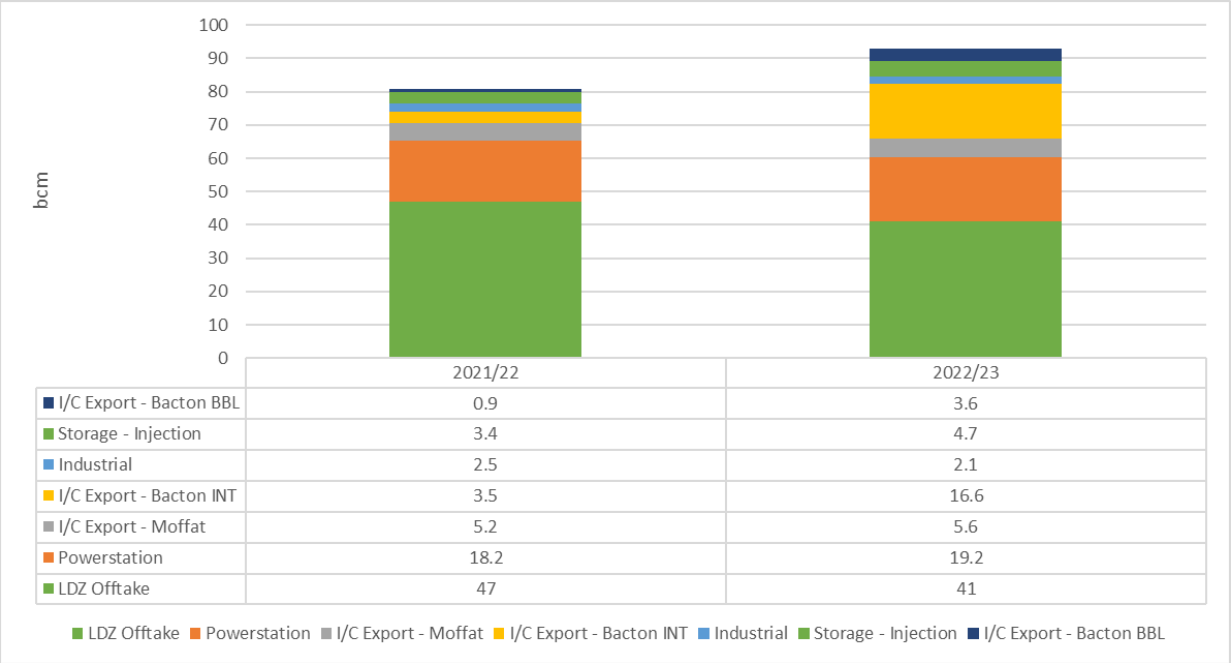


Figure 3 - SAP Price (Avg and Trend) (p/th)

100. On 15 Dec 2022 we had the second highest demand day in the past 10 years at 417 mcm, second only to Beast from the East (1 Mar 2018). This was driven by a combination of the cold weather and high gas for power demand. During the 15 Dec 2022, LDZ demand was 280 mcm and, when taking account of the 12% reduction mentioned above, this could have resulted in closer to a 440 mcm demand on that day which would have been the highest demand day in the past 10 years.



	2021/22	2022/23
I/C Export - Bacton BBL	0.9	3.6
Storage - Injection	3.4	4.7
Industrial	2.5	2.1
I/C Export - Bacton INT	3.5	16.6
I/C Export - Moffat	5.2	5.6
Powerstation	18.2	19.2
LDZ Offtake	47	41

Figure 4 - Total UK Gas Demands 2021/22 compared to 2022/23 (bcm)

101. Power Station demand, with large variations between days due to intermittent renewable generation, was another challenging element to managing the operation of the NTS during 2022/23. There was a large dependency on gas for power for the electricity network across the year supporting both electricity exports to Europe and days with low UK renewable generation. Although overall demand was similar to 2021/22 this does not fully reflect the increasing variability in demand we are seeing.

102. Gas for power reached near peak levels in 2022/23, with the highest power station flows seen on the 12 Dec at 95.9 mcm/d. The peak power station demand added to the operational challenge of high demand but was exacerbated when it switched to the lowest gas for power day of 2022/23 on the 20 Dec of 9.4 mcm. This 90% reduction was due to the quick response of the electricity network to winds. The average gas for power demand during the summer also increased, from 49.9 mcm/d in 2021/22 to 56.59 mcm/d in 2022/23 and was primarily due to outages on the French nuclear fleet and electricity being exported to France.

103. Another weather impact on the NTS during 2022/23 was a sustained period of high winds at the Milford Haven port December through to Jan 2023. This resulted in LNG cargos being unable to dock. There was a smaller impact in November, impacting only Dragon. Whilst this specific incident wasn't an issue for gas supply, as electricity generation required little gas for power generation, it did result in challenges as the wind dropped and cargos were then able to dock. This highlights an example of the need to ensure we have a resilient and flexible network to meet the varying conditions of supply and demand

104. Prior to the winds dropping the NTS had been set up in a North to South flow configuration. As cargos docked the NTS had to be reconfigured quickly to a West to East flow configuration going from 25 mcm/d entry flows at Milford Haven to maximum flows within 24 hours. This gave some operational challenges, particularly when one key compressor station tripped for

a short time due to an external power cut. This led to us needing to take commercial actions, in the form of locational actions, to avoid over-pressurising the Network. Locational sells were carried out at Milford Haven with corresponding buy actions at various other locations.

105. These large variations between high demand and low demand and high supply and low supply, impacts on how the network is operated as it alters the amount of gas that needs to be transported around the country, requiring different operating strategies.

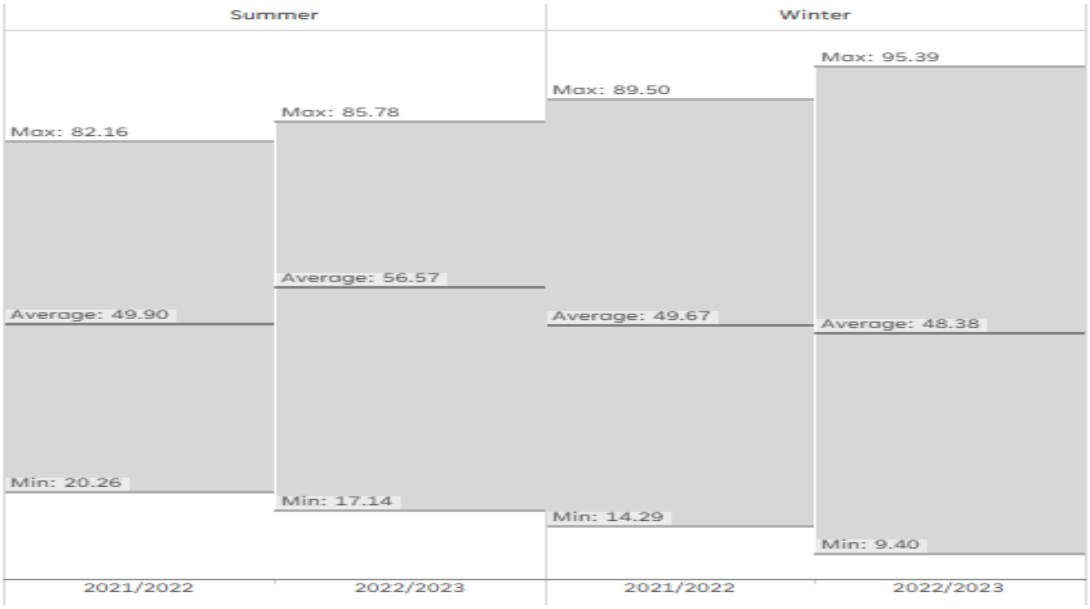


Figure 5 – Min, Max and Avg end of day volume power station demand (mcm/d)

106. Following the Russia / Ukraine conflict, and a sustained difference between gas prices in the UK and Europe, BBL and Interconnector export flows increased to a never previously seen sustained 75 mcm per day.

107. This led to occasions where there were issues with Interconnector (INT) flows where dust particles entered into the filters. The filters are designed to capture any solid particles in the gas. Although we were able to deliver the required gas, the customer had to reduce flows to clean their filters. Since then, we have worked with the customer to propose potential solutions to reduce the impact/likelihood of dust ingress including:

- Cleaning the feeders by carrying out in-line-inspections earlier than the statutory requirement,
- Double filtering some of the Interconnector gas within the Bacton terminal when possible
- Maximising pressures where possible to reduce velocities within the pipeline.

108. The total gas exports from UK to Europe were at the highest level, increasing by 4-fold from the previous five years up to ~20 bcm/yr. NGT helped facilitate flows of greater than baseline

on 60% of days across the year contributing significantly to a healthy European storage stock position throughout winter as the lower non export demands enabled NGT to facilitate this.

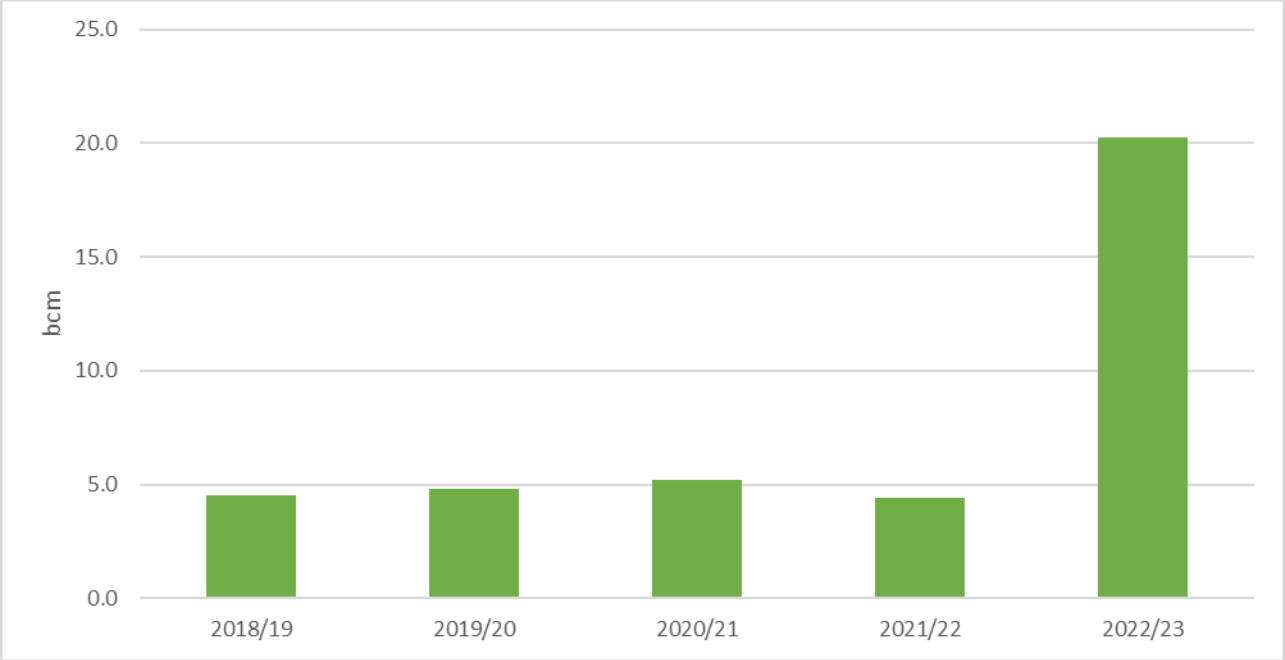


Figure 6 - Total Interconnector Exports (past 5 years)

Winter Preparedness

109. We continually monitor supply and demand behaviour throughout the year, identifying potential risks and taking appropriate mitigating actions to ensure we have the right measures in place for UK Security of Supply. We also look for opportunities to implement improvements, especially considering the current geo-political context surrounding the energy landscape.

110. Ahead of winter 2022/23, we worked closely with the Department for Energy Security and Net Zero, Ofgem, and National Grid ESO to develop improvements and understand the energy landscape to ensure we were well prepared to maintain safe and secure operation of the gas transmission system.

111. As well as the significant and successful preparatory works carried out by our operational teams to ensure asset reliability ahead of winter, we also adapted our approach to communicating with our customers, providing earlier insight into our winter activities via an Early Winter Outlook and more detail in our Outlook publications with the use of scenarios paired with market analysis. This included a new margin notice forecast in addition to our existing five-day-view. This was to provide a view of what the day ahead trigger level might be on any day out to D-7 at the week ahead and was published daily on National Gas Prevailing View during the winter period.

112. We also reviewed demand side response (DSR) as part of our winter preparedness activities. Following extensive engagement with customers and stakeholders we led on reforms, which allowed shippers to pre-contract for DSR with NGT in return for an availability payment, and enabled shippers without access to the On-The-Day Commodity Market (OCM) to participate in this process.

113. A further improvement was the addition of a supplementary Operating Margins (OM) tender to ensure we had adequate OM procured given the uncertainties that were at play. We don't anticipate the need for further tenders, as we have taken last year's supplementary tender and additional requirements already into account for winter 2023/24.

114. We successfully delivered our annual network emergency exercise 'Exercise Degree', once again demonstrating that the gas industry is prepared and able to meet its obligations in the event of a Network Gas Supply Emergency. Exercise Degree was held over four days, with over 400 industry participants taking part.

115. Whilst we take every appropriate step to prepare for winter, there are several factors outside of our control that could affect what we see in winter 2023/24, including the weather, the cost of energy to end consumers in GB and EU and how this may affect demand, the EU storage position, continued disruption to European gas supplies due to the war in Ukraine and global LNG availability.

116. Winter 2022/23 has highlighted the integral role that gas continues to play in the GB energy system, underpinning energy security both at home and in Europe. Our network performed throughout, ensuring that we were able to deliver the energy needed to heat homes, power British industry, and facilitate secure electricity generation whilst providing essential flexibility to intermittent renewables. We intend to build up on the positive progress made this year and will look to drive further improvements to enhance our understanding of the market going forward.

Summary

- We have experienced the highest compressor utilisation of over 54,000 run hours due to customers use of the network
- High gas prices have significantly changed GB consumer behaviour with an overall demand reduction of 12%
- We have experienced issues and unpredictably with LNG supplies during high winds, highlighting the need to ensure resilience from other parts of the transmission network to mitigate any issues
- We had near peak gas power generation utilisation during December 2022
- There has been a 4-fold increase in exports through the European interconnector to 20 billion cubic meters of gas
- The above highlights the integral role of our infrastructure to providing a secure, flexible and resilient energy system now and in the future

national gas transmission

III. Consumer Priorities

117. Through the development of our RIIO-T2 Business Plan, we undertook extensive stakeholder engagement, using and building upon the three main output categories that Ofgem identified as stakeholder priorities in their Sector Specific Methodology Decision (SSMD) document. These output categories were:

- Meet the needs of consumers and network users
- Maintain a safe and resilient network
- Deliver and environmentally sustainable network

118. These priority areas focus on delivery of outcomes that our customers and stakeholders have told us that they value most. There are also a series of more specific outputs that sit within each of these three key priority areas. These include Price Control Deliverables (PCDs), Output Delivery Incentives (ODIs) and Licence Obligations (LOs). Further detail on our performance against these outputs can be found within Table 2 (Page 22-23) and have been used in our assessment of our 2022/23 performance.

119. We have continued to implement several strategies and applied these through a range of initiatives to deliver our outputs as efficiently as possible and to provide the greatest benefit to customers. Our 2022/23 performance against these key outputs is outlined further below.

IV. Meeting the needs of consumers and network users

120. Our customers and stakeholders have told us that they want us to deliver a high quality and reliable service to all network users and consumers. They expect data and insights that we produce to be transparent, accurate and timely, and for our processes to allow for quick and easy connection or disconnection to the network. Our customers and stakeholders want us to be able to meet the needs of consumers and network users both now and in the future, helping to lead the way with decarbonisation, decentralisation, and future energy systems transition. The provision of these services must be balanced with the overarching need to keep domestic and non-domestic consumer bills as affordable as possible.

121. The section below details how we have performed against the deliverables that sit within the 'Meeting the needs of consumers and network users' priority area. This year has proven particularly challenging with the current global-economic conditions having a significant impact on our ability to meet our incentive targets.

122. Our commitment to customer and stakeholder satisfaction has been recognised with both areas achieving scores considerably higher than the baseline target. Customer feedback highlighted that we continue to communicate more effectively and deliver timely and thorough responses in our engagement.

123. In summary we have met most of our outputs in this area, with the exception of not meeting the residual balancing price performance measure (PPM) target and the demand forecasting incentives. This is discussed further in the 'Residual Balancing' and 'Demand Forecasting' sections below. Meeting the needs of consumers and network users' outputs not discussed in the below section are covered in XI. Non-Load Related Capital Expenditure.

Digitalisation Strategy and Action Plan

124. The future energy system will be more dynamic than ever before, and we recognise that digitalisation of our processes and exploitation of our data will be key to making the right decisions and ensuring that we continue to offer the best service to our customers and stakeholders.

125. Over the course of the last few years, digitalisation of the energy system has become a growing priority for our stakeholders. There is increased focus on the value of energy data and digitalisation for society, with organisations such as the National Infrastructure Commission, the Centre for Digital Built Britain, and the Energy Data Task Force from DESNZ, Ofgem, and the Energy Systems Catapult – all emphasising the opportunity and outlining principles and steps needed to deliver that benefit for society. We have recognised the importance of data and digitalisation, and have invested in meeting the highest priority needs of our stakeholders and laying strong foundations for future work:

- We continue to participate and deliver outputs within the Digital Data Strategy Group, working and collaborating with other Gas/Electricity Networks i.e., Meta Data Standards, Open Data Licensing.

- We are also working with Ofgem's Digital team in responding to Request for Information and Data Best Practice Guidance Consultations; engaging with Ofgem to deliver actions to meet compliance.

- Internal Target Operational review to align with Data Best Practice Guidance guidelines to ensure delivery is adaptable to any changes going forward.

126. Our New Information Provision (NIP) Project has been established to enable us to deliver transformation of our data provision platform over the next 3 years. The NIP project is in flight, and we have been working on designs and bringing information provision together, with our first update going live through 2023/24.

127. The NIP update will include:

- Introduction of National Gas Transmission Data Portal Landing Page
- Enhanced Prevailing View
- Improved navigation across the platform
- More intuitive descriptions, labels and help information
- Easier access to Data Triage Request
- Enhanced Excel Integration Tool

128. The completion of the common data environment proof of concept, to test the feasibility and capability of implementing a construction cloud collaboration system to improve the delivery of our capital projects and to align our processes to international (ISO) Business Information Modelling standards. The outcome and the metrics gathered as part of the proof of concept has helped to shape the functional requirements needed to successfully deliver the full Enhanced Asset design capability.

129. Digital Asset Management is the programme which separates NGT's existing Asset Management Systems and replaces them with a mix of new and like-for-like technologies. The primary goal of the programme is to achieve business separation, mitigating the risk of costly TSA extensions at the end of the 2-year period.

130. To ensure the focus on business separation, the program has been split into two significant business releases:

- Release one delivers in March 2024 and will deliver a minimum viable product which enables NGT to operate on standalone systems.
- Release two, currently planned for July 2024, will deliver enhancements to the system, bringing in new capabilities, improving user experience whilst unlocking new business benefits, capabilities, and efficiencies for NGT.

131. The technology scope within the Digital Asset Management programme is Ellipse (Enterprise Asset Management), ArcGIS (Geogrid) and OpenText (Enterprise Content Management).

132. Ellipse will be replaced by Maximo, ArcGIS will employ the same technology but in a standalone instance and OpenText will be replaced by Microsoft SharePoint.

Customer and Stakeholder Satisfaction Survey

133. The Customer Satisfaction Incentive is a financial incentive which allows us to earn revenue from surveying customers on their experiences of working with us. The Stakeholder Satisfaction Survey is a similar mechanism but is a reputational incentive only.

134. Both CSAT and SSAT response volumes this year were the highest ever achieved. We have continued to target a broad range of stakeholder contacts with a high number of focused virtual events such as Shaping the Gas Transmission System of the Future. An ever-increasing volume of respondents have stated a preference for email surveys. Whilst this has impacted our response rates, the actual number of responses received was higher than the previous year due to the larger number of contacts that were put forward to survey. This allowed us to obtain valuable insight to improve future events.

135. In 2022/23 we achieved a customer satisfaction score of 8.60 against a baseline of 7.80. This has decreased by 0.03 since last year's score of 8.63 but is the second highest score ever achieved. Four out of the eight survey areas had increases in their scores this year, one stayed the same and three saw slight decreases although two of those latter areas were single figure responses and therefore a below-average score can bring the overall score down very easily.

136. The customer feedback in our higher scoring areas highlights that we continue to communicate more effectively and deliver timely and thorough responses in our engagement. To focus on one area in particular, the scores and volumes for our Connections Process increased by 0.44, from 8.20 to 8.64, and they enjoyed almost triple the volume of response in this area. The feedback supporting the increases tend to focus on good communication and responsiveness as the key drivers. The top performing survey area which enjoyed another increase in its score, was that of maintenance. Feedback for this area highlighted prompt and effective communication and being able to contact the right person.

137. The stakeholder satisfaction score was 8.69 against a baseline of 7.40, an increase of 0.15 from the 2021/22 score of 8.54. This continues a year-on-year increase since 2017/18. The volume of responses increased to 84 compared to 71 in 2021/22, demonstrating a wider range of stakeholders that we have engaged with.

138. Building on the foundations we put in place last year, we've continued to embed our annual engagement programme that enables us to engage with customers and stakeholders across all our business priorities. This not only provides meaningful feedback on our plans but is also a fantastic opportunity for our teams to build closer relationships with a broader range of stakeholders. In addition, we extended our strategic relationship management and Key Account Management (KAM) approach to ensure we understand our customers at all levels across their organisations and were joined up in our approach.

139. **Stakeholder engagement culture:** Ownership for stakeholder engagement sits within all teams with the onus on all individuals to engage, translate and act on feedback from customers and stakeholders. Our Customer and Stakeholder Team provide expertise and guidance to ensure the expectations of our customers and stakeholders are at least met and ideally exceeded. We are continually seeking feedback to develop our priorities and strategic thinking and run numerous events to keep stakeholders engaged and informed.

140. **Shaping the gas transmission system of the future:** After the success of the engagement events in 2020 and 2021 and as part of our RIIO-T2 commitment, we again held a series of interactive webinars in 2022. The events were shaped from stakeholder feedback and focused on key topics including our priorities over the next 12 months, which enabled stakeholders to feed in their views on areas that interest and impact them. In total nearly 1200 stakeholders across 215 companies and 25 stakeholder groups attended the events and we received valuable feedback which we will feed into our business and future events. This included doing more events throughout the year to keep stakeholders updated and being more transparent on how we're performing against our strategic priorities.

141. Over the last 12 months we've held numerous events from webinars to consultations, debates to site visits covering all our strategic priorities. All these activities provide opportunities for us to understand our customers better whilst developing meaningful relationships.

142. **Independent User Group:** We successfully transitioned our Independent User Group (IUG) in 2021/22 to focus on how we manage our day-to-day business and evolve the IUG's role. The group continues to meet six times a year and provides scrutiny and challenge on our business plans. In 2022/23 we presented a wide range of topics to the IUG, including Innovation, Environment, Social and Governance (ESG), Operating the Network, St Fergus PCD, Digital Strategy, Wormington PCD, Overarching Stakeholder Engagement, Hydrogen Regulatory Framework, Performance Updates and much more. We've had positive engagement receiving 65 recommendations across all topic areas, which we are actively working on to drive performance by aligning business plans and decision making with the views and needs of customers and stakeholders.

Quality of Demand Forecasting

143. The national demand forecasts published by National Gas Transmission for day ahead (D-1) and for two to five days ahead (D-2 to D-5) are a key tool for the UK gas industry in understanding their positions.

144. Ofgem recognised the improvements the Demand Forecasting incentives had driven during the RIIO-T1 period and opted to continue with a D-1 financial incentive scheme for RIIO-T2. The D-2 to D-5 scheme was changed to a reputational incentive scheme with a corresponding Licence Obligation to report annually to the Authority on our performance.

145. The provision of timely and accurate forecasts aids in ensuring efficient market operation from both a physical and commercial perspective, ultimately reducing operating costs, which impacts end consumers bills. National Gas Transmission strives to continually optimise its forecasting processes, to deliver greater accuracy and increase customer and ultimately consumer benefit.

146. In 2022/23, the weighted average error on the D-1 incentive was 8.97 mcm against a target of 8.48 mcm (Fixed target of 8.35 mcm + Demand Forecasting Storage Adjuster (DFSA) of 0.13 mcm). The weighted average error has increased this year from 8.52 mcm in 2021/22. The associated incentive revenue for 2022/23 is -£0.19m, compared to £0.17m in 2021/22. Total gas injected into Short-cycle Storage facilities (including Rough) during 2022/23 was 4751.20mcm which is an increase from 3387.90mcm in 2021/22.

147. The DFSA was put in place as part of the RIIO-T1 price control. It is designed to take account of storage sites being able to withdraw / inject on the same day and the impact that this has on the demand forecasting and associated volatility. Although this remains an element of the demand forecasting volatility given the changes in the overall supply/demand backdrop (LNG, renewables etc) it is no longer the main element impacting demand forecasting volatility.

148. The D-2 to D-5 incentive weighted average error was 13.95 mcm in 2022/23 against a target of 13.70 mcm. The weighted average error has increased from 12.37 mcm in 2021/22. There is no associated incentive revenue for this scheme as the scheme was amended to reputational only under RIIO-T2.

149. From a demand forecasting perspective, 2022/23 proved to be another challenging year as ongoing global uncertainties led to very volatile gas and electricity prices, both from a forward curve and SAP perspective, for example SAP ranged from ~13p/th on 10 June 2022 up to 568p/th on 29 August 2022. During the winter months SAP ranged from ~24p/th on 18 October 2022 up to 383p/th on 11 December 2022.

150. This continuing volatility in global markets impacted both supplies and demands and therefore demand forecasts as global market pressures have led to divergence from some of the more standard historical behaviour, this has increased the challenge of forecasting the evolving current behaviour against historical market relationships. The total annual exports via BBL and Interconnector have increased from 4,429 mcm in 2021/22 to 20,247mcm in 2022/23. The total annual LNG supply was 25.5 bcm in 2022/23 compared to 16.5bcm in 2021/22.

151. In 2022/23 we saw 12 days showing a greater than 40 mcm total demand change from the previous day, a 2-day reduction from 14 days last year (2021/22). The most extreme of these daily demand changes was 59.76 mcm compared to 76.75 mcm last year. The day-on-day average change in demand remains high, it increased to 12.68 mcm from 12.59 mcm in 2021/22.

152. Power Station gas usage continues to be highly variable, with new sources of electricity from renewable generation and increased capacity from electricity interconnectors impacting the variability and accuracy of forecasting gas for power.

153. The day-to-day change in Power station demand is increasing as renewable capability and electricity interconnector capacity increases. In 2022/23 there were 3 days where the day-to-day changes in Power Station Demand have been more than 40mcm with a maximum change of 44.29mcm[5] and an average change of 10.37mcm. This compares to 0 days more than 40mcm in 2021/22 where the maximum day to day change was 37.76mcm and the average was 9.95mcm.

154. Changes to wind forecasts are also having an impact on forecasting accuracy. Using data published on the Elexon Balancing Mechanism Reporting Service and converting to an mcm impact for a gas day and applying an efficiency factor of 52%[6], the daily average error in day ahead wind generation forecasts is 3.86mcm, which is ~45% of our weighted average error, with a maximum error of 16.77mcm.

155. Supply forecasts and the associated storage injection or interconnector exports have also been affected by changes to wind forecasts. Storms around the Mid Channel Rock have prevented vessels from docking at Milford Haven which can cause variability in LNG supplies. The most notable reductions associated to the prevailing winds were the Milford Haven supply reductions at the end of Nov 2022 and during the Christmas period 2022 into Jan 2023. Week commencing 21 Nov 2022 Dragon reduced from near maximum rates down to 0. Milford Haven started Dec 2022 at a steady rate between 75-80mcm we then observed supply reductions to 16mcm by 30 Dec due to vessels not being able to dock.

156. Fluctuating prices coupled with the impact of storms have meant we have seen LNG tankers getting diverted to other countries. In 2022/23 we have seen several changes to scheduled deliveries, with 39 vessel changes at Isle of Grain and 27 diverted from Milford Haven.

157. Additionally, industrial action in France and the North Sea has caused changes to supply patterns due to LNG cargos being diverted elsewhere and Norwegian maintenance being cancelled at short notice. We have also observed that industrial action in the UK can cause an increase in LDZ demand as peoples routines change.

158. In 2022/23 we have witnessed reductions in LDZ demand because of the energy crisis driving changes in customer behaviour.

159. LDZ demand when compared to 2021/22 reduced by 12.1% in 2022/23, or a 9.7% reduction on a weather corrected basis. The largest LDZ demand component, domestic, which accounts

[5] The power station variability is a subset of the total variability outlined in paragraph 9 and as such the days where a large swing in power demand is witnessed m Residual Balancing actions ay align with or be different to those where the total demand change exceeds 40mcm

[6] We have assumed a CCGT thermal efficiency of 52%, meaning that 52% of the energy in the gas is converted into electrical energy, by applying this we provide an equivalent gas volume for the associated change in Wind generation.

for ~60% of LDZ demand, saw a decline of 17.8%. On a weather corrected basis domestic demand reduced by around 14.5%. As a result of the changes in domestic behaviour due to higher gas prices; where we saw large day to day swings in Composite Weather Variable (CWV) the underlying demand became more unpredictable, this also applied to the predictability of usage over Bank Holiday periods.

160. We continue to focus on improving our demand forecasting accuracy and throughout 2022/23 we have embarked on several activities to drive improvements, including:

161. Process improvements - Supply forecasting. Identifying continuous improvements to better understand supply behaviour and what causes changes to supplies. During this year we have continued to contact sites to better understand their operation, forecasts etc, tracked new fields coming online, or changes to existing fields and embedded this within our teams and their processes.

162. Process improvements – Power Stations. We continued with the internal development of improved demand forecasting capability models, which will continue in the coming year. However, we have faced challenges with elements of the model such as the errors to the wind generation inputs and trying to predict the electricity interconnector behaviour as this has a direct impact on the total electricity demand over the 24-hour period aligned with the gas day. In 2022/23 the investment in model development and ongoing operation totalled ~£45k.

163. Staff development – We continue to prioritise ongoing staff development as this is needed to run alongside any process improvements as an enabler, to continue to perform under the scheme. Alongside the development of new processes staff need to have the capability to adopt them, for example a new process has been introduced to track storms which may affect LNG deliveries and we now also monitor marine forecasts (wind gusts, wave heights and wave periods) to predict if LNG tankers will be unable to dock as scheduled or the potential for them to be diverted elsewhere, this being a new capability for the team. For Power Stations we have started tracking the bias for the total electricity demand to ascertain trends against wind generation and changes to electricity interconnectors. For biomass and coal, we are tracking the changes to usage against gas prices to identify fuel switching triggers.

164. Industry knowledge sharing – we liaised with domestic shippers to share thinking on behaviour changes being witnessed in the domestic markets and to validate our assumptions, which were aligned with the parties we engaged with. This is something we will continue to share learning on and potentially evolve our processes as the market the evolves and the impact of prices on consumer behaviour develops.

165. As we progress through RIIO-T2 we will continue to investigate how new data models can continue to be utilised, they provide flexibility to add future new data sources and support inhouse amendments. Due to this approach, we believe that we will be able to make timelier

changes with reduced costs in continuing to enhance and implement improved models, saving staff time from manual work which will enable them to focus on intelligence gathering/understanding and refining models etc. We will continue to assess and review the ability for automated data acquisition for the Machine Learning platform to enhance modelling accuracy.

Maintenance

166. The Maintenance Incentive Period runs from 1 Apr – 31 Oct each year, to align with the summer outage plan.

167. To ensure the ongoing reliability and integrity of the NTS, we are required to periodically undertake maintenance. Where this work requires an outage, or to reduce the flexibility available at one or more direct exit connections, NGT may 'call' one or more 'Maintenance Days' in accordance with the UNC.

168. We plan maintenance activities to align with periods which minimise disruption to customer operations. If the maintenance period has no impact on customer contractual rights, this is communicated as an 'Advice Notice Day'. Where this is not possible, a 'Maintenance Day' will be called. We are incentivised to minimise the use of maintenance days and changes to the maintenance plan.

169. To incentivise the efficient planning and execution of network maintenance impacting customers at direct exit connections from the NTS, the maintenance incentive is split into three scheme components:

- Use of Days - Maintenance days (Valve Operations)
- Use of Days - Maintenance days (excluding Valve Operations)
- Changes - Minimisation of changes initiated by NGT to the agreed maintenance plan

<u>Use of Days - Maintenance days (Valve Operations)</u>

170. The Use of Days – Maintenance Day (Valve Operations) scheme is designed to reduce the impact we have on our customers when we undertake our routine maintenance activities including Valve Operations (VO).

171. All VO activities were completed in 2022/23, whilst still ensuring minimal impact to customers. This was achieved using mostly 'Advice Notices' and one 'Maintenance Day' outperforming our target of 11 days or less (relating to utilising maintenance days). In 2021/22 we also achieved all VO activities utilising one 'Maintenance Day' with the rest achieved through 'Advice Notices'.

172. This element of the new RIIO-T2 scheme is downside only (£0.5m collar). As we outperformed the target of 11 days or less, no financial downside was triggered, and we incurred £0 cost.

Use of Days – Maintenance days (excluding Valve Operations)

173. The Use of Days – Maintenance Day (excluding Valve Operations) scheme is designed to reduce the impact we have on our customers for all other maintenance activities (excluding VO).

174. This is a new element to the RIIO-T2 scheme. For 2022/23 the incentive included 95 days of customer impacting works, of which 87 were aligned to customer outages. This demonstrates that 92% of customer impacting works (excluding VOs) were successfully aligned with customer outages against a target of 75%. This compares to 133 days of customer impacting works in 2021/22, of which 127 were aligned to customer outages (95% of customer impacting works)

175. This element of the RIIO-T2 scheme has a capped upside and collared downside (+/-£0.5m) therefore as we outperformed the target, we will receive £0.5m.

Changes - Minimisation of changes initiated by National Gas Transmission to the agreed maintenance plan

176. The aim of the Maintenance Day Changes scheme is to reduce the impact our maintenance activities have on customers should we make changes to our planned maintenance after 1 April for the forthcoming summer maintenance period. The incentive scope does not include changes that were initiated by customers, only those initiated by us.

177. The Maintenance Day Changes scheme includes any maintenance days called; it is not limited to VOs. In total, there were 125 days (inclusive of 95 days in the Use of Days – Maintenance Day (excluding Valve Operations)) of planned maintenance in 2022/23 compared to 161 days in 2021/22. This led to an updated benchmark for changes of 9.06 days in 2022/23, which is 7.25% of all Maintenance Days and Advice Notice Days called. This compares to a benchmark of 11.67 days in 2021/22.

178. Although the number of maintenance days categorised under the scheme has gone down in 2022/23 compared to 2021/22, the overall number of maintenance jobs has increased. For example, the number of jobs related to ILI runs, Defect Inspections and Pipeline/AGI works, increased from 259 in 2021/22 to 428 in 2022/23. However, these pipelines did not have customer connections thereby not having a direct increase on the number of maintenance days. It is still expected that the number of maintenance activities will continue to increase due to the profile of spend on capital projects over the RIIO-T2 period.

179. This element of the RIIO-T2 scheme is downside only (£0.5m collar) therefore as we outperformed the target, we incurred £0 cost.

180. In 2022/23, there were zero changes initiated by us during the maintenance period. This is the same level of performance as in 2021/22. This demonstrates the conscious effort that has been made to minimise change, despite several of our In-Line Inspections and pipeline works

impacting customers. Ensuring we minimised the impact of these Inspections was crucial in demonstrating our continued commitment to be flexible to customers' requirements.

181. This performance was primarily delivered by carefully monitoring our maintenance and communications processes, including continuing with our customer face-to-face meetings with renewed engagement at least eight weeks prior to the planned maintenance affecting them, allowing us to capture any changes to customer outages earlier.

182. Minimising the use of Maintenance Days throughout 2022/23 has ensured minimal impact to our customer's operations through taking on additional risk via increasing the alignment of works, saving customers approximately £15 million[7] in potential lost operation time revenue. This provides demonstrable value for our customers and the wider energy industry.

183. Our annual review of the 2022/23 maintenance programme will be published on our website from 1 June 2023 at: https://www.nationalgas.com/data-and-operations/maintenance.

Entry/Exit Capacity Constraint Management

184. The Capacity Constraint Management Incentive is designed to drive National Gas Transmission to maximise the available network capacity and minimise Constraint Management costs, through the efficient and economic planning and operation of the NTS. We therefore release as much capacity as possible, develop effective Constraint Management strategies and make economic and efficient NTS investment and planning decisions. This benefits our customers, and ultimately end consumers, as the costs of commercial Constraint Management actions to industry are mitigated or minimised and balanced against NTS investment whilst maximising NTS capacity. Running a constraint-free network provides choice for our customers to land and utilise the cheapest gas and has a positive impact on the market. A robust Constraint Management Incentive drives an effective strategy which delivers value to the industry and end consumers who share in the benefit of strong performance. The overall 2022/23 Constraint Management Incentive scheme performance was £4.6m.

185. The RIIO-T2 price control, altered the way that the revenues under the Constraint Management Incentive are calculated and reported. Under the RIIO-T1 price control, revenue from all within day sales, Interruptible/off-peak sales plus any non-Obligated sales were included in the Constraint Management Incentive and a 44.36% sharing factor was then applied. In RIIO-T2 Non-Obligated Capacity revenue is included in the Constraint Management Incentive calculation with two percentages then applied to this revenue – 14% of the revenue is included in the calculation and then a 39% sharing factor is applied unless

[7] Figures derived from National Gas calculation tool, factoring, gas, carbon, and electricity prices for a given period. In addition to this, the calculation also takes in to account the assumed efficiency of each individual customer

stated otherwise, all capacity revenues in this narrative are stated prior to the 14% and 39% factors being applied.

186. In addition to Non-Obligated Entry and Exit Capacity, under RIIO-T2 we continue to report on revenue generated from; Locational Sell Actions, Physical Renomination Incentive charges, and any further revenues derived by the licensee that the Authority directs us to include. We also continue to report any Constraint Management costs or revenues including Buying Back Entry and Exit Capacity, Locational Buy and Sell actions, Turn-up or Turn-down Contracts, Offtake Flow Reductions, and Investment Constraint Management costs (entry and exit).

187. The following paragraphs explain the reasons for increased revenue from the sale of both Entry and Exit Non-Obligated Capacity in 2022/23. The main reason for this was increased customer requirements to flow gas to Europe due to the Russia/Ukraine conflict which led to a rise in capacity sales at the Bacton Exit IP. This led to a 4-fold increase in GB exports/supplies to Europe, increasing to ~20 bcm during 2022/23, compared to ~4 bcm during 2021/22. Based on the daily prevailing supply and demand conditions and the constraint risk we therefore released unprecedented levels of Non-Obligated Exit Capacity at the Bacton Exit IP in response to market demand, resulting in increased capacity revenues. We also saw an increase in the Non-Obligated Entry Capacity booked in 2022/23, particularly at the LNG terminals to support the 65% increase in LNG supplies compared to 2021/22 which helped meet the export demand.

188. The following sections provide further information / data regarding both NTS Entry and NTS Exit Non-Obligated capacity but in summary:

- Non-Obligated Entry Capacity revenue in 2022/23 was £2.7m which was a 37% increase compared to 2021/22. This was driven by an increase in short term NTS Entry Capacity sales. Long term Non-Obligated Entry Capacity revenues reduced due to the lower NTS Entry capacity reserve price
- Non-Obligated Exit Capacity revenue in 2022/23 was £20.6m which was ~130% increase compared to 2021/22. This was driven by an increase in short term NTS Exit Capacity sales primarily at the Bacton NTS Exit Point (£15.4m in 2022/23 compared to £2.9m in 2021/22, of which ~£12m was in Oct 2022).

<u>Non-Obligated Entry Capacity</u>

189. In reporting year 2022/23, revenue from Non-Obligated Entry Capacity was £2.7m. In 2021/22, revenue from the same products was £1.9m. The year-on-year net increase in revenue was due to a £1.3m increase from Short Term Non-Obligated sales, offsetting a £0.5m reduction in revenue from Long Term Non-Obligated Entry Capacity sales.

190. For Short Term Non-Obligated Entry Capacity, revenue increased 3.2 times between 2021/22 and 2022/23 and the volume of sold capacity increased 4-fold.

191. At Bacton UKCS, the revenue from Short Term Non-Obligated Entry Capacity sales in 2022/23 was 2.2 times higher than the revenue generated in 2021/22. In 2022/23, 24% of the aggregate Short Term Non-Obligated Entry Capacity was sold at Rough and Theddlethorpe which compared to no sales at these locations in 2021/22.

192. Other notable year-on-year changes to Short Term Non-Obligated Capacity that had less of an overall impact were at Isle of Grain and Milford Haven LNG terminals. The changes in capacity booked at these terminals were due to the increased LNG supplies, which helped to support the higher export flows to Europe that were seen through 2022/23.

- At Isle of Grain, over nine times the amount of Short Term Non-Obligated Entry Capacity volume was sold in 2022/23 compared to 2021/22, which was an increase to 16% of the total Short Term Non-Obligated Entry Capacity volume sold in 2022/23 compared to 7% in 2021/22.
- At Milford Haven there was 10 times the volume of Short Term Non-Obligated Entry Capacity sold in 2022/23 compared to 2021/22 which was ~2% of the overall Short Term Non-Obligated Entry Capacity.

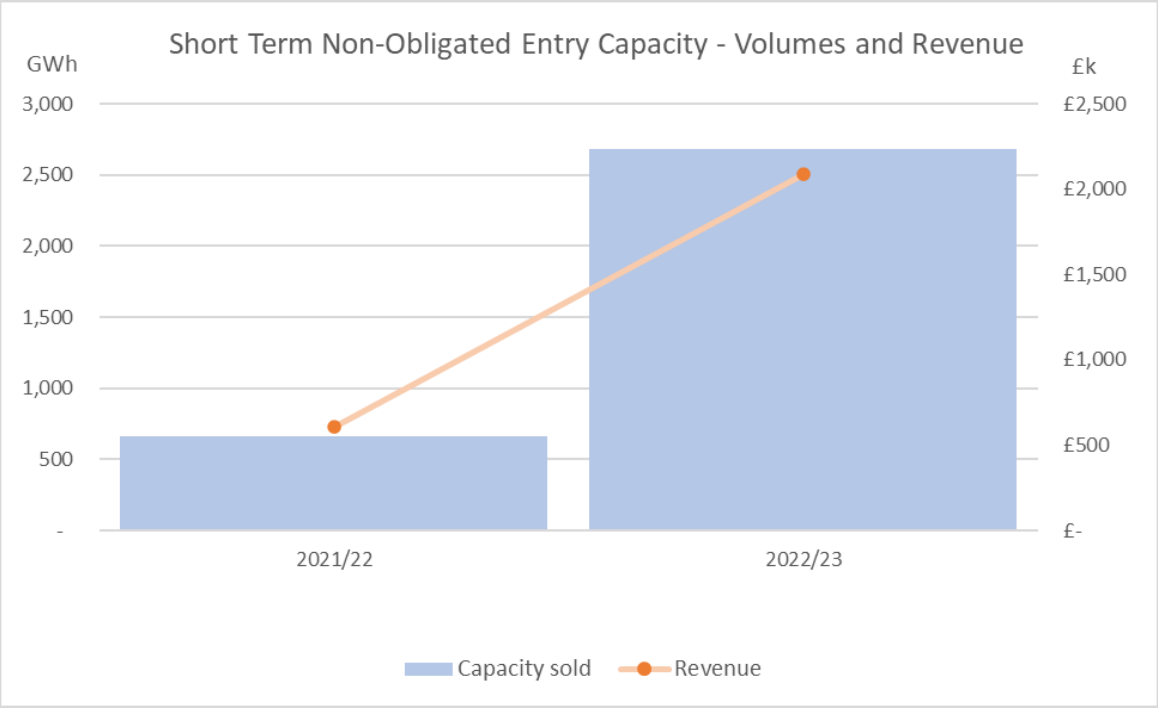


Figure 7 - Short Term Non-Obligated Entry Capacity sold and revenue

193. In terms of prices paid for Short Term Non-Obligated Entry Capacity, the average price paid was lower in 2022/23 compared to 2021/22. Although the average reserve price was lower in 2022/23, we sold over four times the volume of Short Term Non-Obligated Entry Capacity in 2022/23 compared to 2021/22. We sold 2,667 GWh of this Capacity in 2022/23 compared to 620 GWh in 2021/22. The lowest reserve price seen across the two reporting years was in the first half of 2021/22, and this was 0.0717p/KWh for the period April 2021 – October 2021. Although this was the lowest reserve price across the two reporting years, we only received

one bid at this reserve price throughout the whole six-month period in which it was applicable.

194. In 2022/23, there were 660 Short Term Non-Obligated Entry Capacity bids allocated, in the Within-Day Auctions, compared to 470 bids allocated in the Within-Day Auctions in 2021/22. A lower proportion of these were allocated at Bacton UKCS in 2022/23 - 371 bids of 660, compared to 464 bids of 470 allocated at Bacton UKCS in 2021/22.

195. For Long Term Non-Obligated Entry Capacity, volumes purchased across the two reporting years were identical, but 56% more revenue was generated in 2021/22 than in 2022/23. This was due to a year-on-year reduction in the reserve price.

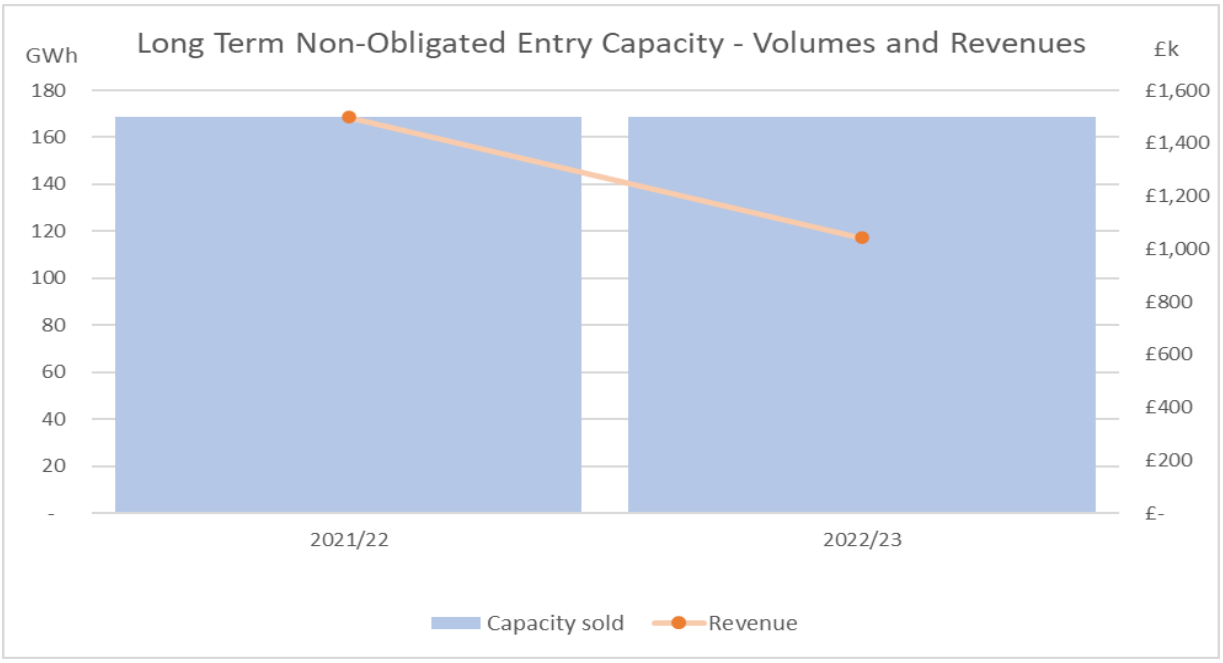


Figure 8 - Long Term Non-Obligated Entry Capacity sold and revenue

196. The vast majority (96%) of Long Term Non-Obligated Capacity was purchased at Cheshire Storage.

197. The final price paid for Long Term Non-Obligated Entry Capacity at Cheshire Storage was higher for the first half of 2021/22 (0.0359 p/kWh) and reduced in Oct 2021[8] (to 0.0185 p/kWh). There was then a further price reduction effective from Oct 2022 (to 0.0170 p/kWh). The effect of these price changes over the two formula years led to a 40% reduction in revenue when comparing 2022/23 to 2021/22.

198. The other site with Long Term Non-Obligated Entry Capacity booked was Murrow. The final price paid at this site was lower for the first half of 2021/22 (0.0718 p/kWh) and increased in Oct 2021 (to 0.0928 p/kWh). There was a subsequent price reduction effective from Oct 2022

[8] In October 2021 the storage discount increased from 50% to 80%.

(to 0.0852 p/kWh). The effect of these price changes over the formula years led to an 8% increase in revenue when comparing 2022/23 to 2021/22.

Non-Obligated Exit Capacity

199. In 2022/23 the total revenue generated from Non-Obligated Exit Capacity was £20.6m, compared to £8.8m in 2021/22. The increase in revenue is largely attributable to the Short-Term sales, which in 2022/23 generated revenues of £19.0m, compared to £6.9m in 2021/22. Revenue from Long-Term capacity sales were £1.6m in 2022/23 compared to £1.9m in 2021/22.

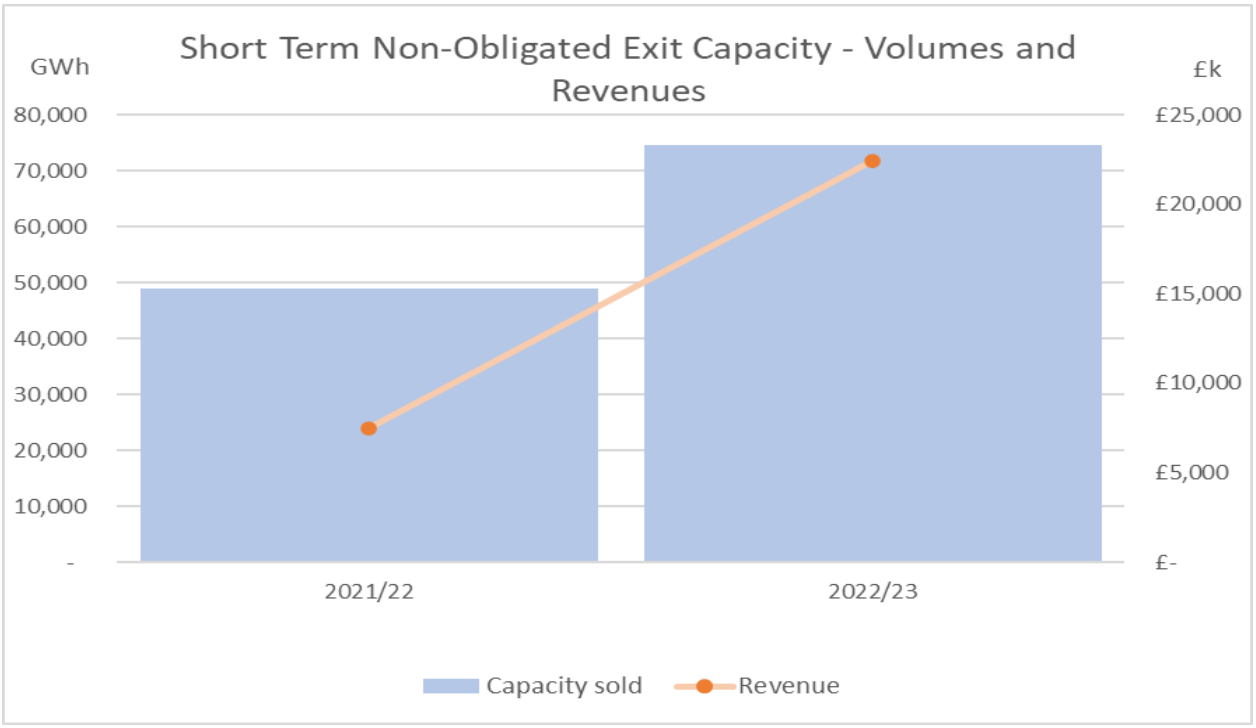


Figure 9 - Short Term Non-Obligated Exit Capacity sold and revenue

200. For Short Term Non-Obligated Exit Capacity, volumes sold were 1.5 times higher in 2022/23 than in 2021/22, and revenue increased by three times. The most notable year-on-year change relates to the Bacton NTS Exit Point where in 2022/23, we saw £15.4m Short Term Non-Obligated Exit Capacity Revenue compared to £2.9m in 2021/22. This is explained in more detail below:

201. Bacton Exit IP – in 2022/23, we saw £15.4m Short Term Non-Obligated Exit Capacity revenue generated, with ~77% of this revenue (£11.9m) generated in Oct 2022. In 2021/22 the total revenue for Short Term Non-Obligated Exit Capacity was £2.9m.

202. In response to market need, we facilitated increased exports to the EU by releasing ~150 GWh/d of Short Term Non-Obligated Exit Capacity. This had an impact on the Constraint Management Incentive due to the increase in Non-Obligated Exit Capacity revenue.

203. We saw different approaches adopted by adjacent Transmission system Operators (TSOs) across 2022/23 which appeared to impact on customer behaviours and the revenue generated from Short Term Non-Obligated Exit Capacity.

204. The Winter 2022 strategy for one TSO was to offer no EU Entry capacity through Long Term products ('Implicit Allocation'). Therefore, all Technical Capacity from 1 Oct 2022 was offered in Short Term auctions. Prices rose in Oct 2022 (peaking at 3.1468p/kWh) which had a significant impact on the Non-Obligated Exit Capacity revenues generated.

205. From 1 Dec 2022, the same TSO ceased physical EU Entry flows although they continued to offer EU Entry Capacity on PRISMA (the EU capacity trading platform). This capacity was automatically bundled with our GB Exit Capacity, effectively sterilising ~170 GWh/d. To mitigate this effect and following customer queries, we recommenced the release of Short Term Non-Obligated Exit Capacity for the remainder of the winter period. The additional Non-Obligated capacity released was not considered to be increasing the constraint risk because ~170 GWh/d of capacity released was not supporting physical flows as the TSO was not flowing to Europe. The situation was, however, monitored closely and discussed with the relevant TSO. It should be noted that there was no financial benefit from releasing the additional Non-Obligated capacity on days when Obligated capacity had not been fully utilised as the associated revenue was included in the calculation of the Obligated entry capacity revenues and not the Non-Obligated Capacity revenues.

206. A total volume of 4,500 GWh was purchased as Short Term Non-Obligated Exit Capacity at Bacton Exit IP in Oct 2022, which is nearly 20% of the total volume of the Short Term Non-Obligated Exit Capacity product purchased in 2022/23 at this NTS Exit Point.

207. The graph below gives a view of Bacton Exit Firm capacity sold in aggregate between Oct 2022 and Mar 2023:

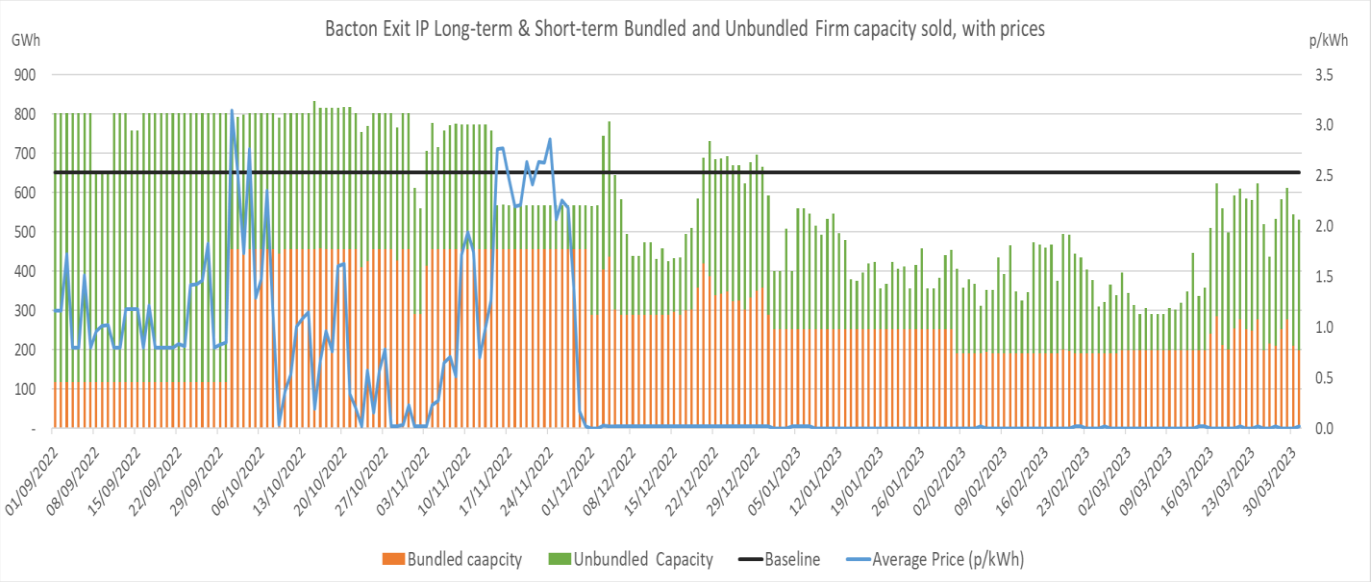


Figure 10 - Bacton Exit IP Long Term and Short Term Bundled and Unbundled Firm Capacity sold.

208. Some other notable points are:

- In 2021/22 at Stublach Storage, 20,257 GWh of Short Term Non-Obligated Exit Capacity was sold, compared to 27,147 GWh in 2022/23. Despite the volumetric increase, revenue generated was lower in 2022/23 (£1.0m revenue in 2022/23 versus £1.3m revenue in 2021/22) due to changes in the reserve price. The reserve price was higher for the first half of 2021/22 (0.0099 p/kWh) and reduced in Oct 2021[9] (to 0.0042 p/kWh) before increasing slightly in Oct 2022 (to 0.0044 p/kWh).
- The volume of Short Term Non-Obligated Exit Capacity sold increased between 2021/22 and 2022/23 at Grain Power Station, from 8,827 GWh in 2021/22 to 11,153 GWh in 2022/23. The revenue increased from £1.7m in 2021/22 to £2.0m in 2022/23.

209. For Long Term Non-Obligated Exit Capacity, the Capacity purchased in 2022/23 was 14% lower than in 2021/22, and the revenue was 10% lower.

210. Between 2021/22 and 2022/23, the NTS Exit Points where there were the most notable differences in behaviour year on year were:

- Offtake sites that doubled their NTS Exit Capacity holdings: Littleton Drew, Royston, Sutton Bridge, Turlangton and Westwinch.
- Sites that halved their NTS Exit Capacity holdings: Fordoun Industrial, ICI Billingham Industrial, Rawcliffe Offtake and St Fergus Offtake (2022/23 Capacity holdings were a third of those in 2021/22).
- For the NTS Exit Points that reduced their Long Term Non-Obligated Exit Capacity holdings between 2021/22 and 2022/23; this difference was largely netted off by six additional NTS Exit Points holding Long Term Non-Obligated Exit Capacity in 2022/23 that did not hold Long Term Non-Obligated Exit Capacity in the previous reporting year. These six NTS Exit Points accounted for 25 GWh of the overall Long Term Non-Obligated Exit Capacity holdings - 9% of the overall Long Term Non-Obligated Exit Capacity sold in 2022/23.

[9] In October 2021 the storage discount increased from 50% to 80%.

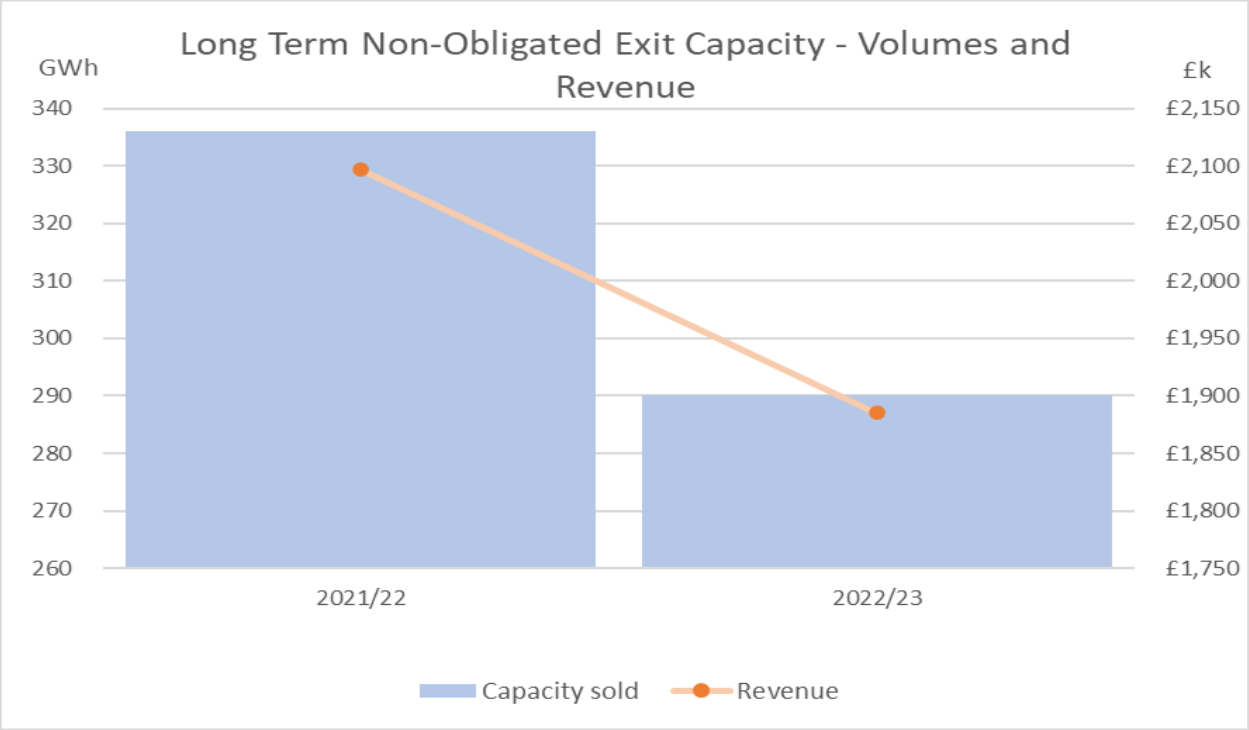


Figure 11 - Long Term Non-Obligated Exit Capacity sold and revenue

Capacity constraint risk management

211. We assess the impact of maintenance planning throughout the year; be that planned maintenance forming part of the annual maintenance plan, or ad-hoc maintenance resulting from an unforeseen event.

212. The commercial risks are assessed alongside the physical risks, and a decision reached collectively as to the most efficient approach to be taken. Depending on the criticality of the work and likely physical and commercial impact to customers of carrying out the maintenance, the work will either go ahead or be rescheduled, or other options may be considered. There is always a level of risk associated with taking assets out of service or limiting their operation.

213. Some maintenance is based on legal requirements and other maintenance is required to ensure continued operation of the asset(s). Irrespective of the driver across NGT, proactive management and communication of all physical works requirements is essential as well as understanding / considering the potential commercial and physical impacts. This is essential to ensuring the right decisions are made for our customers.

214. If maintenance work is essential which increases the level of operational risk, a different approach may be developed with stakeholders and customers, to manage this risk effectively for the duration of the physical works. An example of this was the introduction of a new way of working using PIE analysis (Pipeline Integrity Engineers). This indicates whether corrosion inspections can take place under full line pressure or reduced pressure which allows us to keep assets operational and therefore reduce any impact to customers. This new way of

working was successfully applied in August 2022, when we undertook ILI digs and inspections on Feeder 12 (between Bathgate and Roberton) without the need to isolate and impact the customer.

215. In 2022/23 we managed an emerging entry constraint on the network using commercial tools on one occasion. In Jan 2023 we responded to high forecast and actual LNG flows at Milford Haven and increasing pressures in that part of the network by taking Locational Actions on 18 Jan 2023.

216. To accommodate high Milford Haven flows, we rely on a chain of compressors located strategically throughout Wales and England to pull gas away from the terminal and push it towards the middle of the NTS where the gas can be distributed. These compressors are Felindre, Wormington and Churchover.

217. A sustained period of high winds in January 2023 at the Milford Haven port prevented LNG cargos from docking for two weeks and supressed LNG imports during this period.

218. The NTS was reconfigured to accommodate the increase in flows that materialised when weather conditions improved, and cargos were able to dock.

219. On 17 Jan 2023, Wormington compressor station experienced trips due to an external power cut. Although recovered, this then impacted the operation of the other compressor units in the chain which led to increased pressures in that part of the network.

220. Given the continued high flows and the prevailing demands on Gas Day 18 Jan 2023, pressure monitors showed that a constraint was forecast, and intervention was required to maintain safe operations – customer notifications and physical flows exceeded physical capability. The operational context at that time was a light[10] National Balance and LNG cargo queueing to dock.

221. To mitigate the forecast constraint, Locational Sell Actions with a total volume of 44.5 GWh were accepted which generated a total revenue of £1.2m. This achieved the required physical flow reduction and thus reduced pressures in that part of the network.

222. Due to the light National Balance, Secondary Locational Buy Actions were required to maintain the wider system balance. We therefore accepted Locational Buy Actions totalling 19.3 GWh, at a total cost of £1.2m. This allowed us to maintain overall system balance.

Supporting our customers

223. We continually strive to improve and maintain customer relationships, and to support industry with all aspects of the capacity regime. Our aim is to help raise understanding and aid participation in capacity auctions, and to provide a contact point for any capacity-related processes and queries. Throughout the year, we used several different approaches as

[10] Where supply is less than demand, resulting in linepack depletion.

a means of raising awareness and offering support, all with the objective of helping meet customer's requirements and managing network capacity more efficiently.

224. In 2022/23 we presented at several Operational Forums on capacity-related topics. These primarily focussed on Bacton Exit capacity (to support maximising exports to EU) and Milford Haven Entry capacity (our Entry Capacity Release (ECR) consultation and proposal). We also provided a deeper dive into the events surrounding the 18 Jan 2023 constraint and how we managed the network to minimise the need for further intervention. Throughout the year, we provide Operational Forum material for specific 'interesting days', giving industry the opportunity to ask questions and enhance their understanding of how we have prevented and/or managed capacity constraint situations.

225. Aside from Operational Forums, we also held focussed industry webinars for customers in response to emerging key topics including 'Supporting gas flows to Europe - Bacton overview' and 'Exit Constraints'. These webinars were well attended with ~140 customers and stakeholders joining the 'Supporting gas flows to Europe - Bacton overview' event.

226. We also provided a new RAG status indicator which detailed the likelihood of the release of Non-Obligated Exit Capacity to help provide additional information to our customers.

227. Daily, we provide support to customers on all aspects of capacity, via our email account and phoneline. We seek feedback as a means of continually improving the service we provide, ensuring customers' needs have been fully satisfied and that additional information is provided to further their understanding, where required.

228. We have developed a one-page view of all GB and Interconnection Point capacity auctions this year, to try and show customers in a simple format, the fundamental aspects of all auctions. This is shown below for illustrative purposes and is signposted on our Capacity webpages.

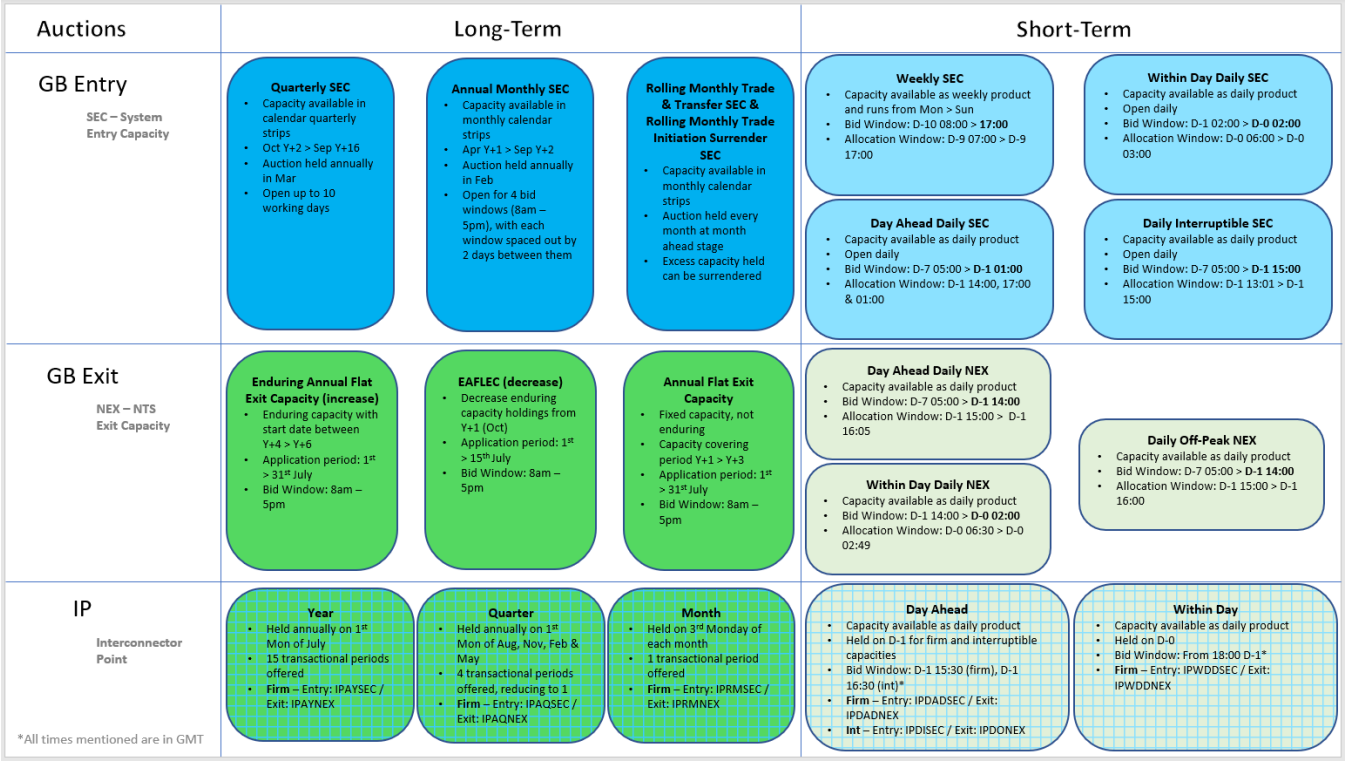


Figure 12 - Capacity auctions 1-page overview

229. We continue to assess and develop our suite of useful information including our Frequently Asked Questions (FAQ) document and the Capacity Guidelines document. The latter has undergone a complete review in 2022/23 to reflect customer queries and increase clarity further for customers.

Residual Balancing

230. The aim of the Residual Balancing incentive scheme is to incentivise NGT's residual balancing activities in two ways:

231. The Linepack Performance Measure (LPM) incentivises NGT to minimise differences in the linepack volumes measured at the start and end of each gas day. This is to help ensure that any system imbalances within the gas day are managed, and that any associated costs are levied across those system users responsible for that day's imbalance.

232. The Price Performance Measure (PPM) evaluates the impact NGT has on the market in its Residual Balancing role by measuring the price range of its residual balancing trading actions compared to the System Average Price (SAP). This incentivises the System Operator to minimise the impact it has on market prices.

233. The LPM element for 2022/23 achieved a daily average linepack performance of 2.5 mcm/d, compared to the 2.8 mcm/d incentive target. This is an increase from 2021/22 where the average linepack performance was 2.0 mcm/d. The LPM was better than the incentive target of 2.8 mcm/d on 225 days during the year (62% of days), a decrease in performance

compared to 2021/22 (268 days, 73% of days). Minimising linepack change was challenging because of market uncertainty driven by global events impacting supply and demand.

234. The PPM element achieved an average price spread of 4.0% of SAP, compared to the 1.5% incentive target. This represents a decrease in performance compared to the 2021/22 value of 1.8%. We took Residual Balancing actions on 273 days (75%) compared to 252 days (69%) in 2021/22, representing an increase in the number of days we were required to enter the market to encourage balancing. On the days when we took actions, the average price spread was 5.3%, compared with 2.7% in 2021/22 and 2.0% in 2020/21.

235. Minimising linepack change and the price spread of our Residual Balancing actions was difficult to achieve because of market uncertainty driven by global events impacting supply, demand and associated volatility. Gas prices continued to increase from 2021/22 levels, peaking above 600 p/therm and we saw increased price volatility both between and within days. We also witnessed gas day price spreads on the OCM prompt market of up to 260p/therm (equivalent to 74% of SAP for that same gas day) and overall averaging 41 p/therm for 2022/23 (equivalent to an overall average of 27% of SAP). SAP changed by up to 123 p/therm between consecutive gas days. The NTS continues to manage wide system imbalances in supply and demand throughout/during a gas day, presenting a challenging environment for Residual Balancing to operate efficiently in. As a result, we continue to enter the market earlier and more frequently during challenging periods.

236. Shipper behaviour remains a primary factor influencing the balancing of the NTS, and we continue to engage with Shippers to help understand the changing drivers behind Shipper imbalance positions. We are also proactively monitoring several balancing metrics in conjunction with our control room (for example, linepack swing and weekend / weekday balance positions) and these are helping to drive discussion, action plans, risk assessments and are shaping our Residual Balancing approach.

Summary

- We have maintained a strong customer satisfaction score of 8.60 with increased volumes of customer responses
- Stakeholder Satisfaction has increased to 8.69 building on successful engagement programmes.
- Demand forecasting remained challenging given volatility market conditions, leading to increased focus on process improvements and industry knowledge sharing
- We have achieved positive Capacity Constraint Management performance, using adaptive approaches to identify early, and manage emerging or heighted risk periods. Operational and commercial strategies have been adapted when needed throughout the year to manage specific dynamics such as continued high EU exports from Bacton, to maximise asset use, without unduly creating constraint risk.
- Residual Balancing delivered positive performance on the LPM element of the incentive but was below target for the PPM element. This area remains challenging due to the need to increase market actions in response to customer behaviours
- The Gas Transmission Digitalisation Strategy was published in March 2022. The updated Action Plan was published June 2023

national gas transmission

V. Maintaining a safe and resilient network

237. Providing a safe and resilient transmission network that is efficient and responsive to change is fundamental to everything we do. Through the development of our RIIO-T2 business plan, our customers and stakeholders told us that safety of the public, our employees and of our assets is a key priority. They expect to be able to access a resilient and reliable network and to be able to flow gas without restriction.

238. In 2022/23 we have made steady progress against our outputs in this priority area, but performance in some outputs such as Cyber IT and OT, and Asset Health has been influenced by the current global economic conditions. We have put measures in place to accelerate delivery through the remainder of the price control and are therefore still forecasting to deliver our outputs. The section below provides further detail on how we have performed against specific deliverables that sit within the 'Maintaining a safe and resilient network' theme. Outputs linked to this theme but not discussed in the section below can be found in XI. Non-Load Related Capex and XIII. Other Costs.

Safety

239. The safety and health of our workforce, the public and our assets remains an integral part of how we work at National Gas and a top priority within our overall strategy. We aim to be proactive in our approach to achieve the highest level of safety maturity which is crucial to a strong performance and to ensure delivery for our customers, the communities we serve and to maintain the reputation of our business.

Gas Transmission Safety Performance

240. NGT continues to focus on its ambition to be 'Safe every day', which supports the progression to a proactive safety maturity. The ambition sets the strategic direction for the RIIO-T2 framework and associated safety and health plans - focus within these plans continue to be aligned to four key target areas:

- Keeping our assets and processes safe every day
- Demonstrating safe behaviours every day
- Supporting health and wellbeing every day
- Improving safety every day

241. Year one of the Gas Transmission four-year programme to becoming proactive has concluded with positive progress.

242. The NGT Lost Time Injury (LTI) for 2022/23 was 0.02[11] (0.18 when converted to 1,000,000 hours), ahead of the 0.1 target. This rate was made up of one employee lost time injury which resulted from a torn calf muscle when walking across site in inclement weather. This event has been investigated, and learnings shared. This is a significant improvement when compared to 2021/22 performance of 0.1.

243. In 2022/23 there were five high potential controllable events (HPCE's) - this is half the number reported in 2021/22. There have been no tier 1 or 2[12] process safety events and no public safety injuries attributable to NGT operations/assets in 2022/23.

244. Visible senior commitment to safety, health and the environment (SHE) is critical to strong performance and as such we run a programme of SHE visits (minimum of four visits per leader per year). 100% of SHE Leadership visits were completed in 2022/23 with leaders exceeding requirements, further increasing their visibility. The SHE Leadership programme has now been re-set in preparation for FY23/24 delivery. Investigations have been delivered to a high standard, against our internal incident review panel metrics, with quality assessed at 79.55%. The action closure rate concluded at 93.13% which is slightly below the required target of 95%.

245. Key highlights delivered in 2022/23 include:

- A 'deep dive' maturity assessment was completed to understand improvement opportunities within the National Gas Transmission Safety Management System (SMS). In 2023/24 work will begin to simplify the SMS and address key actions from the maturity assessment.
- Process Safety Risk Control Indicators have been updated and embedded to support compliance against the risk control standards and manage risk. Process safety training was also reviewed and enhanced to ensure maintenance of knowledge and process safety understanding across the organisation.
- A refreshed Technical and Safety Competence Management System was developed and implemented within the Operations Team. Work continues in 2023/24 to advance the competency systems within other areas of the business.
- A new occupational health contract reflecting NGT is in place and ensures that all core services to employees are operational. In addition, our employee assistance programme has been extended for use by family members in the same household.
- The functionality of our incident management system was improved to encourage increased reporting and therefore greater opportunity for learning and continual improvement.
- Gap analysis into fatigue management was completed and actions closed out.

[11] Calculated as: (Number of lost time injuries in the past 12 months x 100,000) / Total number of hours worked for the past 12 months.

[12] Tier 1 and 2 process safety events are those which have the potential for a catastrophic or serious outcome

246. The 2023/24 Safety and Health plan which reflects year two of our journey to becoming proactive is in place.

Network Asset Risk Metric (NARM)

247. For RIIO-T2, the NARM is building on the progress made in RIIO-T1 and is using Monetised Risk as the primary measure. Ofgem is using this measure for defining the outputs and setting allowances associated with our asset management activities. In RIIO-T2 we have outputs defined using the Long-Term Monetised Risk measures. This is a Monetised Risk measure over a defined period of time greater than one year from a given start date and equal to the cumulative Single-Year Monetised Risk values over the defined period.

248. Network asset risk relates to the consequence of failure of a network asset and the probability of a failure occurring. If we do not maintain, replace, or refurbish assets, the probability of them failing will generally increase over time, and so would the risk of the consequence of failure materialising. To keep network asset risk within reasonable bounds, we are funded to carry out asset management activities such as replacement or refurbishment. NARM has been developed to allow Ofgem to quantify the benefit to consumers of our asset management activities and hold us accountable for our investment decisions.

249. In 2022/23 we have delivered a further R£50.1m[13] in Long-Term Risk Benefit in NARM outputs (A1 Unique Identifiers (UIDs)) subject to work closeout between now and the final RRP NARM submission. With this alongside last year's delivery of R£13.5m takes the total delivered in RIIO-T2 so far to R£63.5m against the target of R£200.8m. We have undertaken a dry run using last year's NARM RRP template provided by Ofgem, using NARM long term monetised risk benefit (LTRB) values delivered during 2022/23, and a revised forecast of the NARM position at the end of RIIO-T2 based on planned and forecast work. We will confirm the final NARM delivered outputs and forecasts in the specific RRP NARM submission.

Annual Network Capability Assessment Report (ANCAR)

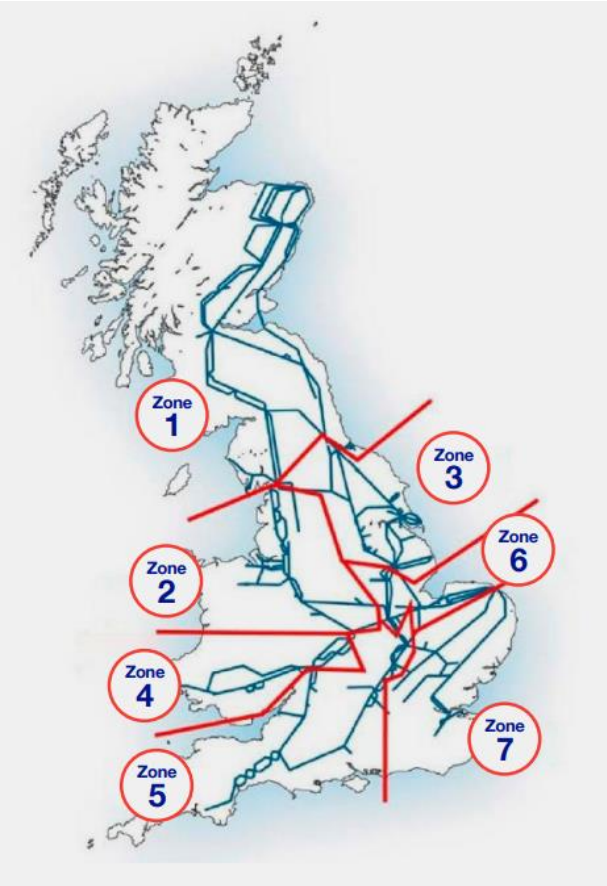
250. The Annual Network Capability Report (ANCAR) is a document which National Gas Transmission is required to publish under the special license condition 9.10-part B, introduced as part of RIIO-T2. ANCAR includes, for all NTS Exit and Entry Zones, so far as is reasonably practical:

- Flow forecasts
- Physical capabilities
- Capabilities that can be delivered using commercial tools
- Explanations of any changes resulting from changes in our assets

[13] The unit used to denote Monetised Risk values. R£ is used to differentiate from financial monetary values. However, provided methodologies for deriving monetised risk have been properly calibrated then Risk Pounds can be considered like-for-like with other monetary costs and benefits.

- A view of the situation in 10 years' time.

251. The Network Capability Zones:



252. The second edition of the ANCAR was published in June 2022, and the main findings, based on a fully reliable and available asset base (see reference to the resilience sections), were:

- The entry and exit capabilities of most of the zones, are sufficient to meet all the supply and demand flows anticipated under all FES scenarios, over the next 10 years. The exceptions being South Wales entry, South East entry and East Midlands exit.
- South Wales' entry capability shows the strongest indication of all the zones that an increased capability is required for both now and in future years, due to a greater reliance on the imports of LNG.
- The South East's flows indicate the network has sufficient capability to meet most of the requirements now and over the next 10 years. For those scenarios where capability is insufficient, economical short-term operational and commercial solutions are available to manage flows. The report highlights the importance of maintaining the current capability levels at Bacton specifically with regards to the importance maintaining capability at King's Lynn compressor and the associated flows to and from the EU interconnectors following MCP works.

- East Midlands exit flows indicate that currently we have sufficient capability to meet exit demand for the majority of days with the chance of constraint being less than once per year in the current year. Looking ahead into 2030, there is sufficient capability to meet all anticipated exit flows.

253. The investment programme in the current 10-year Business Plan, including the proposals brought forward as part of the Uncertainty Mechanisms, as contained within our RIIO-T2 proposals, remains the appropriate and economic approach to meeting forecast customer needs.

254. A greater reliance on imports, either LNG or through interconnectors, means that key compressors sites, impacted by the Industrial Emissions Directive, must be able to maintain their capabilities.

255. Out to 2030, the data supports the proposals we made in our latest Business Plan. That is, the range of physical capability available to us via existing and planned assets is consistent with the requirements as indicated by the supply and demand scenarios.

256. The supply and demand are based on the Future Energy Scenarios (FES) we have selected as the most applicable over a 10-year period, this includes scenarios from both 2021 FES and 2022 FES, as outlined in the Gas Ten Year Statement (GTYS) publication.

257. Several initiatives were delivered in the 2022 ANCAR publication. Informed by our external engagement from the previous ANCAR. New sections included asset availability and resilience, active linepack management and inter-zonal transfers. Both prior to and after the publication of the report, a number of engagement activities were held with stakeholders to hear their feedback on 2022 ANCAR and to gain insight into how they would like to see the document evolving.

258. Following stakeholder engagement, ANCAR 2023 will include a greater depth of analysis on asset utilisation and resilience.

259. As part of the Future System Operator scope, as contained in the Energy Bill, it is likely that they will be accountable for producing and developing several the elements within the ANCAR publication in the near future.

Exit Capacity

260. The annual exit capacity process is run according to the Exit Capacity Planning Guidance[14] (ECPG) introduced as part of RIIO-T2. The aim of this guidance/process is to ensure that Flat and Flex capacity bookings as well as Assured Offtake Pressure (AOP) requests (as defined in UNC – TPD Section J) are booked as efficiently as possible given the removal of the incentive arrangements on the GDNs as part of RIIO-T2. The ECPG process also aims to make the

[14] Exit Capacity Planning Guidance | Ofgem

process more transparent and increase our engagement with the GDN's. The ECPG outlines the methodology, engagement, and reporting requirements of this process.

261. Capacity bookings were largely in line with what we would expect to see (based on previous years). AOP bookings saw more changes than previously experienced in RIIO-T1, given the increased engagement with the GDN's it was possible to adjust AOPs in a way which did not increase our exit risk while avoiding any unnecessary investment and therefore was to the financial benefit of customers and ultimately consumers.

262. We provided the outcome of the process in the 2022 Exit Capacity Allocation Report to Ofgem, as well as a version made publicly available (with GDN data redacted, as per GDN's own published documents) in Oct 2022[15] with the accompanying Exit Capacity Assessment Methodology Statement[16], in Jan 2023, in line with the licence condition under ECPG.

Asset Health – non-lead assets

263. Most of our asset health plan is covered by NARM – work that is necessary to maintain the safety and reliability of the network, and outputs are measured in LTRB. There are 20 intervention types (UIDs) across five asset sub-themes, that have received baseline funding and have price control deliverables (PCD) with volume targets. The 20 UIDs cover:

- Security fences and gates
- Pipe supports
- Access roads and paths
- Lighting
- Major remediation of Civils at Bacton

264. The Non-Lead asset interventions associated with fences, gates, roads, pathways, and pipe supports are being considered alongside similar NARM assets requiring intervention within the National AGI Renovation Campaign (NARC). In this manner, bundling efficiency and timely intervention is best achieved.

265. Delivery of these interventions is often complex with work on defined assets sometimes having a knock-on impact on other assets. This is particularly the case with fencing where to undertake works on other asset types located within very close proximity or under the fence line, fences may be required to be removed and replaced. Fence replacement in these circumstances is essential but would not have been included in our non-lead asset fencing volumes and thus results in us exceeding the expected volumes.

266. Whilst the delivery of the Non-Lead Assets has been considered to be more efficiently delivered alongside the NARM deliverables, future considerations are being developed to

[15] Exit capacity planning | National Gas

[16] Exit capacity planning | National Gas

identify bulk pipe support replacements. This should enable greater procurement savings/reduced costs through bulk material order (rather than ad-hoc basis aligned to NARC sites). This initiative has been started within 2022/23 and will be further developed in the year ahead.

267. The Non-Lead Assets associated with electrical lighting form part of the wider national electrical campaign. 19 of these volumes have been identified for delivery in the national electrical project. These are forecast to be committed into sanction for Q1 of 2023/24 with detailed delivery year phasing to be agreed following placement of contract.

268. In addition, opportunities have been investigated to deliver some of the less complex lighting works using in-house teams. These lesser complex works typically entail replacement of light fittings inside our compressor buildings. Ten of this type of project have been approved toward the end of the 2022/23 reporting period and are expected to deliver in 2023/24. Other electrical volumes are in development and are expected to be committed for build early in the 2023/24 period.

269. Major remediation of Civils at Bacton entails work on pitwall transitions. During 2022/23 non-intrusive surveys have been undertaken covering this asset. The detailed scope requirements are currently under development by subject matter experts.

Summary

- We have facilitated the delivery of 100% of gas requirements for our customers
- We are focused on ensuring our 'Safe every day' ambition: our Lost Time Injury (LTI) for 2022/23 was 0.02
- Delivery of our Cyber OT, Cyber IT, Asset Health and PSUP programmes of work have been impacted by global supply chain challenge's, a shortage of skilled labour and high summer flows resulting in reduced access to the network to take outages. Where possible we have mitigated risks and have plans in place to further ramp up delivery over the remainder of the price control
- The ANCAR was published in June 2022
- The annual exit capacity process ran from Apr 2022- Jan 2023. The Exit Capacity Allocation report was published 31 Oct 2022

VI. Deliver an environmentally sustainable network

270. As one of our key outputs under RIIO-T2, delivering an environmentally sustainable network is important both to us and our customers. As a responsible business, we are committed to delivering environmental and community benefit, prioritising the issues that matter most to stakeholders.

271. In 2022/23 we have made good progress against our deliverables in this consumer priority area. Our engine inhibiting trial as well as control panel improvements and a new 'dry cranked' process has resulted in a saving of circa 300 tonnes of GHG venting.

272. In the Environmental Action Plan[17] and associated environmental incentives, we have outperformed against all but one of our baseline targets, including operational and office waste and water usage. This level of performance has been supported by the Covid-19 guidance to work from home where possible, and the subsequent hybrid patterns of working that have been adopted resulting in people traveling to and using the office spaces less frequently.

273. There are a number of projects that contribute to this overarching consumer priority but that are covered under the XI. Non Load Related Capital Expenditure section. This includes the compressor emissions projects such as Peterborough and Huntingdon, Wormington, King's Lynn, St Fergus and Hatton.

Environmental Action Plans

274. NGT aims to reduce the impact its operations have on the environment, whilst delivering positive benefits for the communities we serve. In RIIO-T2 NGT developed an Environmental Action Plan (EAP) which underpins our aim and helps us to measure how we're progressing.

275. The EAP contains 30 commitments split over five key areas:

- Air Quality and Compressor Emissions
- Climate change and our climate change commitments
- Responsible Asset Use
- Caring for the environment
- Leadership for change

276. We have now completed year two of this plan with positive progress being made against four of the five areas: air quality and compressor emissions, responsible asset use, caring for the environment and leadership for change. NGT will not be able to meet the initial climate change commitment which was to develop a science-based target by 2023 - all oil and gas industries are out of scope of the current initiative. Whilst we await the development of a specific oil and gas methodology, a glidepath to net zero and associated decarbonisation

[17] https://www.nationalgas.com/document/142876/download

strategy is in development and will align to the science-based target initiative. Detailed performance for each of the five areas has been captured in the table below:

Area	Target	Update	RAG
Air Quality and Compressor Emissions	We will work to reduce our NOx emissions from the business by the end of RIIO-T2. This includes replacing some of the most-polluting compressors on our network with cleaner technologies, improving local air quality.	NOx emissions from compressors have risen over the last year by 8.7%, due to the increased utilisation to support natural gas exports to Europe. However, the NOx intensity measure of kilograms per hours (kg/h) have fallen from 8.9 to 6.3 kg/h which equates to a 29.2 % reduction due to the increased utilisation of BAT units (newer, cleaner units)	
Climate Change and Our Climate Commitment	Our key commitment in this space is to develop a science-based target by 2023. Update: The Science Based Targets initiative (SBTi) stated that the oil and gas sector is imperative and one of the most challenging sectors to decarbonise. Work is ongoing to develop sector-specific methodologies for oil and gas (O&G) Whilst waiting for the methodology to be developed National Gas Transmission is developing a decarbonisation strategy that will include a glide path to net zero and this strategy will align to the methodology of a science-based target. The glide path to net zero will set out a pathway to reduce Green House Gas	Work on the decarbonisation strategy has commenced and will be approved in 2023. In addition, the Methane Emissions Reduction Campaign has led to the submission of a methane emission focused reopener with Ofgem. National Gas Transmission sought £31.3m of investment targeting up to 1,000 tonnes of methane emission reduction and improvements in fugitive methane emission detection and quantification. The funding proposals to Ofgem include three items: 1. Reduce to near zero pipeline, compressor station and PIG trap venting 2. Deliver trials of Combined Gas Recompression and Zero Loss Seal technology for the gas compressor fleet 3. Deliver an above ground fugitive methane emission performance baseline.	

	(GHG) scope 1,2, & 3 emissions. In RIIO-T2 we have set out reduction targets from elements of each scope.		
Responsible Asset Use	We will address eighty redundant assets, asset groups or sites, supporting a sustainable lower carbon future through responsible demolition including asset repurposing.	Opportunities have been taken to minimise waste by reusing assets, this includes the recovery of grey spares for reuse within the business and redeploying redundant assets for the Hydrogen FutureGrid project. This is in addition to identifying opportunities to sell assets that are no longer required.	
Caring for the Environment	We will make sure both new construction and demolition projects include initiatives to protect and promote biodiversity, and we will enhance the value of natural assets on non-operational land.	The Aylesbury and Creekside initiatives delivered 4.5% environmental value improvement. Plans are being developed for years three, four and five to achieve 10% target by the end of RIIO-T2. Our major construction project at Hatton has measured the Biodiversity Net Gain loss of the project and enhancement units required to reach a 10% netgain. This equates to three BNG units. We are working with a third party to deliver the units on our behalf over the next two years.	
Leadership for change	We will embed sustainability in our decision making, be transparent on our progress, and work with industry to drive forward the sustainability agenda	An Environment, Social and Governance survey has been completed. This survey has identified a base line for employee engagement and has informed a targeted employee training and communication plan. The survey will be reissued in year three and progress of employee engagement will be monitored. National Gas Transmission have also become a corporate partner of the Institute of Environmental Management and Assessment (IEMA) who have delivered a climate change briefing to the National Gas executive team.	

Table 6 – Overview of EAP progress

277. Progress against the 30 Environment Action Plan targets are reported annually to Ofgem in the Annual Environmental Report and our next submission will be in October 2023.

GHG Emissions (venting)

278. The aim of the Greenhouse Gas (GHG) Emissions incentive scheme is to incentivise NGT to reduce the amount of natural gas vented from our compressors (primarily methane), and to reduce the effect of our operational activities on the environment. This is important to our customers, stakeholders, ourselves, and society in general.

279. The GHG venting allowance is set each year by Ofgem; the allowance for 2022/23 was 2,897 tonnes. For each tonne of natural gas vented over or under this allowance a price is levied. Should we vent more than 2,897 tonnes we are subject to a charge and for each tonne under this allowance, a revenue under the incentive scheme. These are based on our NTS GT Licence, as detailed in Special Conditions 5.6, Part D.

280. For 2022/23 this price was £2,104 per tonne of natural gas vented, this is an increase of £188 or 9.8% from 2021/22.

281. Compressors are used to increase pressure in parts of the NTS and to move gas from the sources of supply to areas of demand. To undertake this activity to deliver customer requirements, we will select the Best Available Technology (BAT) in accordance with the Industrial Emissions Directive (IED).

282. The need to operate an individual compressor on any given day is dependent upon several variables, including the sources of supply and demand, the prevailing network conditions, and the need to accommodate maintenance and construction plans.

283. The total amount of natural gas vented from compressors in 2022/23 was 2,287 tonnes, which is 79% of the target allowance. This is an 11% increase from 2021/22 (2,061 tonnes).

284. The increase in venting was primarily due to the record high LNG supplies and transit of gas through the NTS to Europe which therefore led to an increase of compressor usage and compressor running hours to support these customer LNG import/Interconnector export requirements. This increase impacted our ability to maximise emissions saving initiatives.

285. The table below illustrates the increase in summer (Apr-Sep) compressor running hours and venting between 2021/22 and 2022/23 for those compressors that support this west to east transit during the summer.

Compressor	Hours ran 21/22	Hours ran 22/23	% Increase	Venting in tonnes 21/22	Venting in tonnes 22/23	% Increase
King's Lynn	104	5390	5082%	54	127	135%
Churchover	71	1169	1546%	29	32	10%

Felindre	2	1230	61400%	22	55	150%
Wormington	57	1566	2647%	30	75	150%

Table 7 – Compressor summer running hours and venting between 2021//22 and 2022/23

286. The average annual venting through compressors in the last 10-year period including 2022/23 is 2,865 tonnes, with the maximum venting being 3,928 tonnes (2017/18) and the minimum being 2,061 tonnes (2021/22).

287. To support this year's emissions identification and reduction activities we continued to embed previous years initiatives, although impacted by the requirement to run more compressor units to export gas to Europe we utilised supply and demand forecasts to identify future flow requirements to make early compressor pressurisation and depressurisation decisions, the effect of this has been a saving on unit static seal losses. System control panel improvements helped reduce emergency shutdowns, and continued revisions to our maintenance policy around emissions testing and winter assurance preparedness tests to prioritising critical units, these initiatives and the two further detailed below helped save approximately 300 tonnes of venting emissions in 2022/23.

288. Following last year's successful summer engine inhibiting trial, we have continued to embed this into our decision making and processes. The inhibiting process allows compressor units identified as unlikely to be required over the summer period to be temporarily isolated from the network. The process involves the engine internals being sprayed with an environmentally friendly preservative spray to prevent the deterioration of engine condition, during summer 2022 a total of 7 units were successfully inhibited saving approximately 60 tonnes, although this was less than the 200 tonnes recorded in 2021/22 this was in part as a result of more units being required to support our customers in utilising the network, and the associated increased supply to meet the increased export demand to the EU.

289. Additionally, during 2022/23 we trialled a new process called 'Dry Cranked'. This process includes spinning the engine on the bearings to reduce any potential damage/wear and checks all unit ancillary systems which include motors, pumps, leaks, uninterruptible power supply (UPS) control systems, governor systems, this provides assurance and integrity of inspection whilst avoiding full pressurisation and subsequent venting. Out of our overall unit fleet 32% can be dry cranked. For 2022/23, due to the requirement to run compressor units three units were able to be dry cranked saving approximately 15 tonnes.

290. The following images show an example of an NTS compressor which has been removed for engine inhibiting and where the remaining pipe work has been bunded and wrapped to keep parts clean and erosion free.

Figure 13 - Compressor which has been removed for engine inhibiting

291. The GHG emissions calculation methodology for calculating the mass of natural gas vented in 2021/22 was verified by an Independent Examiner and submitted to the Authority in Jul 2022. In accordance with our Licence an audit will be carried out again this year for 2022/23 emissions and will be submitted to the Authority by 31 July 2023.

292. In Dec 2022 we submitted the final submission of the Net Zero Pre-construction and Small Net Zero Projects Re-opener (NZASP) uncertainty mechanism to address methane emissions from operating the NTS. Our proposals cover three themes (these are covered in more detail in Section VIII.Net Zero). The implementation of compressor machinery train investment will help capture and further identify opportunities to remove methane losses from our operations, following the trial towards the end of RIIO-T2, dependant on the success larger impacts may be seen through RIIO-T3.

NTS Shrinkage

293. We are responsible for managing the procurement of energy and emissions for NTS Shrinkage, in our role as NTS Shrinkage Provider. These costs are recharged back to users as part of general non-transmission charges. A reputational incentive is in place for NTS Shrinkage for RIIO-T2. Under the scheme, from 2022/23 onwards, annual gas procurement costs are compared to benchmark costs, which are based on forecast volume requirements, actual volumes, and market prices.

294. Total NTS shrinkage costs for 2022/23 were £577.7m (in 2018/19 prices), including £517.5m for gas (including third party revenues), £43.7m for electricity and £16.6m for emissions. Costs were three times higher than 2021/22, driven by increased volumes of gas shrinkage, and gas market prices rising to unprecedented levels following the Russian invasion of Ukraine.

295. Gas procurement costs (not including third party revenues), which are the costs of trades and energy imbalance cashout for the year, were £533.8m. This is comparable to (2.5% higher

than) the average cost benchmark for the year, which is calculated according to the published methodology and based on benchmark and actual volumes and average market prices, of £520.9m. This was achieved in the context of a highly volatile gas market. For example, for the Summer 2022 product, over the six months ahead of delivery, the standard deviation of the daily closing price assessment was 80 p/th, around 18 times higher than for Summer 2021 and 43% of the average benchmark price; for Winter 2022/23, this metric was 142 p/th, around 3.6 times higher than for Winter 2021/22 and 38% of the benchmark price.

296. For gas shrinkage for 2022/23, we procured our forecast requirement utilising forward and prompt markets. We constantly reviewed our trading strategy to manage the price risk for consumers, in particular for the winter months for which we procured a high proportion of forecast volume ahead of the month, as seasons, quarters and month products, to mitigate against increasing prices. Following the Russian invasion of Ukraine in February, gas market prices rose to unprecedented levels, peaking in late August (at £8.87 a therm for Q1 23 delivery), with the market price for the Winter 2022/23 contract (for delivery in October to March) ending around £5/th in late September. Prices generally fell over winter driven by reduced demand which was helped by relatively mild weather and customers reducing their consumption due to the gas price.

297. NTS Shrinkage gas includes Own Use Gas (OUG, for compressor use), Calorific Value (CV) Shrinkage (gas that cannot be billed), and Unaccounted for Gas (UAG, the remaining quantity of gas after taking into account measured inputs and outputs to the system). The overall volume of NTS Shrinkage gas was 6,795 GWh in 2022/23. This represents a near-doubling of overall volume from the 2021/22 outturn of 3506 GWh.

298. This was largely driven by UAG volume increasing from 2051 GWh in 2020/21 to 4655 GWh in 2022/23. This is pre-reconciliation UAG, which includes some energy that is reconciled to particular users after close-out. The increase in UAG has been mainly attributed to a large increase in throughput throughout the summer period and a significant meter error detected within that period. The annual UAG volume for 2022/23 was 0.45% [this is as per UAGCVS Report] of the annual NTS throughput, higher than previous years, but still significantly below the meter error tolerance standard of 1.1% in energy terms. More details on UAG volumes are given in the published May 2023 UAGCVS report, available via the following link: https://www.nationalgas.com/document/143046/download.

299. The volume of OUG increased from 1139 GWh in 2021/22 to 1648 GWh in 2022/23 while electricity consumption for electric compressor units increased from 129 GWh to 168 GWh. Compressor use is primarily driven by the supply/demand patterns presented by the market, and the high volumes in 2022/23 were primarily driven by transit flows to support high exports to Europe.

300. CV shrinkage volume remained a relatively small part of overall gas shrinkage but increased from 317 GWh in 2021/22 to 491 GWh in 2022/23.This was predominately driven by CV capping in the North-East Local Distribution Zone, where gas of different calorific values

(energy contents) from different entry points converged, and some energy associated with the gas of higher calorific value could not be billed.

301. As a result of the increase in overall volume of NTS shrinkage gas, our trading activity stepped up, with 2023 trades completed for 2022/23, compared to 890 trades for 2021/22, and an average of 555 per year over RIIO-T1.

302. Electricity and emissions costs also increased year-on-year but remain a smaller percentage of overall costs.

303. Shrinkage costs for 2023/24 are expected to be significantly lower than 2022/23, due to lower market prices seen in 2023, though uncertainty remains particularly for the winter months.

Environmental Incentive

304. The National Gas Transmission Environmental Action Plan (EAP) sets out how we intend to take forward specific actions relating to the environment. The EAP includes stretching targets that go above our Licence obligations, and as such it was recognised that there was value for consumers and wider society in incentivising some of these.

305. The following narrative defines our environmental incentives reporting progress based on the baseline figures produced. It should be noted that some increases are likely a result of baselines being created using figures representative of times of Covid-19 restrictions.

306. The table below summarises our 2022/23 performance against our EAP targets.

Environmental Incentive	Baseline Levels	Benefit Threshold	Penalty Threshold	2022/23 Level	2022/23 % difference to baseline levels	RAG
Operational transport emissions (tCO2e) (% change)	1748	-12% (1,538.24 tCO2e)	8% (1,887.84 tCO2e)	1,797 (Operational Fleet incl EV's)	3%	
Business mileage (tCO2e) (% change)	1608 (2019/20)	-3% (1,559.76 tCO2e)	-1% (1,591.92 tCO2e)	741	-54%	

Percentage of operational and office waste recycled (value)	-------	52%	44%	96.8%[18]	N/A	
Office waste generated in tonnes (% change)	54.60t (2019/20)	-3% (52.96 t)	-1% (54.05 t)	47t	-14.7%	
Office Water use in m3 (% change)	7,380m3 (2019/20)	-3% (7,158.6 m3)	-1% (7,306.2 m3)	3,910m3	-47%	
Environmental value of non-operational land (£m) (% change)	32.92 (2020/21)	1.4%	0.6%	£1.5M increment	4.5%	
Biodiversity Net Gain (BNG) on projects affecting the local environment	All years in RIIO T2	Reward if a project achieves 15% or more BNG	Penalty if a project achieves 5% or less BNG	No commenced in T2 have years completion	NA	

Table 8 - Environmental Incentive performance against baseline targets

Operational transport

307. Our operational transport emissions target is set at 1,538.24 tCO2e to achieve the benefit threshold. With 1,797 tCO2e emitted for 2022/23, target levels were not met this year, but remain below the penalty threshold.

308. Future RIIO-T2 plans include increasing Electric Vehicle use across all business mileage options and installation of electric charging points at sites to support this transition. These initiatives will support a reduction in transport tCO2.

Business mileage

[18] Please Note: Waste categorised as "diverted" is currently assumed to be "recycled". We are working with our waste contractor to gain more detailed data on the specific quantities recycled. Once such data is available, the percentage of waste recycled may change.

309. Our business mileage emissions target is set at 1,559.76tCO2e to achieve the benefit threshold. Results for 2022/23 were 741 tCO2e, meaning our benefit threshold target level was exceeded.

310. A reduction against baseline in business mileage was largely due to reduced air travel following restrictions imposed during the covid-19 pandemic and general business mileage not reaching levels experienced in the base line year, which was pre-covid-19.

311. Future business mileage reduction plans will include revising company car and hire car lists to ensure hybrid or EVs are the only options. Reducing personal usage of cars by the promotion of car sharing or using virtual meeting tools, offering alternative meeting spaces which support traveling by public transport.

Office waste

312. The combined office and operational waste recycled for 2022/23 was 96.8%. This exceeded our benefit threshold target of 52%. Furthermore, the total office waste generated in tonnes was 47t for 2022/23 which exceeded the benefit threshold target of producing 52.96t or below.

313. Future office waste reduction plans include a campaign to raise awareness of recycling facilities and extending the service to include a food recycling scheme.

Office water

314. Water use for 2022/23 was 3,910 $m3$. This exceeded our benefit threshold target of 7,158.6 m3, this exceedance is despite the addition of data for Warrington archives being reported. The contributing factor to the reduction is that office occupancy is still below the pre pandemic baseline year. We will continue to monitor this and implement further plans as required.

Environmental value

315. In 2022/23, a 4.5% increase in natural capital valuation was achieved, contributing towards our target to obtain a 10% increase in environmental value by the end of RIIO-T2. This exceeded the benefit threshold target which was set at 1.4%.

316. We are continuing to work towards increasing our environmental value on non-operational land, through increasing biodiversity and natural capital. The Conservation Volunteers project at Aylesbury includes 9.5 hectares of land which is subject to intervention which will deliver four streams of environmental value: to enhance grassland management, to increase volunteering visits, to enhance woodland management and to enhance the management of hedgerow. The Creekside Education Trust Project incorporates 0.3ha of land. This is a rolling programme delivering yearly accruing benefits over the course of an expected minimum 10-year period. Since the project began, an additional 1,500 environmental education visits have

been delivered per year. These educational visits are focused on teaching environmental conservation to both children and adults.

Biodiversity Net Gain (BNG) on all projects

317. This category refers to delivering 10% minimum net gain in environmental value on all construction projects. In year 1 and 2 we have focused on raising awareness of our target, embedding it into procedures and policies, and carrying out baseline assessments. To date, we have made BNG assessments at 69 sites, with a total planned net gain of 4.2 BNG units required.

318. Our major construction project at Hatton has measured the BNG loss of the project and enhancement units required to reach a 10% net gain. They are working with a third party to deliver the units on our behalf over the next two years.

Redundant Assets

319. As the requirements on the National Transmission System change, there are assets on the network that are no longer required by NGT or our customers to operate the network, these are defined as redundant assets. If these assets remain on the network for longer than required then they represent an ongoing maintenance commitment and operational cost, as well as having the potential to cause a detrimental impact to the environment.

320. Through the development of our RIIO-T2 business plan we identified and agreed 85 scopes of work that were classified as redundant in the RIIO-T1 period. These scopes are the outputs in the Redundant Assets PCD annex. Of these outputs, 84 were to be assessed at the close of the RIIO-T2 price control with one to be assessed at the close of the next price control.

321. In the first year 2021/22, five outputs were physically completed:

- Feeder 6 - Disconnect and Decommission from Billingham ICI to Enron (Fully delivered)
- Enron Billingham AGI – Decommission site (Fully delivered with alternative specification)
- Sellafield Power station – Decommission flow control valve and control cabinet (Fully delivered)
- Carnforth – Decommission Units A and B to plinth level to meet IED compliance [This output is not being assessed as part of RIIO-T2 close-out, as £1.9m has been allocated for RIIO-T3 to fully deliver this output.] (Unit A decommissioned to plinth level to meet IED compliance.)
- Gowkhall Customer disconnection (Fully delivered, one of five disconnections which comprise this output in the PCD table.)

322. Carnforth Unit A has now been removed from the financial asset register, however the other outputs are still in the closeout stage which involves removing them from the regulatory asset base.

323. We have now completed the second year of the price control, 2022/23 and have physically delivered a further five outputs:

- Austrey AGI asset – Decommission the following assets: 350mm Portable Pig Trap connection arrangement; 20m of above ground 250mm pipeline; 5m of 100mm bypass pipework; 2x 350mm valves (Fully delivered)
- Shustoke Offtake AGI asset – Decommission ~35m of above ground pipework on the AGI and ~30m of below ground pipework to the boundary of the AGI. (Fully delivered)
- Yarm Tees Duplicate River Crossing – Removal of one of the 750mm/30" river crossings, including block valves. Pipethrough of mainline valves. Decommission the duplicate feeder including valve arrangements. (Fully delivered)
- Lennel Tweed – Removal of one 600mm/24" river crossing, including block valves. Pipethrough of mainline valves and Decommission the duplicate feeder, including valve arrangements. (Fully delivered)
- St. Fergus – Decommission methanol tanks, bund and filling station. (Fully delivered)

324. In 2022/23, as a stand-alone gas transmission business, we have identified further potential efficiencies such as in-sourcing design works via the recruitment of a specialist conceptual design engineer. This, additionally, gives us increased control over the design process. The ability to deliver some of the design work in-house will result in cost savings against regulatory allowances on some outputs across the price control.

325. We have continued to pursue previously identified opportunities to deliver works efficiently such as bundling (contracts, similar types of work, or works in the same geographical region, with other investment themes).

326. Given the volume of decommissioning works which are to be completed during the RIIO-T2 price control, we have been able to engage a specialist demolitions contractor directly (this was formerly a subset of the decommissioning output and so the sub-contracting to a specialist would be handled by the main works contractor) with a substantial portfolio of work. This will involve additional management by NGT, however, looks likely to result in a net cost saving for the outputs from which we can separate the demolition element and tender and manage this service in-house. This new approach should also deliver savings for the gas consumer in future price controls.

327. The below table shows progress made to date against the agreed Price Control Deliverable (PCD) outputs (Redundant Assets, Compressor Decommissioning and Customer Disconnections)

PCD Output Status	Volume of Outputs
Planned	39
Planned (Pending Customer Application)	0.6 (3/5 Customer Disconnections Remaining)

Sanctioned – Conceptual Design Stage	12.2 (7 outputs plus 1/5 Customer Disconnection)
Sanctioned – Build Stage	29.2 (30 outputs plus 1/5 Customer Disconnections)
Part completed – output to be assessed in the next price control	1
Not Progressing	3
Total	**85**

Table 9 – Breakdown of delivery for redundant assets

328. In total nine outputs in the build stage have been physically completed to date and are pending formal completion once all closure activities are finalised.

329. There are seven outputs linked to the Decom 22 project which has been in delivery throughout the 2022/23 year. Works at Austrey and Shustoke have been physically completed, Moffat is progressing as planned, however there have been delays at Theddlethorpe and Churchover A & B. At Theddlethorpe more asbestos than anticipated has been found in the main building, this has created a delay and increased costs so that we can ensure all asbestos is removed and disposed of in a safe manner.

330. The war in Ukraine caused a material change to gas flow in 2022, with approximately 70mcm flowing through the Bacton interconnector to Europe. This has, necessarily, resulted in a significant reduction in outage availability as the UK and NGT in particular work to replenish EU gas storage. The winter season for the System Operator is now one month longer, shortening the traditional Summer outage period in which vital work is completed. Given the diminution in outage windows combined with the strategically low prioritisation of decommissioning (as compared to activities furthering network resilience) this has delayed delivery of numerous outputs:

- Churchover Compressor – Decommission Unit A & pressure reduction area for Units A & B.
- Churchover Compressor – Decommission Unit B.

331. Sixteen outputs were developed under Decom 23 during the 2022/23 year, with delivery planned during the 2023/24 year. The majority of these have been progressed to the build stage and are moving into the delivery phase, however, three have been deferred due to outage constraints driven by both the Russia/Ukraine conflict and the inability to secure system access without impacting customer flows. One example of this is Feeder 21 where the next customer outage required to enable this work to take place is not due to be until 2027, this presents a risk to us being able to deliver this work in the RIIO-T2 period. There are alternative methods to avoid taking an outage, however, these are prohibitively expensive and delivering via these methods would not offer a value for money solution for the end consumer. We will continue to monitor the customer activity in the event the customer

requires a maintenance outage before 2027 which may provide an opportunity to complete this work in a cost-effective manner.

332. Decom 24 is due to enter development soon and will look at developing the detailed scope for the decommissioning of two units each at Peterborough, Huntingdon and Hatton, this will take place once the new units are fully commissioned and are operating as expected. Decom 24 will also start investigating ways to tackle the decommissioning of Feeder 1 and Feeder 9 under the Humber.

333. This year we have started utilising Operations resources to decommission methanol tanks at Bacton and St Fergus, these works are largely complete. We decided to deliver these works with in-house resources due to their lower scale and lower complexity. Operations typically deliver business as usual activities, however, expanding their remit to deliver minor projects will ensure we are more agile and upskill our workforce enabling more work to be kept in-house going forward. This approach has enabled the works to be delivered quickly and efficiently. Due to the success of this, we are also progressing the disconnection phase of Warrington Compressor Station using Operations resources.

Figure 14 – St Fergus Methanol Tank (Pre decommissioning)

Figure 15 - St Fergus Methanol Tank (Post decommissioning)

334. We have been able to support our sustainability goals by identifying, recovering, and redeploying a range of redundant assets for Hydrogen testing at Spadeadam to facilitate our Hydrogen FutureGrid project. This recycles redundant assets which were at the end of their useful life. Recovered assets also better support testing requirements as their age profile makes them more representative of National Transmission System assets.

335. There is a potential risk to the delivery of the decommissioning of thirteen condensate tanks in the Redundant Assets plan, due to it being conditional upon the installation of mobile condensate connection facilities to replace the functionality of these tanks. Following the decision to decommission these tanks and replace them with a mobile solution, there was an incident on the NTS where a large volume of liquid entered via Bacton, leading to several compressor stations being taken offline due to their filters and scrubbers becoming overfilled. The volume of liquids entering the NTS had not been seen for a significant number of years, however, this has raised the awareness within the business that there is still a risk that these events can still occur, although on a very infrequent basis. While the mobile solution is capable of draining these liquids, there is a lead time if it needs to be transported to site and additionally it may not be sufficient to deal with a similar event where a large volume of liquid is encountered at multiple sites simultaneously.

336. A study is currently underway to understand the impact a similar event would have if all thirteen condensate tanks currently in the plan had been decommissioned. This will allow us to understand whether alternative interventions may be necessary to mitigate this risk at

high priority sites on the network and therefore whether the condensate tank decommissioning should proceed.

Summary

- We performed well in our GHG emissions incentive, exceeding the incentive target at 2,287 tonnes. We initiated system control panel improvements, the continuation of the compressor inhibiting trial, and a new 'dry cranked' process to drive performance despite the challenges caused by high summer running hours
- Compressor emissions FOSR's were submitted for five sites; Wormington, King's Lynn, St Fergus and Peterborough and Huntingdon. We received the Final Decision for Wormington in March 2023
- Our compressor emissions projects in physical delivery at Peterborough and Huntingdon and Hatton have progressed well. At Hatton, the Siemens compressor was delivered to site ahead of schedule in March 2023. At Peterborough all monitoring and testing tasks are due to be completed in the next quarter, with finishing touches to the site due to be completed before the end of the year. For Huntingdon, commissioning and operational acceptance of Unit D and E are scheduled for 2023/24, with all remaining project activities (road construction, drainage, lighting and final finishes) and demobilisation due to be completed before the end of the calendar year.
- We have physically delivered nine of our redundant asset across the first two years of the price control. We are making steady progress in this area, but are behind where we would like to be, with the current geopolitical conditions impacting our ability to gain access to the network. We are looking for opportunities to align redundant asset activities with similar types of work, to deliver our outputs as efficiently as possible and maximise outage
- We have met or exceeded six of our seven Environmental Incentive targets.
- Our Incremental Capacity project at the Milford Haven Entry Point has progressed well with the FOSR being submitted in January 2023.

VII. Innovation

337. Innovation is about taking calculated risks that can drive change and deliver value to our customers. We ensure we manage these risks regardless of the funding mechanism, to ensure value in the end results. In determining our innovation approach, we take into account the various funding mechanisms available for innovation and consider the optimum route to ensure real benefits are seen by the end consumer.

338. In the opening two years of the price control, NGT has sanctioned 51 Network Innovation Allowance (NIA) projects, progressed 38 into delivery and have completed a total of 15 of these projects. A total of 13 sanctioned projects remain under contracting discussions and are yet to commence. In 2022/23, 26 NIA projects were sanctioned and of these, the innovation team progressed 19 projects into delivery with a total spend of £4.0m. This is less than the previous RRP forecast for 2022/23 due to contracting delays and therefore increases the forecasted spend target for 2023/24. The remaining seven sanctioned projects of 2022/23 have not commenced delivery due to the timing of the sanctioning and contract establishment. In 2023/24 we intend to identify and implement process improvements aimed at reducing the time taken for a project to transfer from sanction to delivery.

339. By the close of RIIO-T2 Year 2, £6.0m of the total RIIO-T2 NIA budget of £27.5m (£25.0m NIA Ofgem funding and £2.5m NGT contribution) has been spent, with £10.7m forecast spend for 2023/24. With the current in-flight and planned projects in the NGT innovation portfolio is it forecasted the full NIA will be spent. It is anticipated that additional projects will be required to support NGT's progression to Net Zero, and therefore NGT will seek further NIA funding in RIIO-T2 in accordance with the provisions set out within final determinations paragraphs 8.65-8.68.

340. With regards to the Strategic Innovation Fund (SIF) work, NGT have progressed Round 1 projects both at Discovery stage (10) and Alpha stage (4), applications for the continuation of two projects to the Beta phase have been submitted and would start delivery in 2023/24, if successful. Applications for a further five SIF Round 2 Discovery projects were made in November 2022 with three successful at application and due to commence in April 2023. In total, for 2022/23 NGT spend was £2.3m this includes SIF projects in which NGT supported as well as led.

- **10 x Round 1 Discovery projects delivered**. 10 SIF Discovery projects were successfully delivered in 2022/23 to a value of £0.8m total funding (£0.7m spent in 2022/23). The projects spanned topics including Compression, Deblending, Nuclear opportunities, Hydrogen Injection, Hydrogen Metering, Digital Twins, Pipeline Dataset and Protective Barrier Coatings. These discovery phase projects provided the foundation for future Alpha and subsequent Beta phase funded projects.

- **4 x Round 1 Alpha projects delivered**. Building on the success of Round 1 Discovery applications, NGT secured four Alpha Phase projects which were delivered between August 2022 and January 2023. The topics covered Compression, Pipeline Dataset, Protective Coatings and Hydrogen Deblending for Transport. Collectively, these Alpha phase projects represented £1.6m of funding (including supported SIF Alpha projects the year spend was £1.6m). Supported SIF projects are projects NGT are involved in but are led by other Gas Networks.

341. Our strategic themes have remained consistent through RIIO-T2, driving the reinforcement of the network through 'Fit for the Future', upgrading and developing the technologies and assets needed for the transition through 'Ready for Decarbonisation' and demonstrating net zero ready systems through the 'Decarbonised Energy System' theme.

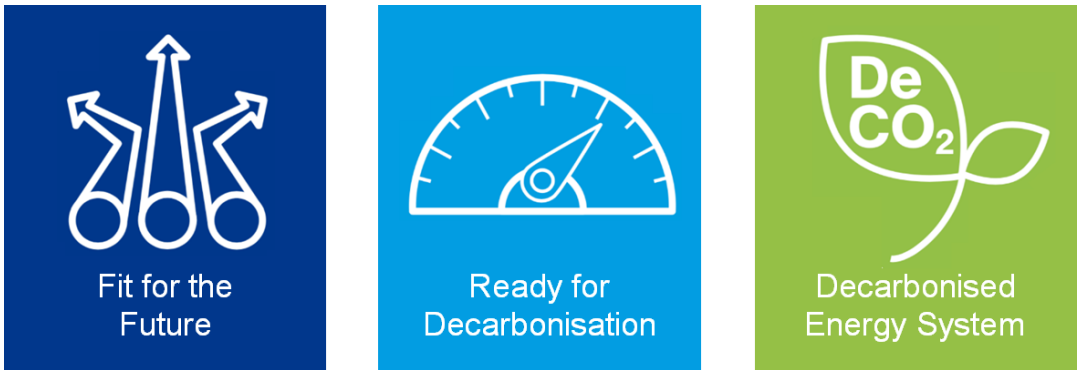


Figure 16 - Gas Transmission RIIO-T2 strategic schematic

342. In RIIO-T2, NGT has a focus not only on regulatory innovation, but on reinforcing our innovation culture across the business, driving innovation and efficiency into every investment and activity. While the transition of the energy system is an immediate focus, we must ensure our transitioned network is optimised to deliver energy at the lowest cost and with the highest levels of safety. The operational innovation team is focussed on ensuring the delivery of RIIO-T1 innovation benefits into the RIIO-T2 business plan delivery. As well as supporting projects and activities not associated with the energy transition or vulnerable customers that are funded through business as usual.

343. NGT is in a unique position, as owners and operators of the NTS, to take a leading role in whole system energy thinking. We will work closely with the UK electricity and gas networks to enable future interactions across the energy networks and supporting our network connections to transition to Net Zero with us. Our updated Innovation Strategy[19] is available at the link.

RIIO-T2 technology development

[19] GT Strategy Interactive Doc_FINAL (adobe.com)

344. Our innovation work is focussed around five technology programmes that feed into our business as usual and our energy transition targets. Encompassing this is our innovation strategy, stakeholder engagement and governance.

345. The five innovation technology programmes are:

- **Asset Development for Risk Mitigation -** Developing hydrogen ready resilient assets with optimised maintenance systems.
- **Digital Systems and Simulation -** Providing accessible accurate data models of the UK Energy Network improving network efficiency.
- **Automation and Measurement -** Developing the inspection and monitoring systems required for the future of gas.
- **Materials and Processing -** Ensuring robust materials and processes extend the lifetime of our assets and enable repurposing of the network for hydrogen.
- **Business Strategy and Development -** Enabling future markets and customers of the gas network by ensuring business systems and processes are relevant for net zero.

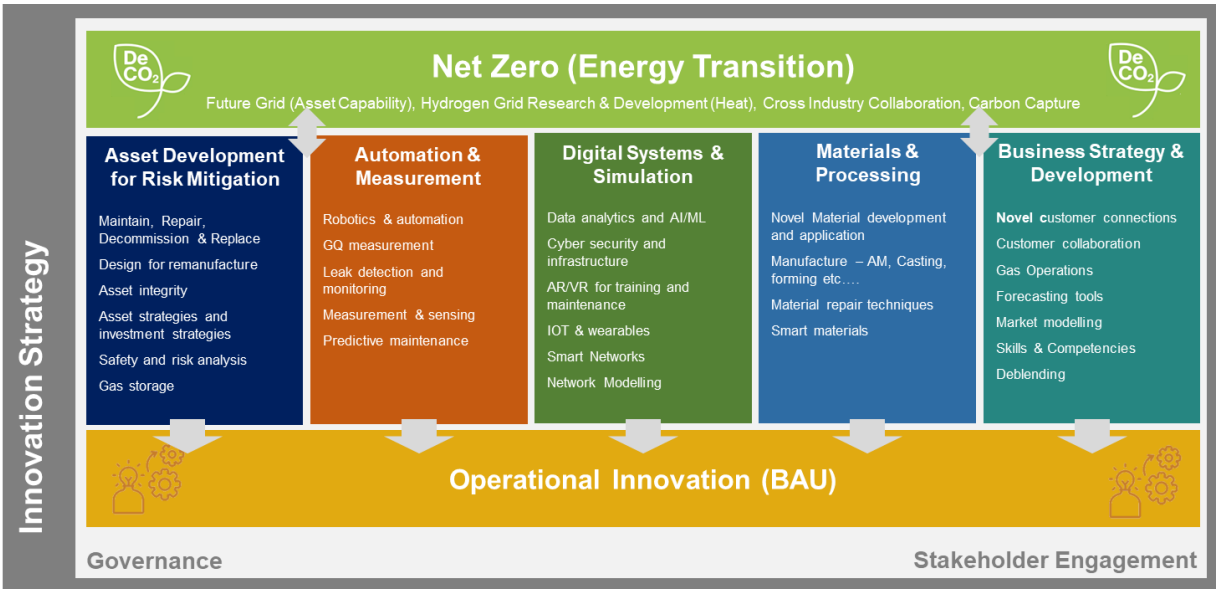


Figure 17 - NGT innovation technology programme

346. The NIA provides an allowance to fund small-scale, low Technology Readiness Level (TRL) projects from early research through to demonstration. The funding is accessible throughout the RIIO-T2 period and has three key drivers:

- Research and Development – encouraging operational and technological innovation
- Collaboration and Dissemination – working with external partners to solve problems and share new learning
- Customers and Strategy – focusing on solutions that deliver benefits to our customers

347. Highlights from the completed projects from 2022/23 are detailed below:

- **Gas and Electricity Transmission Infrastructure Outlook 2050.** This was a collaboration project between National Grid Electricity Transmission, National Gas Transmission and National Grid ESO. The study explored the development of an integrated energy infrastructure for Great Britain to achieve its 2050 Net Zero target whilst reducing costs to consumers and maintaining energy security. One of the key messages from this study is that across all the modelled future energy scenarios, integrated electricity and hydrogen transmission infrastructure planning can realise savings, especially in the System Transformation scenario where energy system savings of £38 billion by 2050 are possible. Early investments common across the transmission networks are needed to realise these savings.

- **Collaborative Visual Data Twin – Phase 1.** The introduction of hydrogen into the NTS poses many technical challenges and additional complexity which digital tools may enable us to resolve. A virtual and data twin is required to fully understand the intricacies of how traditional gas assets are affected by the introduction of hydrogen. This project uses the FutureGrid facility as a test case to explore how the virtual world can directly benefit our physical understanding of assets and the network. The project is established as two parts to develop an interactive and collaborative data twin. Phase 1 built the virtual (visual) elements of the twin and the data structure. The phase also commenced the data collection plus designed the planned approach for mapping both data twin and the virtual twin. This work aligns to NGT's reopener activity for digital construction.

- **Hydrogen Deblending Feasibility – Phase 2.** This project sought to understand deblending on the NTS with an engineering and market framework focus. For the engineering workstream, the objectives were to understand the potential locations for gas separation on the network, what ancillary equipment will be needed and how mobile this could be. Additionally, an overview of the future emerging technology was completed alongside development of a demonstration plant linked to the FutureGrid test facility. For the market framework focus, the objective was to explore how commercial frameworks may need to evolve to accommodate deblending technology considering any potential changes to the existing regime including to connection agreements, capacity allocation, balancing, charging, gas quality and system operation. A series of stakeholder engagement sessions on the topic of deblending were organised to gather industry opinions and feedback.

- **Hydrogen Fuel Gas for NTS Compressors.** The project undertook a feasibility study on an example NTS Compressor Station that examined the safety, environmental, technical, operational and economic issues in establishing an innovative green hydrogen production, storage and supply facility to fuel the SGT-A20 GTs on varying blends of hydrogen. The study found it is viable to run the Siemens Energy SGT-A20 GTs on blends of hydrogen and natural gas up to 100% hydrogen.

- **New Pipeline AI Route Planning.** The aim of the project was to utilise an AI-based tool or platform to enable the rapid exploration of pipeline routing options for new pipelines. The 4-month study took an illustrative 10km pipeline section and assessed the options for design and consenting of a hydrogen pipeline. The pilot demonstrated that relevant routing and development principles can be successfully modelling in the AI software. The AI software tool was proven to reduce the decision-making time by 93% (from 8 weeks to 16 hours). The saving in personnel time equated to ~£25k for the 10km stretch.

- **Impact of hydrogen on Polymer Materials.** Polymer and elastomer materials are used across the NTS in a variety of assets (valves, valve stem seals, pig traps, filters, actuators and gaskets). Due to the complexity of the NTS, and varying standards of record keeping a complete dataset of what polymer/elastomers on the NTS is not available. When exposed to high-pressure hydrogen environments, there is a risk of hydrogen permeation into polymeric materials, which can lead to loss of function via swelling or other degradation mechanisms. This project mapped out all the polymeric and elastomeric materials throughout the entire NTS and confirmed the expected service conditions. A test programme was generated to validate these materials in high-pressure hydrogen environments. The next phase will be to enact this test programme to establish this validation.

348. The Strategic Innovation Fund or SIF provides funding for larger scale demonstration projects and enables their development through several separate project phases – Discovery, Alpha and Beta. This funding is determined by annual challenges which focus on encouraging cross industry collaboration.

- **HyNTS Compression**. The project investigated the key challenges associated with compression of hydrogen and blends through NTS assets. The project determined the most cost-effective, technically feasible solution for this. The early phases of the project focused on the business case, the gas turbine system, the compression system, ancillary equipment and the design of the demonstration facility. Based on thermodynamic model data the compressors can operate on blends of hydrogen up to 50% (with some modifications carried out to enable beyond 25% blends). A 100% hydrogen compressor will be manufactured and tested during the follow-on phase of work.

- **HyNTS Deblending for Transport.** The overall pathway for HyNTS deblending is to develop and demonstrate technologies that separate hydrogen from natural gas (and blends) for transport applications such as HGV, rail, marine and aviation. The solution developed will be low-cost and mobile for deblending and purification that can be migrated around the UK network. This phase of the project developed the business case, test profiles and system requirements. This led to a supplier selection for the next demonstration phase which was designed under this project.

- **HyNTS Protection.** The NTS consists of pipes and valves buried below ground and auxiliary and service units above ground. All of these components have been designed for natural gas and are potentially vulnerable to failure from hydrogen embrittlement.

This project explored the options and application methods to potentially protect our assets from hydrogen gas via a permeation barrier that is continuous, without joins or flaws. Further work is needed but the research suggests the cost of repurposing is 18 times less expensive than installing new pipeline. All the metal materials analysed provided improved hydrogen barrier performance against steel. Electro-forming was deemed suitable for removeable assets and cold-spraying[20] metallic coatings deemed most suitable for in-pipe application.

- **HyNTS Pipeline Dataset.** The project delivered on two objectives; defining and gathering the data necessary to ultimately facilitate repurposing of NTS pipelines and to develop the tools and processes to store, align and visualise data to facilitate effective integrity management and decision-making during post-repurposing service. The study showed that extensive records are generally available and with novel solutions such as automated data scraping and digitisation of written records, significant data gathering can be stored and visualised. The work also identified potential data parameter gaps for hydrogen conversion which can be addressed via existing/novel technologies. Some current In-Line Inspection technologies may not be suitable for high-pressure hydrogen environments and so modifications to these tools might be required.

FutureGrid (Network Innovation Competition - NIC)

349. Over the past year, the FutureGrid offline hydrogen test facility has been constructed and the commissioning process has begun. This is in preparation for testing: firstly 100% natural gas in May 2023, followed by 2%, 5%, 20% and 100% hydrogen tests from June 2023 onwards.

350. The decommissioned assets used to construct the facility have been tested and, where necessary, remediation works have been conducted. We have finished materials testing and started testing our Fatigue Rig, which replicates our network using a 36" X60 pipe with different weld types. These tests simulate hydrogen pressure cycles in the network. Our assets are designed for 15,000 pressure cycles, equivalent to 40 years of service. By February 2023, we had completed over 18,000 cycles with hydrogen without any observed changes.

351. The project completion date has been extended to November 2023 to accommodate delays in delivering the recompression unit. This extension has also allowed for the addition of a 5% hydrogen blend test to be incorporated into the testing programme, funded by NIA as agreed with Ofgem. This additional test is in response to a European Commission draft policy to accept 5% hydrogen by 2025 and ensuring the continued interaction with Europe via the interconnectors.

352. 2023/24 is the final year of FutureGrid Phase 1, where we will deliver the results from the hydrogen testing and review of the safety case to operate the NTS with hydrogen.

[20] Cold metal spraying is the deposition of powdered metal with resin binder to a substrate via a high-velocity gas flow at ambient temperatures leading to rapid coating build up

353. Phase 2 expands our testing with Compression. It includes the construction of a 1km test loop, the trial of an existing compressor from the NTS with blends up to 50% hydrogen, and a new 100% hydrogen compressor being trialled. We will also be progressing with Deblending - demonstrating electrochemical separation, purification and compression, showing how a blend of hydrogen and natural gas can be separated, producing 98% purity hydrogen which can be used directly for industry or further purified and compressed to be utilised as a fuel for transport.

Figure 18 - FutureGrid Hydrogen Test Facility in final stages of construction in January 2023

VIII. Net Zero

354. Our Net Zero strategy has an integral role to play in leading a clean, fair, and affordable energy future for all in the UK. The strategy focuses on facilitating the implementation of a decarbonised energy system while providing energy resilience. In all future energy scenarios, hydrogen as an energy vector has a key role throughout the transition to 2050 and beyond. We are exploring transporting hydrogen as an alternative to natural gas in the NTS to decarbonise heat, power, transport, and industry.

355. We are building the evidence base to convert the NTS to hydrogen through FutureGrid and a suite of innovation projects (see Chapter VII. Innovation). In our RIIO-T2 business plan, we committed to be ready to start the conversion to hydrogen by 2026. All the evidence gained throughout RIIO-T2 will support the transition of the NTS to hydrogen.

Project Union

356. Project Union is a pioneering project led by National Gas Transmission to create a UK hydrogen backbone, transporting 100% hydrogen, while connecting hydrogen production and storage with end users. Through the phased repurposing of existing gas transmission network infrastructure, the backbone will comprise 1,500 to 2,000km of repurposed assets, representing up to 25% of the UK's current methane transmission network, by the early 2030s.

357. Project Union will help the UK achieve secure and reliable access to hydrogen across the country enabling the UK to achieve its Net Zero goals in the most cost-effective way, with a full hydrogen backbone facilitating optimum whole energy system design. The transition will be designed to maintain security of supply and resilience for existing consumers on our natural gas network alongside enabling a clean future energy system.

358. Extensive engagement with our customers and stakeholders has demonstrated that hydrogen transmission infrastructure will be essential to providing a dynamic and resilient physical system on which to operate a liquid and competitive hydrogen market within the UK. By delivering Project Union in line with our proposed phased approach we can account for evolving market and customer needs whilst limiting consumer exposure to cost and the risk of the transition.

359. The project is currently in the Feasibility phase. Key outputs in this stage are a phasing strategy for each section of the backbone, pre-Front End Engineering Design (pre-FEED) activities, and wider market enabling activities including customer and stakeholder engagement.

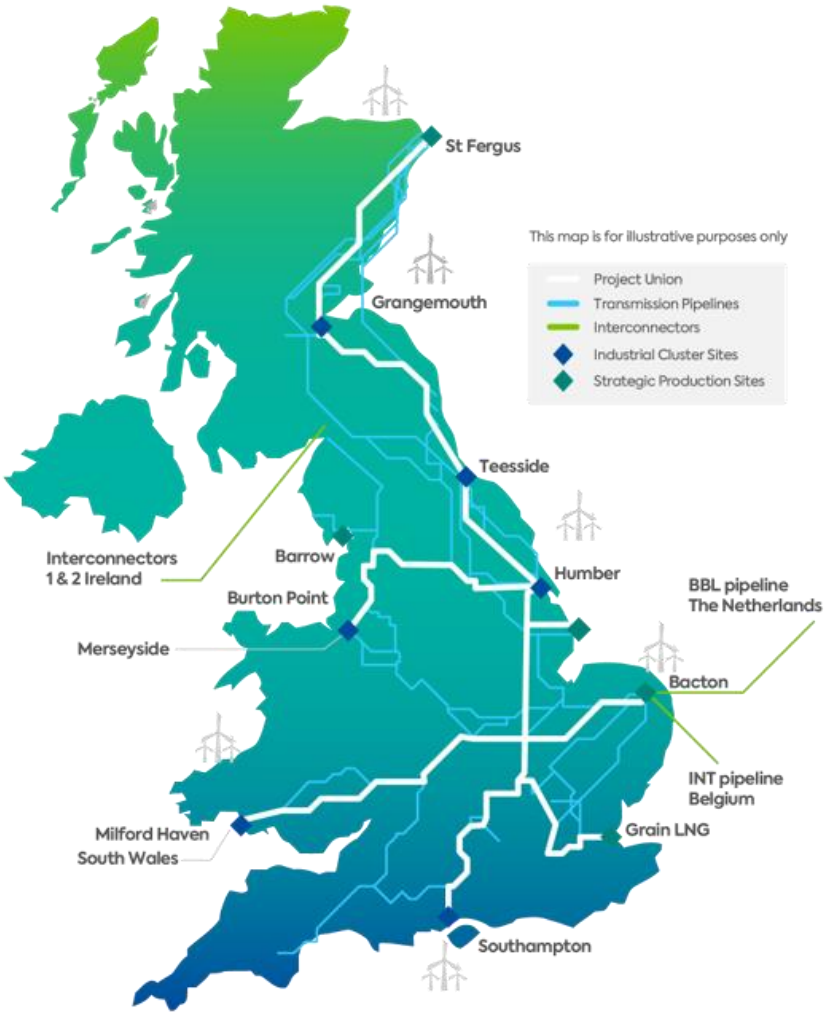


Figure 19 - Illustrative Project Union Overview Map

Net Zero and Reopener Development (NZARD) Use-it-or-Lose-it (UIOLI)

360. In 2022/23, we have focused on strategic activities that will support National Gas Transmission to achieve Net Zero by 2050. The NZARD UIOLI funding enables and facilitates early development work on strategic projects which are critical to progress further through Net Zero re-opener mechanisms.

361. In 2022/23 we undertook 13 UIOLI projects and spent £1.9m compared to eight projects with a spend of £0.7m in 2021/22.

362. Of the 13 projects eight were completed within 2022/23. These are:

- Project Union Transition Strategy – The project conducted business planning activities involving the development and submitted a Net Zero Pre-construction and Small Projects

Reopener to Ofgem in December 2022 for the Project Union Feasibility Phase covering a full UK hydrogen backbone. For further details of the Feasibility Phase please see the Net Zero Pre-construction and Small Projects Reopener section.

- Project Union Economic Assessment – This project supported the needs case element of the Project Union Net Zero Pre-construction and Small Projects Reopener submission. Included a societal Cost Benefit Analysis (CBA) for a section of the hydrogen backbone connecting the East Coast Cluster (Teesside to Humberside) showing an estimated net benefit of £82m (NPV terms) in the central scenario. A broader assessment of the contribution and Gross Value Add (GVA) for a full UK hydrogen backbone connecting all industrial clusters was also conducted which estimates Project Union could directly support £300m annual GVA and 3,100 jobs at peak construction.

- Hydrogen Network Real Options Analysis – A study to assess the value of starting pre-Front End Engineering Design (FEED) and FEED work on the East Coast Hydrogen (ECH2) section now rather than delaying this early work providing a decision evaluation approach that considers the opportunity cost of continuing or abandoning a project. The outputs of this study have shown that even if we take a highly pessimistic view about the speed of hydrogen uptake it would still be valuable to society to start pre-FEED and FEED activities as soon as possible.

- European Hydrogen Backbone Phase 2 – The European Hydrogen Backbone (EHB) consists of 31 European gas infrastructure companies across 28 countries, working together to plan a pan-European dedicated hydrogen transport infrastructure. Phase Two built on phase one work by deep diving into hydrogen supply and import corridors, storage, and geographical reach. A final report was published May 2023, which identified five key hydrogen supply corridors. A first 'European Hydrogen Backbone Day' event was held in Brussels on 7th June 2022. Stakeholders across the hydrogen value chain including policy makers attended. The CEOs across the gas infrastructure companies pledged to the European Commission to establish hydrogen supply corridors by 2030 enabling hydrogen market creation.

- The European Gas Research Group (GERG) H2 Velocities – The study delivered a technical report which detailed the impact of using an existing natural gas transmission network for transporting hydrogen while maintaining the same energy capacity as for natural gas. Specifically, issues relating to the increase in flow or gas velocity were identified and summarised.

- Capital Hydrogen – This project studied London's future hydrogen supply, demand and storage requirements. A publicly available feasibility report was produced detailing the vision for hydrogen in London and the steps to achieve it, how much hydrogen will be needed for London by sector, the feasibility of an overall gas network conversion and laid out an over-arching programme for London's hydrogen conversion.

- Hydrogen Regulatory Framework –Aligned to the timing of the Project Union Feasibility stage re-opener submission, and the DESNZ Hydrogen Transportation and Storage Business Model consultation, this project involved the assessment of regulatory framework options for hydrogen, looking at strategic planning, business models, cost allocation and recovery, repurposing and asset transfer values, and interim and enduring approaches.

- Pan-European integrated hydrogen infrastructure – This project looked at assessing the benefits of having an integrated European-wide hydrogen backbone versus a disconnected hydrogen cluster infrastructure approach. A number of key performance indicators will be developed, including hydrogen infrastructure utilisation, the levelised cost of hydrogen and additional societal benefits that a European-wide hydrogen backbone can provide. A report was published in March 2023, and in person event scheduled May 2023. The study showed that the development of integrated pan-European hydrogen network delivers significant benefits including about €325 - €380 billion[21] cost savings over the timeframe 2030-2050

363. The following five projects were initiated in 2022/23 and are ongoing into 2023/24:

- Hydrogen System Operator – The project will develop and consider options for physical and commercial aspects of a future hydrogen system operator to meet the proposed hydrogen transition.

- Hydrogen Valley – A collaborative project with Cadent to deliver a hydrogen vision for the West Midlands and the East of England with supporting evidence-based cases for early investments in the gas network and hydrogen infrastructure.

- East Coast Hydrogen pre-FEED – A collaborative project between Gas Transmission, Northern Gas Networks and Cadent Gas to enable regional decarbonisation through both repurposing and building new pipeline infrastructure. NTS infrastructure would crossover and contribute to Project Union and East Coast Hydrogen.

- Hydrogen Grid R&D System Transformation Network Modelling – This project facilitates modelling provision to the System Transformation workstream which is a key component of the UK government's hydrogen grid research and development programme. This supports key aligned outputs to determine the network configuration, provide appropriate resilience in the end state transition and provides analysis of assumptions and other critical issues.

- CH4RGE Emissions Capture Methane Reduction from Gas Equipment (CH4RGE) – Throughout the reporting year, we have maintained momentum with the project, using Strategic Innovation Funding (SIF) via the Discovery Phase, to fund the development of

[21] £279.5 billion - £326.8 billion based on an exchange rate of 1 euro = 0.86 pound sterling

the Feasibility design. Further UIOLI funding was used to carry out the selection of sites and compressor units, taking into consideration the compressor venting amounts, seal leakage rates and run hours. This, with the support of the Gas Construction Project Team, we have started the Conceptual FEED with the selected Original Equipment Manufacturer (OEM) suppliers. Three sites have been chosen for deployment of the two technology solutions being proposed - Combined Gas Recompression and Zero Loss Seal.

Net Zero Reopener

364. This is an Ofgem triggered mechanism designed to support larger scale Net Zero projects. Projects brought forwards under this mechanism must exceed a materiality threshold of £10.7m. Triggering of the mechanism is contingent of the occurrence of a significant 'Net Zero development' the detailed definition of which is included in the Gas Transporter licence. In 2022/23 no projects were started or delivered under this funding mechanism however we are continuing to develop our portfolio and programme of work and will continue to review those with the potential to trigger a Net Zero Reopener in 2023/24.

Net Zero Pre-Construction and Small Projects Reopener

365. This mechanism allows Gas Transporter licensees to undertake early design, development, general pre-construction work, and Net Zero facilitation capital projects that will enable the achievement of Net Zero Carbon Targets. Broadly, the mechanism covers:

- Early development/design and pre-construction work which is too material to be covered by the Net Zero and Re-opener Development Use It or Lose It allowance.
- Net Zero projects that are too material for the Net Zero and Re-opener Development Use It or Lose it allowance, but not material enough, or appropriate for the Net Zero Re-opener.

366. The mechanism can only be triggered by Ofgem based on a detailed engagement phase where it will establish the needs case in principle. The project must exceed £1m in value, but there is no specified upper limit under this mechanism.

367. In 2022/23 we submitted two applications under this mechanism as below:

- **Project Union** – We have undertaken valuable and constructive engagement with Ofgem through a series of regular bilateral discussions over a 15-month period commencing September 2021 and culminating in a reopener application which was submitted in December 2022 for the Project Union Feasibility Phase. The final decision by Ofgem approved £5.6m in funding in addition to a company contribution of £0.6m over a 12 month period to deliver this phase which will complete a phasing strategy for delivery of each section of the hydrogen backbone, pre-FEED activities for a full UK hydrogen backbone and development of hydrogen market enabling activities.

- **Methane Emissions** – This submission under the NZASP re-opener allows us to start to reduce known methane emissions arising from operating the NTS, while also establishing a measurement-based fugitive methane emission performance baseline. The submission comprises of three investment proposals totalling £28.2m which are submitted separately and are considered individual submissions under the NZASP reopener mechanism, and a core document comprising common elements of the submissions. The three themes of the submissions are Mobile Recompression, Compressor Machinery Train and Detection and Analytics.
    - **Mobile Recompression** – This submission in October 2022 was for additional mobile pipeline recompression capability and new mobile recompression units to capture methane emissions arising from pipeline inspection works and compressor station depressurisations.
    - **Compressor Machinery Train** – This submission was for the trials of combined gas recompression and zero loss compressor seal technology to reduce methane emissions from the compressor machinery trains, which was submitted in December 2022. We requested funding over a 4-year period to develop detail designs and deliver the trials at the chosen site locations.
    - **Detection and analytics** – In October 2022 this submission covered an expansion of the periodic fugitive monitoring programme and an implementation of new continuous fugitive monitoring systems at selected above ground installations.

IX. Totex (TO and SO)

368. The table below summarises spend and allowances (baseline and uncertainty mechanisms) for 2022/23 and for the five-year RIIO-T2 period.

369. The table and commentary in this section reference allowances that include Real Price Effects ('RPE'), whereas commentary provided for each individual category of spend in the remainder of this document excludes the impact of RPE.

Activity	FY23 Totex Spend	FY23 Allowance	FY23 Cost vs Allowance	5 Year Totex Forecast	5 Year Allowance	5 Year Cost vs Allowance
	(£m, 18/19 prices)	(£m, 18/19 prices)	(£m, 18/19 prices)	(£m, 18/19 prices)	(£m, 18/19 prices)	(£m, 18/19 prices)
TO Load Related Capex	10.8	9.8	1.0	99.0	93.3	5.7
TO Non-Load Related Capex	154.5	186.3	(31.8)	846.7	766.7	80.0
TO Non-operational Capex	8.6	27.2	(18.6)	94.5	123.0	(28.5)
TO Other Capex	59.6	94.6	(35.0)	240.9	235.2	5.7
TO Opex	111.9	133.0	(21.1)	542.4	598.3	(55.9)
TO Totex	**345.4**	**450.9**	**(105.5)**	**1,823.5**	**1,816.5**	**7.0**
SO Capex	17.0	31.7	(14.7)	173.9	144.7	29.2
SO Opex	49.0	62.9	(13.9)	252.9	313.1	(60.2)
SO Totex	**66.0**	**94.6**	**(28.6)**	**426.8**	**457.8**	**(31.0)**
Total	**411.4**	**545.5**	**(134.1)**	**2,250.3**	**2,274.3**	**(24.0)**

Table 10 - Summary of 2022/23 and five-year forecast spend and allowances

370. In 2022/23 our Totex spend was £411.4m compared to allowances of £545.5m. Over the five-year RIIO-T2 period, Totex is forecast to be broadly in line with allowances at £2.3bn.

371. Totex forecast and allowances include some spend for uncertainty mechanisms. Spend and allowances for Western Gas Network and Wormington projects are included in the table above as the needs case has been approved. The 2022/23 Totex spend for asset health work at the St Fergus terminal is also included, but the allowances have not at this stage as they are subject to needs case approval. RRP table 8.10 includes a list of all other re-openers we are expecting to submit, which if successful would increase the total Totex spend and allowances over the RIIO-2 period to £3.1bn.

372. A further breakdown of the key variances is detailed below.

TO Totex Overview

373. TO Capital Expenditure for 2022/23 was £233.5m against total allowances of £317.9m. Capital Expenditure for the five-year period is forecast to be £1,281.1m against allowances of £1,218.2m.

374. Load Related Capital Expenditure was £10.8m against allowances of £9.8m in 2022/23. Of this, £6.8m relates to Western Gas Network Upgrade against £6.8m of allowances under the relevant Uncertainty Mechanism. The underspend versus the 2022/23 forecast is primarily the result of re-phasing the procurement of long-lead time items (pipes and valves) into 2023/24. Cumulatively this spend totals £9.2m. In 2022/23 £1.2m was incurred on unfunded projects, principally the Felindre VSD project, which results in cumulative spend of £5.4m on Entry RIIO-T1 Carryover works in RIIO-T2 and accounts for the majority of the forecast overspend versus allowances across RIIO-T2.

375. Non-Load Related Capital Expenditure was £154.5m, £31.8m lower than allowances. Cumulative spend is £276.1m, £29.7m lower than allowances. During 2022/23 we have experienced higher than expected difficulty in gaining access to sites due to the role of the NTS in moving gas into Europe and procurement delays, resulting in a re-phasing of work into RIIO-T2 years 3-5. Whilst activity has increased year on year, Asset Health expenditure was £51m below allowances (including RPEs) in 2022/23 and as such, a revised programme of delivery across years 3-5 of RIIO-T2 is being assessed, including the involvement of our Operations and Pipeline Maintenance teams to reduce reliance on external contractors, as summarised in Chapter XI. In aggregate, spend across Bacton Site Redevelopment Feed and Emissions projects is £15.1m lower than allowances, with activity due to be completed in years 3-5 of RIIO-T2. This was partly offset by £2.4m spend on Stopples and Recompression, largely reflecting a partial recovery of prior year underspend.

376. We have incurred £16.1m of expenditure at St Fergus (cumulatively £32.5m) against the relevant Uncertainty Mechanism.

377. A further £35.3m has been incurred on RIIO-T1 Carryover Non-Load Related projects in 2022/23 (cumulative £73.7m). This primarily consists of ongoing expenditure on Peterborough and Huntingdon Compressor works (£66.0m). NGT continue to engage with Ofgem on how best to provide the required level of network resilience and security of supply at Peterborough and Huntingdon following Ofgem's Proposed Final Preferred Option in respect of proposed investment to comply with MCPD emissions legislation, alongside ongoing consultation surrounding Uncertainty Mechanism investment submissions for other compressor sites.

378. Forecast RIIO-T2 spend on Non-Load Related Capital Expenditure remains broadly in line with allowances, lower spend on Asset Health of £25.5m is offset by additional spend relating to St Fergus Asset Health Uncertainty Mechanism at £32.5m. The forecast £80.0m variance in the table above largely reflects expenditure on RIIO-T1 Non-Load Related Capital Expenditure, principally on Peterborough and Huntingdon compressor works.

379. Non-Operational Capex spend was £8.6m in 2022/23, £18.6m below allowances. Cumulative spend is £40.0m (£32.6m excluding one-off property purchases in 2021/22), £15.3m below allowances. This largely reflects IT programmes spend being lower than allowances across the first two years of RIIO-T2, which reflects additional system planning to determine the best and most efficient solution given projects are closely interwoven with delivering separation from National Grid. Expenditure across the RIIO-T2 period is expected to be broadly in line with allowances as project spend accelerates in years 3 and 4 of RIIO-T2. In 2022/23, a credit of £3.1m has been received against 2021/22 unfunded costs in respect of a new Enterprise Resource Planning ('ERP') system, resulting in cumulative unfunded costs of £1.8m.

380. TO Other Capex expenditure was £59.6m, £35.0m below allowances. The underspend against allowances across Physical Security Resilience, Cyber Resilience IT/OT and Non-Operational Capex reflects additional planning processes being necessary to determine the best and most efficient solution, notably in cyber programmes where the focus on proof of concept and scalability of solutions to meet the NISD EU Directive continues and limitations on outages caused by the impacts on the network caused by the situation in Ukraine. RIIO-T2 forecast spend of £240.9m is £5.7m higher than allowances, primarily reflecting spend carried over from RIIO-T1.

381. TO Opex costs in 2022/23 were £111.9m against allowances of £133.0m. Direct Opex was largely in line with allowances, with lower maintenance costs driven by utilisation of Gas Operations resource, reduced use of agency staff and procurement efficiencies, offset by higher fault maintenance costs caused by higher than expected levels of Linewalking and DSEAR defects costs and Operational Property costs (£3.8m higher than allowances) driven by a significant market-driven increase in own use electricity costs. TO Indirect costs were lower than allowances due to the net result of setting up an independent and efficient operating model on separation from National Grid that is right-sized for NGT. TO Opex is

expected to be £55.9m lower than allowances across the RIIO-T2 period, reflecting the ongoing impact of the factors noted above.

SO Totex Overview

382. SO capital expenditure in 2022/23 was £17m, £14.7m lower than allowances (cumulative spend of £34.9m versus allowances of £59.7m). This was primarily driven by IT Capex, with this programme of work progressing at a slower rate than was previously forecast. This progress mirrors that described above in the TO non-operational Capex section, where additional time is being taken by the business as it attempts to both optimise the chosen solutions and indirectly drive efficient spend.

383. SO Opex costs were £49.0m in 2022/23, £13.9m lower than allowances. Direct Opex costs were lower than allowances, primarily due to new ways of working and ensuring the SO is correctly resourced across all teams and reducing reliance on agency resource, combined with lower Market subscription and Xoserve costs. SO Indirect costs were also lower than allowances due to the net result of setting up an independent and efficient operating model on separation from National Grid that's right-sized for NGT and lower CNI spend. SO Opex is expected to be £60.2m lower than allowances across the RIIO-T2 period, reflecting the ongoing impact of the factors noted above.

Consumer Bill Impact

384. Our consumer bill calculation aims to quantify the financial impact on consumers for the work we do in maintaining and operating the National Transmission System (NTS). We apply Ofgem's methodology for calculating the components of a domestic consumer's bill; there are inherently a number of assumptions used. Approximately 50% of gas transmission charges are recovered via entry charges and classified by Ofgem as costs entering the wholesale market prices. We excluded these costs as not being directly attributable to the consumer. The exit costs, which include the 'direct' domestic sector consumption, are allocated to Gas Transmission network costs.

385. In 2022/23 the portion of the consumer bill attributable to National Gas Transmission was £7.99. This is an increase compared to 2021/22 where the National Gas Transmission portion of the domestic consumer gas bill was estimated at £7.30. This increase was caused by higher General Non-Transmission revenue in 2022/23 as a result of higher forward gas market prices ahead of the year driving higher expected shrinkage costs.

Return on Regulated Equity (RoRE)

386. The Return on Regulatory Equity (RoRE) figure will be provided as part of Regulatory Finance Performance Reporting (RFPR) in September 2023.

387. At a notional gearing, the combined 2022/23 National Gas Transmission TO and SO operational RoRE was 4.9%. This reflects a 0.4% increase compared to 2021/22 largely driven by the increase in Totex performance. The 2022/23 debt and tax performance has a

combined RoRE to 0.9%, with financing costs being impacted by the current high levels of inflation

388. The current forecast results in an operational RIIO-T2 RoRE of 5.9%, predominantly reflecting Totex outperformance 0.1% and incentive revenue 0.2%, partly offset by BPI -0.2%

Allowed Revenues TO and SO

389. Allowed Revenues for NGT TO in 2022/23 was £894.4m; however, £1,172m was recovered through charges. Consequently, NGT TO over-recovered by £277.9m for 2022/23, generating a Kt in 2023/24 Allowed Revenue.

Revenue Term		**(£m 2022/23)**
Calculated Revenue (as published)	$R_t^* \times PI_t^* / PI\ 2018/19$	893.1
AIP adjustment term (as published)	ADJ_t^*	-15.7
Adjusted revenue (as published)	$ADJR_t^*$	877.4
Legacy Allowed Revenue	LAR_t	-26.4
K Correction Factor	K_t	43.5
Allowed Network Revenue	$\boldsymbol{AR_t}$	**894.4**
Collected Regulated Network Revenue	RR_t	1,172.4
(Under) / Over recovery		**277.9**

Recovered Revenue for NGT SO 2022/23 was £522.5m, resulting in an over-recovery in the PCFM of £8.5m against the final Allowed Revenue £514.0m, generating a 'Kt' in 2023/24 Allowed Revenue.

Revenue Term		**(£m 2021/22)**
Calculated Revenue (as published)	$SOR_t^* \times PI_t^* / PI_{2018/19}$	422.6
AIP adjustment term (as published)	$SOADJ_t^*$	126.4
Adjusted revenue (as published)	$SOADJR_t^*$	549.0
Legacy Allowed Revenue	$SOLAR_t$	-27.8

K Correction Factor	SOK_t	-7.2
Allowed Network Revenue	**$SOAR_t$**	**514.0**
Collected Regulated Network Revenue	$SORR_t$	522.5
(Under) / Over recovery		**8.5**

X. Load Related Capital Expenditure (TO)

390. In 2022/23 our LR expenditure was £10.8m compared to an allowance of £9.8m. This variance was primarily driven by RIIO-T1 carry over works and Network Capability. Cumulatively, our RIIO-T2 spend was £12.9m compared to allowances of £14.2m.

391. Currently, our forecast spend for RIIO-T2 remains in line with allowances.

392. For our Western Gas Network Upgrade (WGNU) Uncertainty Mechanism submission, our expenditure in 2022/23 was £6.8m compared to an in-year allowance of £6.8m. RIIO-T2 costs-to-date are £9.2m. Allowances were phased anticipating a higher level of procurement of long-lead items (pipe and valves) in 2022/23, but following a detailed procurement review it has been decided to execute this in early 2023/24 to optimise price and lead time. We expect this spend to ramp up in the coming months.

393. In terms of RIIO-T1 unfunded Load Related Capital Expenditure, we incurred £1.2m costs in 2022/23 for Entry T1 Carryover works, principally driven by the Felindre VSD project. Cumulatively, for the first two years of RIIO-T2 costs for Entry T1 Carryover works total £5.4m.

Entry RIIO-1 carry over

394. Felindre Compressor Station was built as part of the South Wales Expansion Project (SWEP), triggered by the requirement to connect the Milford Haven LNG terminal to the NTS. Construction of the compressor station was completed in 2010 but commissioning could not be completed until Tirley PRI was operational and protecting the downstream pipelines that have a lower pressure rating. The environmental aftercare category of RIIO-T1 funding included completion of Tirley PRI and associated works, such as commissioning Felindre compressor station.

395. Commissioning of the electric variable speed drive (VSD) was further delayed because the volume of gas for which the assets had been designed did not materialise. However, flows were high enough to commission the two smaller gas turbine units. The VSD unit was put into preservation from 2014 to 2016, due to the continuing low flows through Milford Haven.

Based on higher flow forecasts, in January 2016 we made the decision to progress with commissioning the VSD.

396. Work has been ongoing since then to bring the unit out of preservation and prepare it for commissioning runs. After the prolonged period between construction and commissioning, many issues were identified and have been resolved. Some of these issues cannot be fully resolved until the control system is replaced, which is planned as part of our Cyber OT programme of works for delivery in 2024/25. Although the unit will be available for use before then, it will be on a restricted operation basis until replacement of the control system is completed.

397. Commissioning test runs of the unit progressed during 2022, with some delays due to the need to prioritise operational requirements, to protect safety and security of supply. The test runs have continued to highlight issues with the compressor unit and ancillary equipment. The self-delivery approach we adopted to complete the commissioning has allowed direct engagement with specialist contractors, enabling efficient resolution of the issues.

398. The delays due to operational requirements and additional equipment issues have moved the target of having the VSD available for use on a restricted operation basis to summer 2023. However, in February 2023 it was made available for essential use if manned and was successfully run remotely during March.

Incremental Capacity - Western Gas Network Project

399. Since receiving a PARCA for incremental capacity at the Milford Haven Entry Point, we have followed the approved capacity methodologies and framework obligations to develop a proposal for the Western Gas Network Project. The capacity requests cannot be met by the existing network in any scenario and is therefore to be treated as Funded Incremental Obligated Entry Capacity.

400. We submitted our Need Case in June 2021 and approval was published in December 2021. The majority of the project works will be carried out without the need for planning permission (permitted development rights). Although, one small planning permission was requested and granted for site extension works to facilitate the connection of one of the new pipelines.

401. Since last year's submission, long lead materials have been ordered for the new pipelines including pipe, valves, and fittings. This will contribute to the spend to date. Work overall is proceeding to plan.

402. We have looked for efficiencies across the range of work required to deliver the project, such as scope refinements, the coordination of ILI runs already scheduled within the RIIO-T2 period and the alignment and learning taken from related projects.

403. The most recent example of scope refinement was the descoping of the Tirley Bypass modifications, where the scope item was deemed not required through a scope querying

process. The current preferred option, which has the lowest capital cost with the greatest consumer benefit, includes:

- 9km of new pipeline between Wormington and Honeybourne and 2km of new pipeline between Churchover Compressor and Churchover Multijunction;
- Related works at several existing Above Ground Installations (AGIs) to facilitate the connection of new pipelines;
- Pressure uprating of part of the existing Feeder 28 pipeline between Felindre and Three Cocks (note this now specifically excludes the section between Felindre and Cilfrew now); and
- Related works at several existing AGIs and compressor stations to facilitate the pressure uprating and increased flow rates.

404. Please note that the above items do not include items descoped since the Needs Case submission in June 2021. The items descoped are the following:

- Wormington compressor rewheels.
- Felindre compressor rewheels.
- Felindre to Cilfrew pipeline uprating.
- Tirley Bypass reconfiguration.

405. We continuously review the evolving energy landscape. For example, the increased LNG flows at Milford Haven support justification for future investment at Tirley.

406. We continue to engage with stakeholders at all levels including local residents and politicians. This engagement aims to provide stakeholders with further understanding and clarity on the project and seek meaningful feedback to help inform our programme. Further engagement events have been organised for 2023 including both virtual and face-to-face events.

407. A particular area of focus for our stakeholder engagement plan has been with landowners who are impacted by the project. We have taken the time to explain NGT's land rights requirements, kept landowners informed of progress of the project, encouraged them to take professional advice and considered any feedback received. We have negotiated voluntary agreements (option agreement for easement or option agreement for lease) set out in Heads of Terms, with all but one of the grantors, for the project. The land rights strategy for the project includes a Compulsory Purchase Order (CPO) which has been 'made' to include all land rights required to deliver the project. CPO powers will only be exercised where we have failed to secure voluntary agreements with grantors.

408. We have worked with suppliers to understand supply constraints. The Russia/Ukraine conflict continues to affect global prices and availability of materials. For pipelines, quoted lead times have risen whilst validity periods have fallen. To mitigate the risk of delays, we have altered our procurement strategy to order long lead items earlier than we normally would

and free issue them to the Main Works Contractor (MWC). This helps to shorten the timeline of project delivery, helping us maintain our programme of capacity release by January 2026. It also allowed us flexibility to purchase materials at an opportune time, given the current volatility in prices.

409. First stage tenders have been submitted by bidders for both pipelines and uprating which we are continuing to assess.

410. We have maintained positive Ofgem engagement throughout 2022 and 2023 in the lead up to submission, to achieve an accelerated assessment and maintain a challenging programme.

Network Capability - Changing customer needs

411. These works are to upgrade metering assets at two sites, ICI Billingham and Weston Point. These upgrades will ensure greater accuracy of flow measurement of gas to ensure that customers are charged correctly and that there is an accurate view on the NTS energy balance.

412. These projects involve the replacement and upgrades of various metering assets on the network. The physical works at ICI Billingham were completed in 2022/23. Detailed design activities at Weston Point are ongoing with physical works planned to start in 2023/24.

Network Capability - Tactical Access (Tirley AGI)

413. The Tirley Tactical Access project at Tirley Above Ground Installation (AGI) is required to enable filter maintenance to be undertaken without causing constraints on the network. The primary driver is network resilience for consumers in Wales and for Milford Haven. The investment will also contribute to NGT's continued security of supply. We remain on track for full project delivery within the RIIO-T2 period. Other investments are planned in this area within the RIIO-T2 period, and we have been assessing project interactions both in terms of design and delivery.

414. Since our 2021/22 submission, we have:

- completed the Option Selection phase. The scope of the preferred option is to remove and replace the existing plug valves immediately upstream and downstream of the three 750mm nominal bore filters.
- changed contract strategy from design AND build to design THEN build to accommodate for an earlier detailed design. This allows us to deliver the project earlier.
- established that the funding allocated to the project in RIIO-T1 is insufficient.

415. The Russia/Ukraine conflict continues to impact lead times for material quotes. The validity period for quotes has also reduced significantly from the typical 30-day period, one supplier giving a 24-hour validity on their quote. We have ordered valves to negate the negative impact of the long lead times. They will be free issued to the contractor to support the timely

delivery of the project. It allows us flexibility to purchase materials at an opportune time, given the current volatility in prices.

Offtakes

416. Delivering connections is significant to the network, not only due to our licensed obligation but to continue supporting a competitive market for natural gas to both enter and exit the network. The end-to-end process can take several years to complete depending on the scale of the project. A project will move through the Application to Offer (A2O) process, design and build phases before being commissioned as a live connection.

417. In total, there were 18 NTS connection applications received within the A2O process during 2022/23.

418. Of the 18 applications made, eleven were for exit connections, five were for entry connections and two were for entry and exit connections combined.

419. Of the 18 competent applications received, ten Final Connection Offer's (FCOs) were not due within this period and were carried over to 2023/24. Eight offers from applications within the 2022/23 period were produced, three of which were signed, two have been extended, two are awaiting customer decision and one was withdrawn after the feasibility study was delivered.

Connection Application		**Offers made in 2022/23**	
Received in 2022/23	18	Applications not progressed	1
		Offers accepted	3
		FCO Extensions	2
		FCO pending customer decision	2
		FCO'S not made – Application carried over to 2023/24	10

Table 11 - Summary of the NTS Connection Applications and Offers

420. Comparing the number of applications received to the previous year, we have seen an increase in activity for new connections onto the NTS, this includes biomethane and hydrogen blend impact assessments. This follows the rising trend of activity from previous years.

421. There were six projects carried forward from RIIO-T1. Of those six projects four are currently in the build phase and two have been commissioned and closed.

422. In 2022/23 we received one new application to disconnect from the NTS. There has also been an increase in the number of modification applications to current connections due to customers considering the best use of their assets.

423. We have successfully implemented the Uniform Network Code (UNC) modification 0771S - Removal of the absolute requirements to include a remotely operable valve (ROV) installation for new NTS entry connections. This has been used by one project that was submitted in 2022/23 and is in place for future customers where applicable.

424. Our priorities to deliver improvements across the business has continued in IT. Work has progressed over that last twelve months to deliver an external Gas Customer Hub with internal workflow management capability. The first release of the project is due to be delivered in Q3/Q4 this year (2023).

425. We continue our commitment to engage with existing/new customers across the industry to encourage green gas connections onto the network to support the pathway to Net Zero. This includes engagement through blending innovation projects and biomethane forums. We have received a further four applications to connect biomethane facilities to enter green gas onto the NTS along with a noticeable increase in enquiries relating to biomethane. We have also had an ongoing interest from customers wishing to discuss potential hydrogen connections and have received two requests to complete pre-connection studies. There is an expectation that this will increase in the next twelve months.

XI. Non Load Related Capital Expenditure (TO)

426. This section covers our Non-Load Related Capex, where in 2022/23 our RIIO-T2 expenditure (excluding UMs and RIIO-T1 expenditure) was £103.1m, which was £66.0m below allowances of £169.1m.

427. This compares to expenditure of £66.7m (excluding Uncertainty Mechanism costs) versus allowances of £111.1m in 2021/22. Cumulatively, our RIIO-T2 Non-Load Related Capex spend of £169.8m is £110.4m below allowances.

428. The first two years of RIIO-T2 have experienced slower than expected progress across many of our Non-Load Related Capex deliverables. During the second year of RIIO-T2 the Russia/Ukraine conflict has meant that we have experienced higher than expected difficulty in getting access to assets. This is a direct result of the importance placed on the NTS in moving gas into Europe, which has led to necessary rephasing of work delivery, whilst this high level of activity continues.

429. Plans have been revised to recover work originally planned for 2022/23, and as such we expect increased activity during RIIO-T2 Years 3-5.

430. For 2022/23 spend, the key variances to forecast include:

- Asset Health – Delivery of our RIIO-T2 programme continues, but the additional delays highlighted above in gaining access to assets has deferred some 2022/23 work into the later years of RIIO-T2. Our Asset Health spend was £40.2m below our Year 2 allowance, and is broken down as follows:
    - £11.3m lower on Plant and Equipment
    - £10.4m lower on Pipelines
    - £10.2m lower on Compressors
    - £4.1m lower on Electrical
    - £3.3m lower on Valves
    - £0.6m lower on Civils
    - £0.4m lower on Cabs

431. For Asset Health, the project team continue to review the delivery performance to-date and are in the process of reprofiling c£40.0m of gap actions against baseline allowances, specifically focused on Plant and Equipment, Civils and Values into a revised programme of delivery across 2023/24-2025/26.

432. Redundant assets of £8.5m incurred lower spend (£13.9m), with programme delays from design and contractor selection, as well as network access difficulties, resulting in spend being reprofiled into later years.

433. Bacton Site Redevelopment FEED – our spend was £2.3m below Year 2 allowance, which is consistent with last year's update and is a direct result of the ongoing review associated with the Bacton future operating strategy.

434. Hatton Emissions spend in 2022/23 was £4.0m lower than Year 2 allowance. However, this was offset by increased spend in 2021/22 as the project timeline progresses towards the emissions compliance deadline of 31 December 2023, with the compressor unit now delivered to site and in the process of being connected to the network.

435. Lower spend also occurred on the other compressor emissions projects due to the decision to extend the submission deadlines impacting the phasing of spend. This covers King's Lynn (£1.6m), St Fergus (£1.5m), Peterborough and Huntingdon (£1.2m) and Wormington (£0.7m).

436. Our spend on GRAID was £2.9m below allowances due to needing to revise the project delivery schedule as we resolve complications with the GRAID sensor technology. The project team is still in the process of being stood up with overall delivery still forecast within the RIIO-T2 timescales.

437. The above underspends were partly offset by the following:

- Our 2022/23 spend on Stopples was £1.5m above allowance and represented a partial recovery of our 2021/22 under spend against allowances. Stopples costs manifest themselves on pipeline interventions within the Pipelines Asset Health theme and are only used where the relevant pipeline intervention cannot be achieved without usual outage shutdown and where we need to maintain supply, for instance to a customer.

- Our 2022/23 spend on Recompression was £0.9m higher than allowance, due to phasing, as this represents a partial recovery of prior year underspend.

438. For our Non-Load Uncertainty Mechanism (UM) we have incurred St Fergus Compressor Emissions spend of £16.1m during 2022/23, which when added to the prior year spend of £16.4m results in a cumulative RIIO-T2 spend of £32.5m on these projects.

439. In terms of RIIO-T1 carry over Non-Load Related Capex, we have incurred a further £35.3m of costs in 2022/23. Cumulatively, for RIIO-T2 we have incurred £73.7m of RIIO-T1 carry over Non-Load Related Capex. These costs cover the ongoing Peterborough and Huntingdon Compressor works (£66.0m), with further costs incurred on asset health RIIO-T1 carryover spend (£5.5m), Feeder 9 RIIO-T1 carryover spend (£1.8m) and DSEAR (£0.4m).

Compressor Emissions

440. For NGT it is important to do the right thing for society by reducing the impact of our activities on the environment. 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.

441. This submission provides an update on the programme of works planned or currently inflight on the gas NTS. These works ensure our assets are compliant with the Medium Combustion Plant Directive (MCPD) and Large Combustion Plant Directive (LCPD) elements of the Industrial Emissions Directive (IED) at the following sites: Peterborough, Huntingdon, Hatton, St Fergus, Wormington, and King's Lynn.

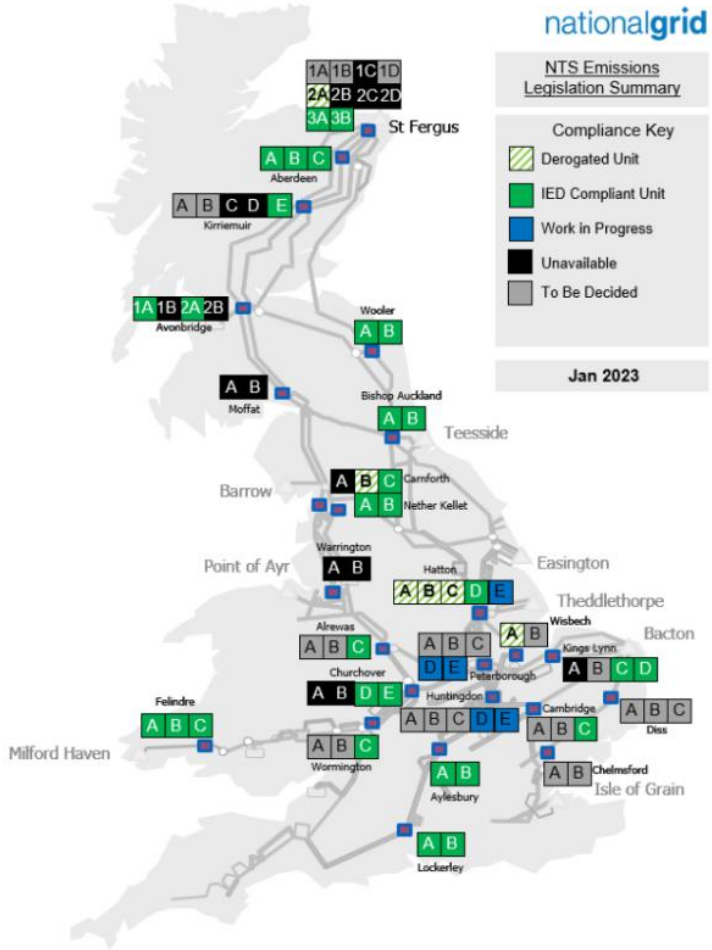


Figure 20 - NTS legislation summary

Compressor Emissions - Peterborough and Huntingdon (RIIO-T1)

442. Both sites are critical to efficient transmission across the centre of the network. For example, Peterborough provides essential North to South and West to East compression services while it works in tandem with Huntingdon to enable North to South gas flow which is important for balancing across the entire NTS. A simplified diagram of the role which Peterborough and Huntingdon have on the NTS is provided below in Figure 21.

Figure 21 - Role of Peterborough and Huntingdon on the NTS

443. At the start of the RIIO-T1 period, Peterborough and Huntingdon consisted of three Siemens (formally Rolls Royce) Avon machines each. The units can operate in series or parallel. Under RIIO-T1 allowances, two new gas turbine compressor units from Solar Turbines were approved for installation at both sites as part of the Emissions Reduction Project 3 (ERP3) initiative, which falls under Integrated Pollution Prevention and Control (IPPC) legislation. When commissioned, these two new Dry Low Emissions (DLE) compressor units will provide primary compression duty, leaving the existing Avon units on standby for resilience purposes. An overview of both sites can be seen in Figures 22 and 23 below.

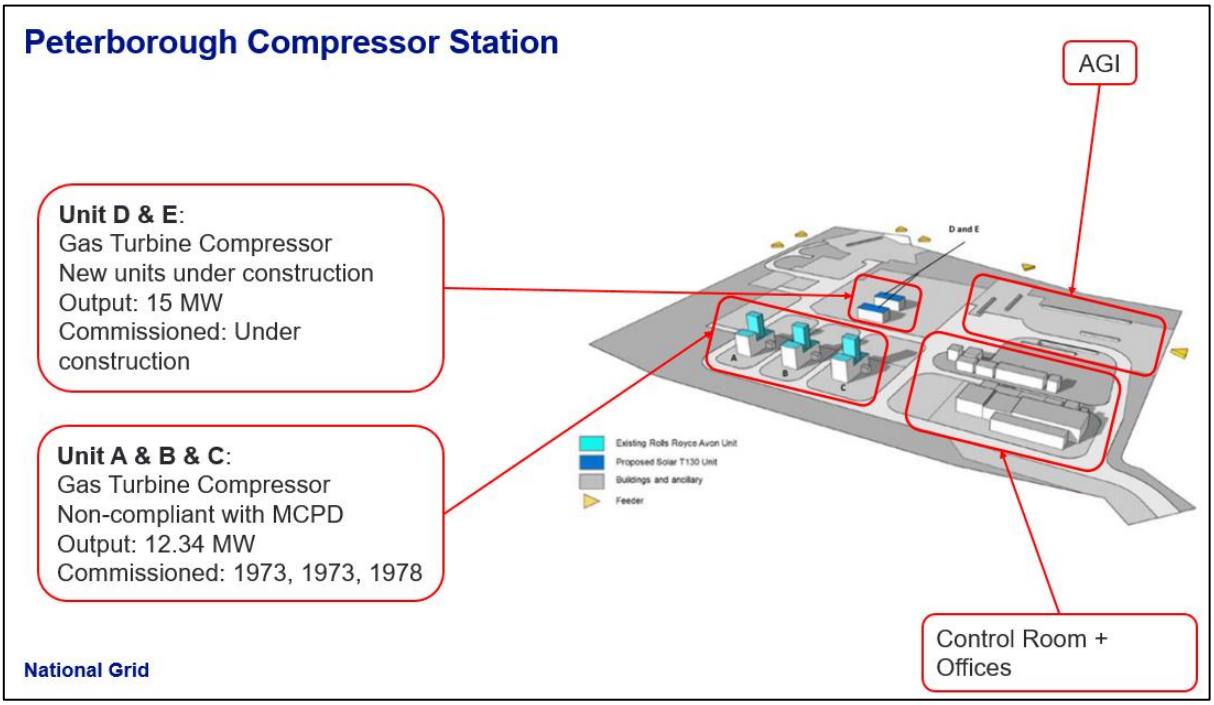


Figure 22 - Peterborough Compressor Station Overview

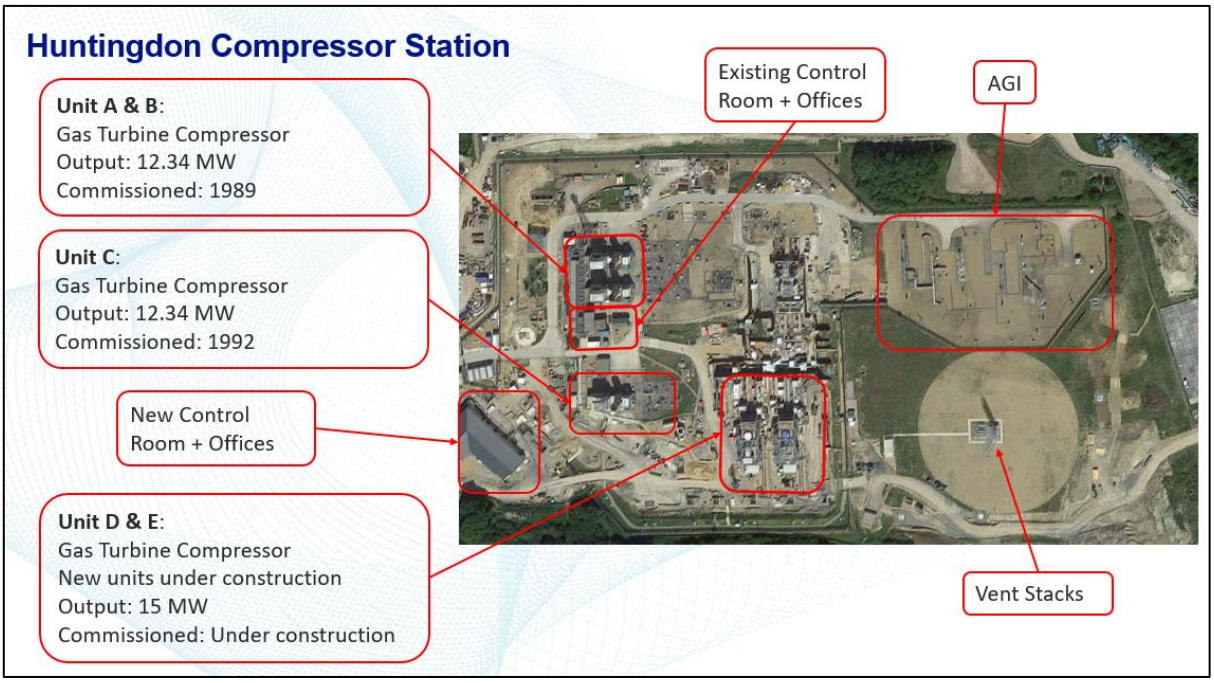


Figure 23 - Huntingdon Compressor Station Overview

444. At Peterborough during 2022/23, key activities which were carried out include, completion of mechanical installation, new control and protection systems for all units commissioned and Unit D and all auxiliary systems commissioned up to remote testing. Unit E, and all auxiliary systems, are currently in the process of final commissioning. In October 2022, Units A, B and C were brought back to service to support NTS Winter compression, while new compressor units D and E were also made available. Unit D and E are currently on outage until July 2023 to complete commissioning works and the performance of site noise monitoring to comply with permitting requirements. In April 2023, site-wide finishings were actioned including the addition of access road tarmac and compressor cladding. These actions can be seen in Figures 24, 25 and 26.

Figure 24 - Aerial Image of Peterborough Site (2022)

Figure 25 - New Compressor Unit cladding being fitted

Figure 26 - Concrete being poured at Peterborough

445. At Peterborough, the remaining tasks consist of parallel testing, performance testing, vibration and noise monitoring, road construction, drainage, lighting, final finishes and demobilisation. All monitoring and testing tasks are due to be completed in Spring 2023, with finishing touches to the site due to be completed by the end of 2023.

446. At Huntingdon during 2022/23, key activities which were carried out include completion of mechanical installation, new control and protection systems for all units commissioned and Unit D and E commissioning is also in progress. Huntingdon commissioning following Peterborough commissioning has enabled detailed lessons from the Peterborough project to be applied at Huntingdon. Whilst these lessons allowed the Huntingdon Electrical Control and Instrumentation (EC&I) installation to be completed ahead of schedule a number of defects were still found, which has impacted progress as they continue to be resolved.

Figure 27 - Aerial View of Huntingdon Site (2022)

Figure 28 - New Maintenance Workshop at Huntingdon

Figure 29 - Huntingdon site road finishing works

447. Due to the volatile energy market, the decision was made to bring the Avons back into service to support Winter 2022 compression requirements. The installation of new

compressor units D and E were therefore placed on hold until spring 2023 which has impacted the remaining programme.

448. Unit D and E commissioning continues in 2023 with operational acceptance planned before the end of summer outage period. All remaining project activities (road construction, drainage, lighting and final finishes) and demobilisation are due to be completed before the end of the calendar year

449. The Peterborough and Huntingdon ERP3 projects continue to identify several defects which require rectification. Defect rectification and programme elongation has exposed the projects to impacts such as inflation pressures linked to the Russia/Ukraine conflict such as significant cost increases to materials and labour.

Compressor Emissions – Hatton

450. Hatton is pivotal in the transmission of high East flows to the wider network given its close proximity to the network entry points of Teesside and Easington Terminals as well as supporting large directly connected loads and storage sites in the immediate vicinity. Hatton also facilitates North to South flows and is therefore critical to exit loads across the South of the country, international exports and 1-in-20 obligations. A geographical representation of Hatton's interaction with the NTS can be seen in Figure 30.

Figure 30 - Geographical Importance of Hatton Compressor Site

451. Hatton compressor station consists of an electric VSD (Unit D), which is the lead compression unit, and three RB-211 machines (Units A, B and C) which supplement the VSD and provide backup capability. We are now committed to the installation of a new gas-powered compressor (Unit E), of equivalent capability to the 35MW Electric VSD, which is planned to be operational by the end of 2023.

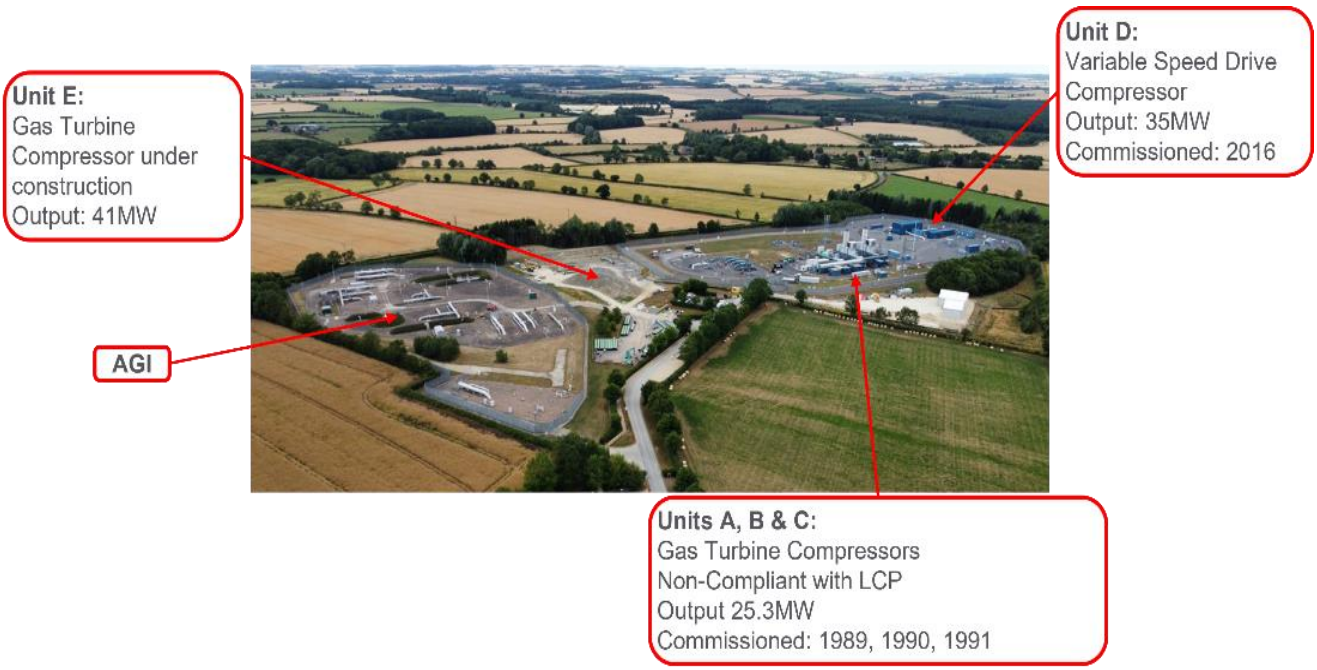


Figure 31 - Hatton Compressor Station Overview

452. Units A, B and C do not comply with the requirements of the Large Combustion Plant (LCP) Directive. On 1 January 2016, Units B and C were each placed on 17,500-hour Limited Life Derogation (LLD) and are due to be decommissioned from operational service by December 2023. Unit A was placed on 500-hour Emergency Use Derogation (EUD). Entering one unit into the 500 hours' derogation provides flexibility in terms of the future solution for the site and extends the potential construction window for any new units.

453. The majority of the works performed at Hatton Compressor Station during 2022/23 have been associated with the installation of the new Siemens SGT-750 41MW compressor unit.

- A bundled contract for pipework and steelwork was awarded to United Living Infrastructure Services (ULIS) and the associated materials delivered to site well in advance of the compressor delivery.
- Mechanical works (installation of new suction, discharge and recycle lines) was performed to enable the new compressor unit to be connected into the existing compressor station.
- The interconnecting pipelines between the AGI and Compressor Station were diverted to the north during the 2022 Summer Outage to create space for the new unit. This new pipework was successfully pressurised, and isolations removed.
- Main civils works were also completed during this time including foundations for the gas-turbine, compressor and balance of plant equipment along with drainage & ducting works.
- Following completion of their Factory Acceptance Tests (FATs), the Siemens compressor was delivered to site ahead of schedule in March 2023, see Figure 32. The Compressor and Gas Turbine (GT) are now on their foundations following initial installation and alignment works, see Figure 33.

454. The new compressor unit is planned to be operational by the end of 2023 in advance of the LCPD legislation deadline of 31 December 2023. Mechanical, Electrical and Instrumentation and piping works continue before testing and commissioning works can begin. There are still outstanding civil works (finishing of access roads, paths, removal of the site offices and storage yards) before the project can be formally completed.

Figure 32 – SGT-750 Gas Turbine package being delivered in March 2023

Figure 33 - New SGT-750 Compressor during installation

Figure 34 - Hatton Materials Delivered

455. Similar to the Peterborough and Huntingdon compressor installation projects, the Hatton LCPD project has experienced significant cost increases in 2022/23 due to inflation pressures linked to the Russia/Ukraine conflict, energy price increases and reduced availability of suppliers resulting in increased equipment, material and labour costs and lead times. The completion of electrical switchover before the end of the outage works is on the critical path, due to material deliveries.

456. An example of the procurement issues faced is the recent difficulty we have experienced in tendering for the transformer isolator switch. We issued an Expression of Interest to a total of seven suppliers but received limited responses, with no response from three suppliers, two suppliers declining to bid and a further supplier unable to provide a compliant bid.

Compressor Emissions – St Fergus (including subsidence)

457. As the highest utilisation compressor site on the NTS, St Fergus Gas Terminal enables UK Continental Shelf (UKCS) and Norwegian gas supplies entry onto the NTS. As the situation in Ukraine continues, along with its associated effects on European Gas supplies, this terminal continues to play a critical role in ensuring UK Security of Supply. The terminal receives gas from three sub-terminals (currently owned by Ancala, Shell and North Sea Midstream Partners (NSMP)/Gassco). Uniquely on the NTS, National Gas Transmission provides 24/7/365 compression services for gas received from the NSMP terminal under the terms of the Network Entry Agreement (NEA). The NSMP terminal is operated by PX. Compression is required to raise the pressure of the gas supplied via the NSMP sub-terminal to NTS pressure.

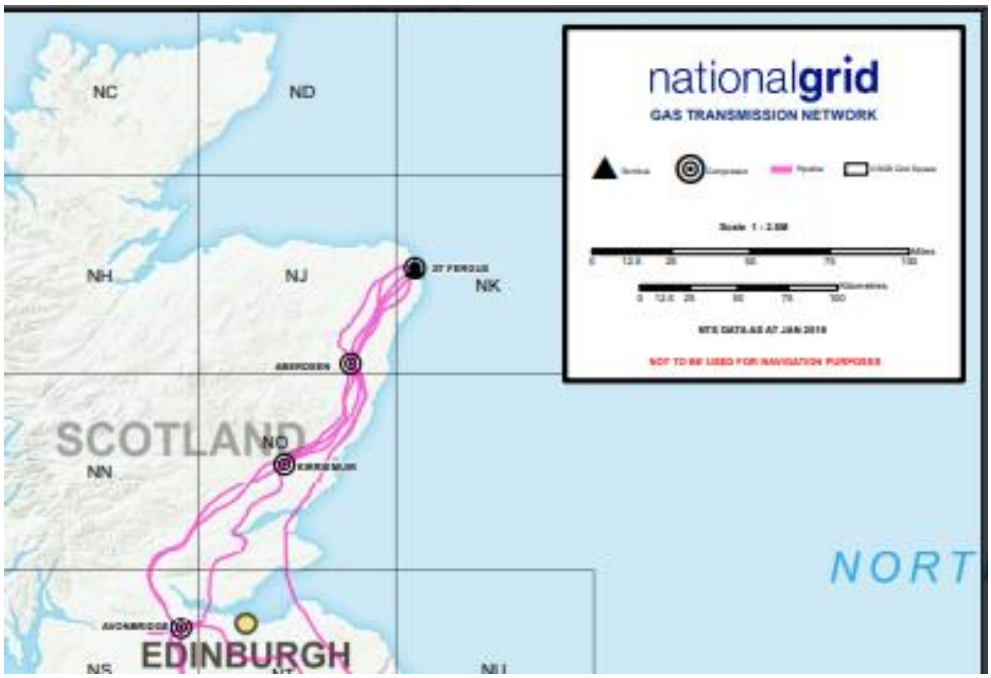


Figure 35 - Geographical location of St Fergus Terminal

458. St Fergus comprises three plants. Plant 1 has four Avon units and Plant 2 has one Avon (2B) and one RB211 (2A) in addition to two other units, due to be decommissioned in RIIO T2.

Once the new units, set out in NGT's January 2023 emissions UM submission, are operational the decommissioning of those units no longer required will be completed. Plant 3 has two electric Variable Speed Drives (VSDs). Although described as a Plant area, it should be noted that Plant 3 consists of compressors only and use of these electric drive compressors relies upon the auxiliaries of either Plant 1 or Plant 2, and therefore cannot be used as an independent plant.

459. In developing our investment programmes at the St Fergus Gas Terminal, since the RIIO-T2 Final Determinations, we have adopted a two-phase strategy to ensure clarity between short-term asset health (AH) and long-term site operating strategy. Our St Fergus short-term strategy provides certainty on the terminal operation requirements, including minimum compression across Plant 1 and 2, for operation out to 2030. The long-term strategy will deliver the enduring terminal solution, including compression, required for operation beyond 2030.

Long Term Strategy

460. In terms of LCPD, we gained approval from the Scottish Environment Protection Agency (SEPA) to enter the RB211 units (2A and 2D) into the Limited Life Derogation (LLD) from 1 January 2016.

461. With MCPD affecting the operation of the Avon units from 2030 onwards, we also investigated options on how best to utilise them until the end of 2029.

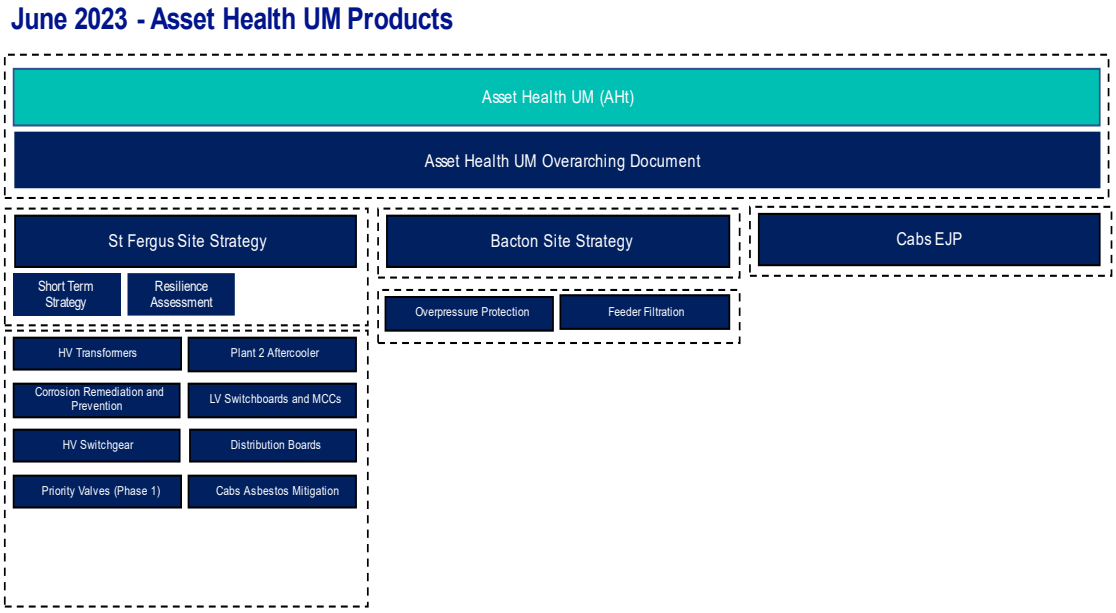
462. Based on Ofgem's Final Determination in December 2020, St Fergus Compressor Emissions compliance is being funded via an Uncertainty Mechanism rather than baseline funding. This funding strategy is the same as at Wormington, King's Lynn and Peterborough and Huntingdon i.e., provision of development funding and deposits to enable long lead item procurement as part of Baseline funding.

463. A two-step reopener process is continuing where the Final Option Selection Report (FOSR) was submitted to Ofgem on 31 January 2023 (selection of final preferred investment option). In this submission we recommended that St Fergus requires four compliant units across Plant 1 and Plant 2 by 2030. Four gas powered units (one of which is proposed to trial a Dry Low Emissions retrofit), in addition to the two electric drive units, provides the required capability to be able to manage a range of differing network flows. Having these units split across two Plants provides the necessary resilience should there be planned or unplanned circumstances that render some of the units unavailable.

464. Ofgem issued a minded to consultation supporting this submission in June 2023. As such, submission of the cost reopener, agreement on costs for remainder of programme of works, remains on schedule for submission in June 2025.

Short Term Strategy

465. In conjunction with the progression of our St Fergus compressor emissions FOSR we have continued to develop the AH investment programme which maintains and, where necessary, replaces assets to ensure continued safe operation of the site. At this continuously operating terminal, the availability and optimisation of outages presents significant challenges to investment delivery due to incoming supply factors or NGT operations. NGT will seek to schedule and deliver as efficiently as possible and risk trade investments, if necessary, to maintain Terminal performance and operational safety.



466. The intention of the short-term strategy is to ensure the continuity of the terminal operation requirements, including minimum compression across Plants 1 and 2, for operation to 2030. It recommends investments which maintain the integrity of the site and reduce risk to site staff, ensure continued operation of the terminal and maintain compression. The initial five AH EJPs which were submitted in the AH UM reopener in January 2023 are seeking the funding for some of these works, with further submissions due June 2023 and January 2024.

467. The strategy supports demolishing Units 2C and 2D, replacing the Cathodic Protection System and initiating a site-wide painting programme. Continued operation of the wider terminal will require the delivery of the actuator replacement programme due for completion in RIIO-T2.

Figure 36 and 37 - Removal of old actuator and installation of new unit.

468. Maintaining compression from four operational Avons will be achieved by carrying out cab infrastructure works, which commenced this year, and cyber work to reinstate Unit 2B. Carrying out cyber and AH work to Units 1A, 1B and 1D will also be necessary to enable their continued operation to 2030. This strategy will also facilitate ongoing operation of the gas compression portion of the site to ensure Security of Supply by replacing the required elements of Plant 1 aftercoolers then assessing Plant 2 aftercoolers and resolving identified issues.

Figure 38 - Plant 1 Aftercoolers prior to removal

Figure 39 - Plant 1 following removal of aftercoolers

469. Finally, the short-term strategy looked to retain flexibility of options for the long-term strategy solution by retaining the Avons until the results of the FOS Preliminary FEED were available last summer. As a result of the Preliminary FEED for the Emissions investment, it is now proposed to decommission Unit 1C.

470. The remaining AH funding requests have been and will be staged across the AH UM reopeners in June 2023, January 2024, and baseline funding requests for the next regulatory period. Throughout this process we are in regular dialogue with Ofgem and we review all of our proposed investments against the long term need to optimise the Terminal's operation.

Compressor Emissions – Wormington

471. Compression requirements at Wormington Compressor Station are heavily influenced by entry flows at the Milford Haven terminals. NGT uses Felindre, Wormington and Churchover Compressor Stations, amongst other compressors, to move high volumes of gas, up to a third of Great Britain's daily demand, away from Milford Haven into the rest of the network. Milford Haven is an Aggregated System Entry Point (ASEP), consisting of two Liquified Natural Gas (LNG) terminals (South Hook LNG and Dragon LNG). A gas fired power station is also located at Milford Haven (Pembroke). The LNG terminals can increase and decrease their supplies throughout the year depending on national and international market conditions. Due to its bi-directional flow capabilities, Wormington is also required to support demand extremities in South-Wales when Milford Haven inputs are low, and in the South-West when demand is high. Geographical location in relation to the NTS is indicated in Figure 40 below.

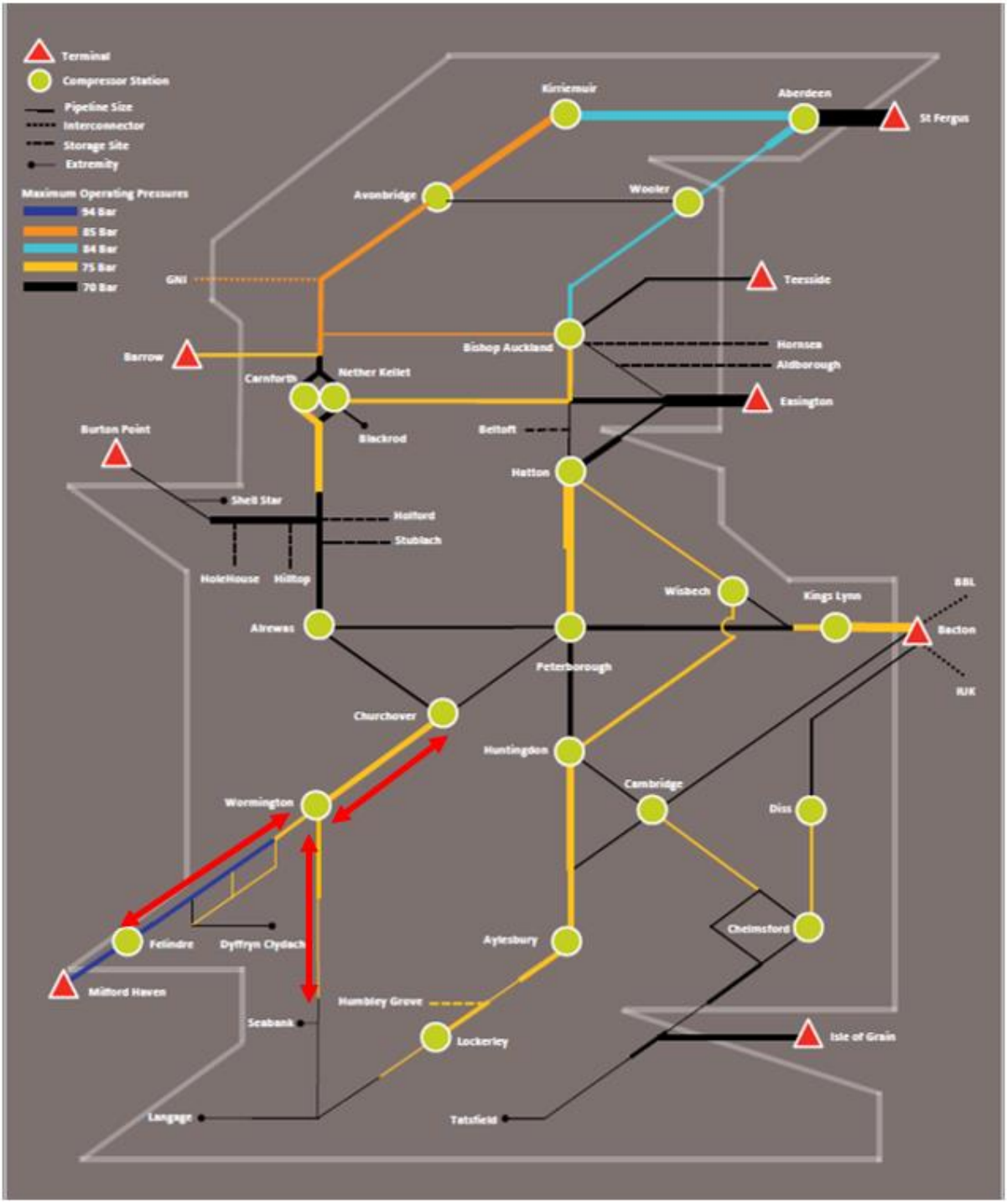


Figure 40 - Role of Wormington Compressor Station on the NTS

472. The outlook for increased flows through Wormington is further reinforced following a 'Planning and Advanced Reservation of Capacity Agreement' (PARCA) request to increase entry capacity by 17% at Milford Haven (25% at South Hook LNG Terminal). The associated Needs Case was approved by Ofgem in December 2021 which identified a Final Preferred Option to accommodate the increased capacity with a series of asset investments and possible future reinforcement. This Needs Case identified a continued need for compression at Wormington.

473. Wormington Compressor Station comprises two Siemens Avon compressors (Avon Units A and B) and one electric driven Siemens VSD compressor (Unit C) which is the lead unit. Units A and B are non-compliant with MCPD emissions legislation and require investment to avoid being placed on 500-hour restricted running (Emergency Use Derogation - EUD) by 1 January 2030. See site overview in Figure 41 and an image of the compressor units taken during a site visit to Wormington during 2022/23 in Figure 42.

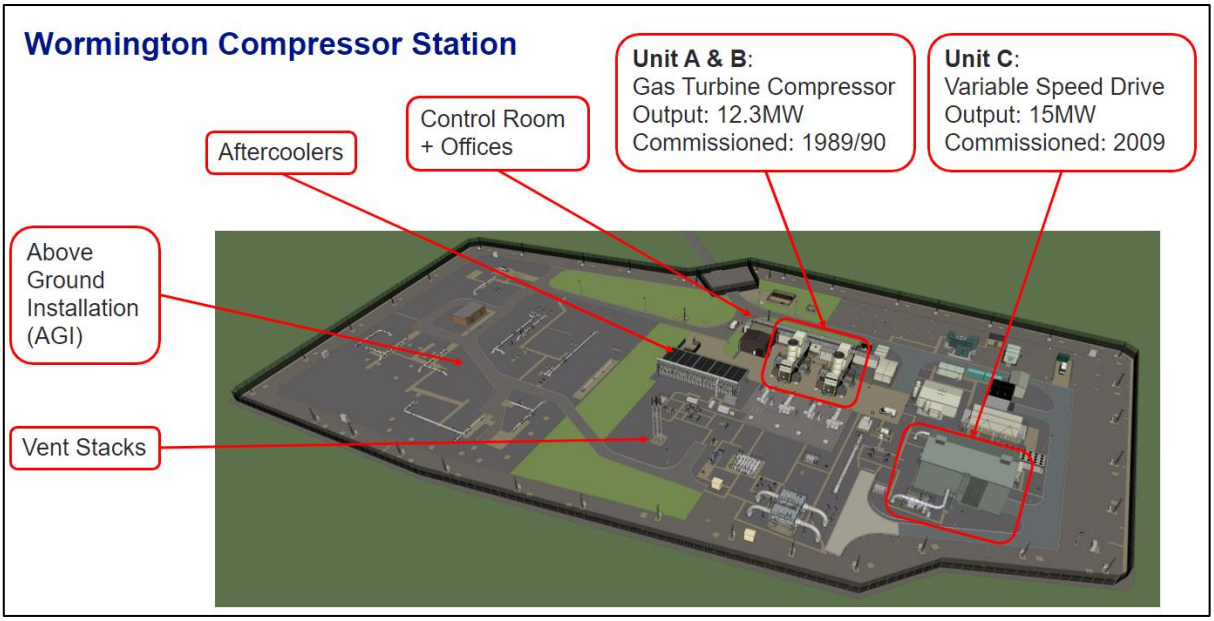


Figure 41 - Overview of Wormington Compressor Station (2023)

474. Based on Ofgem's Final Determination in December 2020, Wormington MCPD is being funded via an Uncertainty Mechanism. Ofgem have provided a baseline allowance to cover development costs and deposits on long-lead items, subject to a true-up during the associated re-opener. A two-step reopener process has been agreed. Wormington's reopeners were scheduled for August 2022 (agreement of the preferred option in the Final Options Selection Report (FOSR)) and in November 2024 (reopener submission to agree costs for remainder of programme of works).

475. In August 2022, NGT submitted their Final Option Selection Report (FOSR) to Ofgem which recommended future investment at Wormington to comply with MCPD emissions legislation. Following a detailed and in-depth option selection process, the FOSR recommended the investment of two new gas-driven compressor units by 2030, with an indicative total project value of £110.4m (±30% cost certainty), as the most economic and efficient solution for UK consumers. Following submission, NGT engaged with Ofgem on a regular basis to address any Supplementary Questions (SQs) raised during their consultation.

Figure 42 - Wormington Units A, B & C taken during site visit 7 March 2023

476. In their Final Determination response (issued 3 March-2023), Ofgem rejected the option identified by NGT and approved the following option: 'the installation of one new gas turbine compressor unit commissioned before 1st January 2030. The new unit should be installed on a new plinth within the existing boundary of Wormington Compressor Station. In addition, one of the existing Avon units should be retained, under the 500-hour EUD allowed for in the Directive, with significant asset health investment to improve unit availability. The other Avon should be decommissioned. The need for decommissioning should be reassessed following operational acceptance of both the new and derogated units. To ensure operation mapping alignment across all site compressors, this option will also consider the case for a VSD re-wheel during the next phase of the project'.

477. To progress the Final Preferred Options towards the cost reopener in November 2024, NGT are engaging with our contractor to perform a pre-FEED study to further refine the agreed investment options at MCPD critical sites (Wormington, King's Lynn, Peterborough, Huntingdon and St. Fergus Terminal). Further option refinement through this pre-FEED phase will ensure future design phases are scoped efficiently and effectively to deliver value for consumers.

478. The scope will include further definition of new compressor unit location and sizes, condition assessments on any Avons to be retained as well as the performance of Remnant Life Studies to help understand how time and aging processes will affect health, safety and environment (HSE), technical integrity and to identify measures required to mitigate the impact of future degradation. Worley will also update risk and lessons learnt registers, update cost estimates with any new identified scope and evaluate the Level 2 programmes produced by each of the

MCPD projects and develop a holistic programme of works to deliver these investments by 1 January 2030.

479. Following Ofgem's Final Determination and its recommendation for reduced investment compared to our Final Preferred Option detailed in the Wormington FOSR, NGT continue to engage with Ofgem on how best to provide the required level of network resilience and security of supply for current and future customers. We maintain that investment in two new compressor units is the most economic and efficient option. To progress with further engineering definition, NGT have included consideration for a second new compressor unit to be delivered by 2030 within the pre-FEED study. This provides greater flexibility and potential future efficiency should the need for a second new unit arise.

480. The MCPD pre-FEED study is planned for completion by September 2023 and will be used to inform the tender event for FEED (Front End Engineering Design - Conceptual Design Phase) planned for 2024. The main FEED study is expected to be nine months in duration and will ultimately refine the engineering and cost scope to ±15% cost accuracy required for the cost reopener submission planned for November 2024.

Compressor Emissions – King's Lynn

481. King's Lynn plays a critical role in ensuring gas can enter and exit the National Transmission System through the Bacton terminal, including the Europe interconnector connections. Compression at King's Lynn is the only option to facilitate high exports to Europe via the Bacton Terminal and the site also plays an important role in moving gas away from Bacton and Isle of Grain when supplies exceed demand. As the UK becomes more import dependent, it is critical that entry and exit capability and resilience is at the required level to ensure UK and South-East Security of Supply. High forecasted gas exports via EU interconnectors and increased supplies from GB LNG terminals are strong indicators for the sustained need for King's Lynn compression. For this reason, a long-term secure, flexible and reliable solution needs to be implemented at the site. A geographical representation of this key function is shown in Figure 43 below.

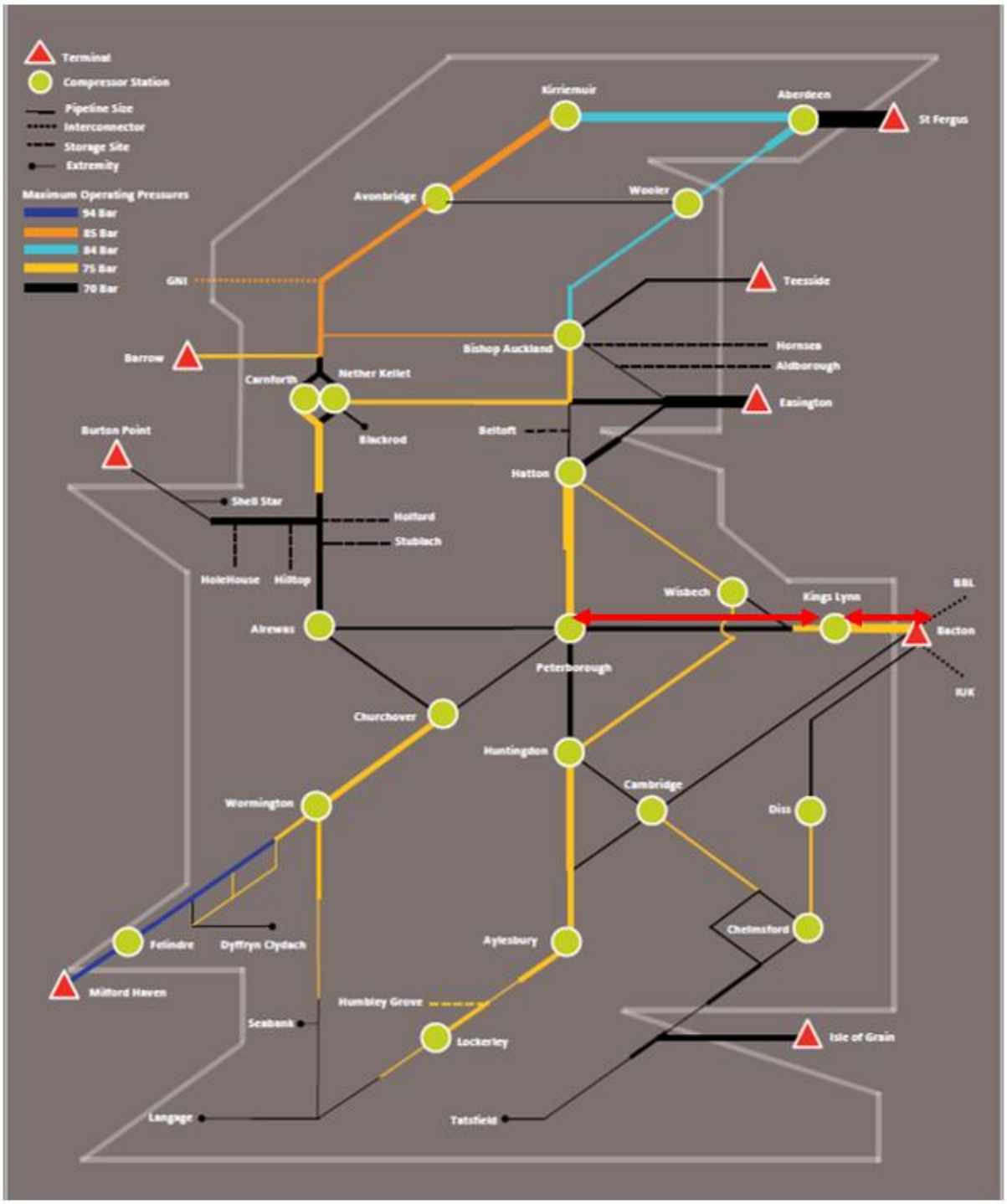


Figure 43 - Role of King's Lynn Compressor Station on the NTS

482. King's Lynn comprises four existing compressor units, two compliant Siemens SGT-400 compressors and two Avon units, Unit A (disconnected) and Unit B (operational), which are non-compliant with MCPD. Unit B is over 50 years old and operating well beyond its original design life. Failure to meet emissions legislation means that, Unit B would be limited to 500-hours running per year, restricting the operation of the site. Please see Figure 44 for an overview of King's Lynn Compressor Station.

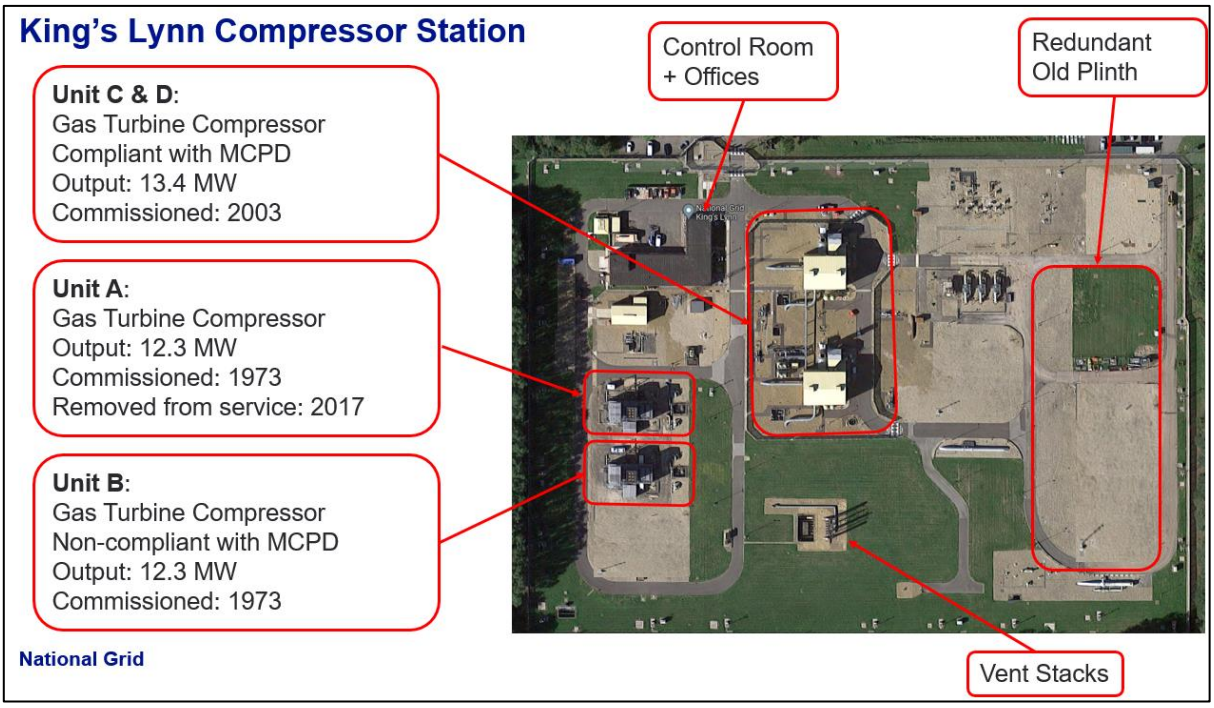


Figure 44 - Overview of King's Lynn Compressor Station (2023)

483. Based on Ofgem's Final Determination in December 2020, King's Lynn MCPD is being funded via an UM rather than baseline funding. This funding strategy is the same as that used at Wormington, i.e. provision of development funding and deposit to enable long lead item procurement as part of Baseline funding. Similarly, a two-step reopener process is now in progress where the Final Option Selection Report (FOSR) was submitted to Ofgem on 31 January 2023 (selection of final preferred investment option) and submission of the cost reopener (agreement on costs for remainder of programme of works) is scheduled for submission in April 2025.

484. In our January 2023 FOSR submission to Ofgem we recommended future investment at King's Lynn to comply with MCPD emissions legislation. Following a detailed and in-depth option selection process, the FOSR recommended the investment of one new gas-driven compressor unit by 2030 (including decommissioning of Avon Units A & B and compressor rewheeling of SGT-400 Units C & D to better align compression mapping across these units), with an indicative total project value of £66.0m (±30% cost certainty) to achieve emissions compliance while ensuring robust and capable compression at King's Lynn, providing resilient long-term operation and sufficient availability to accommodate high Bacton import and export scenarios. Following submission, NGT have engaged with Ofgem on a regular basis to address any Supplementary Questions (SQs) raised during their consultation.

Figure 45 - Image of King's Lynn Compressors taken during site visit in 2022 - Avon Units A & B (black enclosures) front left with SGT-400 Unit D & E (cream enclosures) back right

Compressor Emissions – Peterborough and Huntingdon

485. As stated in the narrative above concerning Peterborough ERP3 (RIIO-T1) project development, Peterborough Compressor Station is critical in supporting multiple supply and demand patterns on the NTS. Huntingdon Compressor Station is critical in supporting demand in the South of the network. Please see Figure 21 in previous RIIO-T1 Carry Over section for context on Peterborough and Huntingdon location on the NTS.

486. Also described in the RIIO-T1 Carry Over section is the compressor station overview for Peterborough and Huntingdon sites. Both compressor stations consist of three existing compressors, Siemens Avon Units A, B and C, which are not compliant with MCPD legislation. Please see Figure 22 and Figure 23 for an overview of both compressor stations.

487. Based on Ofgem's Final Determination in December 2020, Peterborough MCPD is being funded via an Uncertainty Mechanism rather than baseline funding. Again, the same funding strategy is used as at Wormington and King's Lynn. A two-step reopener process is planned with agreement of the preferred option via FOSR scheduled for January 2023 with agreement on costs for the remainder of the programme of works scheduled for June 2025.

488. In January 2023, NGT submitted their Final Option Selection Report (FOSR) to Ofgem which recommended future investment at Peterborough and Huntingdon to comply with MCPD

emissions legislation. Following a detailed and in-depth option selection process, the FOSR recommended the investment of one new gas-driven compressor unit by 2030 at Peterborough and investment in asset health works and an Avon DLE retrofit modification at Huntingdon, with an indicative total project value of £62.9m (±30% cost certainty) to achieve emissions compliance while ensuring robust and capable compression at Peterborough and Huntingdon, achieving resilient long-term operation. Following submission, NGT have engaged with Ofgem on a regular basis to address any Supplementary Questions (SQs) raised during their consultation.

Compressor Emissions – Recompression

489. The use of recompression equipment to reduce methane venting from planned maintenance outages supports our aim of reducing the impact our activities have on the environment. We are investing in Portable pipeline Recompression equipment which will have the capacity to reduce pipeline pressures in isolated sections down to circa 1 bar pressure.

490. A procurement event was undertaken in 2022 to tender for two new recompression units. The contract was awarded in June 2022 with an initial down payment being made.

491. In November 2022 issues were raised by the providers sub-contractor (who are the supplier for the engines) as they do not have type approval for supply to the UK.

492. We contacted the Secretary of State for Transport in January 2023 who suggested an exemption may be fit for this scenario. The Secretary of State for Transport advised to seek type approval from the vehicle Certification Agency as they are responsible for type approval.

493. A formal request was made to the Secretary of State in January 2023. We were then referred to the Vehicle Standards Agency (VSA) where we submitted a formal request for derogation in May 2023. The VSA then referred the derogation application to the International Vehicle Standards (IVS) team who sit within the Department of Transport. The IVS team have confirmed that they are unable to approve the derogation and have referred the request back to the Secretary of State for Transport.

494. We are currently reviewing other options available to progress the procurement event through design changes.

Compressor Emissions – Methane Detection and Quantification

495. Within the RIIO-T2 final determination we were awarded funding for the rollout of the Monitoring of Realtime Fugitive Emissions (MoRFE) continuous fugitive emission detection system. The system was developed initially within the RIIO-T1 Greenhouse House Investigative Mechanism to fulfil Special Condition 8J of the Gas Transporters licence. The monitoring system was subsequently developed further in a Network Innovation Allowance (NIA) funded project (NIA_NGGT0137) which concluded on 31 Mar 2021.

496. Since COP26 in Glasgow in November 2021, the urgency to reduce methane emissions globally has increased. In recognition of this, one of the outcomes from COP26 was the Global Methane Pledge which committed signatories to a 30 % reduction in methane emissions from a 2020 baseline. The oil and gas sector and in particular the natural gas supply chain is a focus for contributions to methane emission reduction.

497. In the 2021/22 reporting period we agreed with Ofgem, while working on a Net Zero re-opener submission, to go further in methane detection and quantification beyond what we committed to in our RIIO-T2 business plan. As such it was agreed that the funding awarded for MoRFE rollout would be more appropriately used for periodic detection equipment.

498. In line with this agreement, we progressed shortlisting of suitable periodic detection equipment and placed orders at the end of March 2023. This spend has not appeared yet in the NLR Capex spend table 6.1 but will appear in the 2023/24 reporting period once received and receipted.

499. The Net Zero re-opener submission to enhance methane detection and quantification was submitted in October 2022. This submission requests the Opex funding to implement an expanded leak detection and repair programme on the NTS to make use of the procured detection and quantification equipment ordered in March 2023.

Asset Health

500. Work continued to deliver our asset health programme in 2022/23, which is vital to mitigate the risks of an aging asset base so that we can continue to provide a safe and reliable network for our customers and stakeholders.

501. Our delivery has been against the backdrop of very challenging gas and commodity markets adding complexity to our delivery plans and ultimately impacting our delivery volumes over the first two years of RIIO-T2. To mitigate against these challenges we have implemented a series of plans which have allowed us to ramp up delivery compared to the first year of the price control and will enable us to continue the accelerated delivery to broadly achieve our spend to allowances in this area.

502. The challenges we are facing include:

- The global Covid-19 pandemic has posed substantial difficulties to supply chains across various industries, including our operations at National Gas Transmission. We have experienced significant disruptions in the procurement of critical materials, particularly valves, essential for our asset health programme of works. Extended lead times of up to 52 weeks for valve supplies have impeded project delivery, causing delays and budget overruns. As a result, we have rescheduled works at certain sites from Year 2 (2022/23) to Year 3 (2023/24) to accommodate the prolonged lead times and secure the necessary outages.

- The Russia/Ukraine conflict has had a profound impact on gas supply and demand dynamics, leading to notable shifts in flow patterns. As a response to higher-than-expected demand, there has been a significant increase in gas exports to Europe. Consequently, our focus has shifted towards facilitating the movement of gas from LNG imports at Milford Haven to Bacton for export to Europe during the summer. This has resulted in heightened utilisation of our compressor fleet along the west/east corridor, posing challenges in securing planned outages that were scheduled prior to the conflict. In light of these shifts in flow patterns, we have had to re-evaluate our outage programme and carefully consider and accommodate the requirements of our customers while planning and executing our work.

- We are currently facing significant cost pressures for planned asset health interventions, making it challenging to achieve target costs. The allowances agreed upon during RIIO-T2 do not always accurately reflect the actual costs associated with completing these interventions, considering the current global skills shortage, slow post-Covid recovery, and the Russia/Ukraine conflict. This is particularly evident in the electrical investment theme. The cost returns from contractors involved in the tendering process have varied, often resulting in higher expenses. Contractor capacity limitations and internal vacancies have further exacerbated the challenges we face. To address these issues, we plan to optimise resource allocation by re-evaluating risks and trades across asset health categories, allowing for a slightly increased allowance for the electrical programme of works than was initially awarded in the Final Determination.

- The utilisation of various flow stop techniques, including stoppling and emerging options such as the Remote Tecno Plug (RTP) and the BISEP option, which offers two seals instead of the conventional single seal, has become increasingly necessary. These techniques allow us to carry out work during outages while minimising disruptions for our valued customers. In alignment with our business plan, we had planned to implement 10 stoppling and flow stop techniques to facilitate essential isolations required for successful asset health interventions across our network. However, as we progressed through Years 1 and 2, we encountered higher than expected costs associated with facilitating isolations. This unforeseen challenge has prompted us to reassess our strategy and consider the possibility of requesting additional allowances to accommodate critical works on our network.

- The energy industry is currently grappling with a significant shortage of skilled professionals, encompassing engineers, project managers, and technicians. This pressing challenge has been particularly exacerbated by the increasing demand for renewable and Net Zero energy infrastructure projects as well as competing major infrastructure investment such as Hinkley Point C and HS2. The scarcity of qualified personnel has resulted in some project delays and delivery cost escalations. As a result, urgent measures are required to address this skills gap and ensure seamless project execution in the energy construction sector.

503. Nevertheless, this year we have continued to build upon the work done in previous years in completing site surveys to establish a comprehensive programme of works for the remaining duration of RIIO-T2. This strategic planning has been instrumental in effectively prioritising asset health interventions and optimising resource allocation amid supply chain disruptions, escalating material and contractor costs, and a shortage of skilled labour. To bolster our capacity and facilitate smooth delivery, we have expanded our team through the recruitment of additional project engineers, project managers, and work supervisors. Their expertise will play a pivotal role in delivering our asset health investment programme over the remainder of the price control period

504. Furthermore, to help mitigate these challenges we have implemented a significant shift in project execution through the active involvement of our Operations teams and National Gas Services (formerly Pipelines Maintenance Centre) in delivering a substantial portion of the remaining asset health interventions. This transition from relying solely on external contractors to internal execution has yielded invaluable benefits, including enhanced project control, improved efficiency, and a higher volume of successfully completed interventions. Although our Operations and National Gas Services (NGS) teams have demonstrated progress in intervention delivery, it should be noted that claiming of outputs such as Long Term Risk Benefit (LTRB) can lag behind work delivery as project closure activities are often undertaken in the following year. There is an active focus on streamlining our project closure process to claim outputs in the year of delivery where possible.

505. Considering these challenges, we recognise the need to reassess our strategy and potentially request additional allowances to accommodate the critical works on our network. The achievement of positive Uncertainty Mechanisms (UM) outcomes remains essential to effectively deliver on our RIIO-T2 plan.

506. Our asset health allowance is broken down into seven categories and the key work delivered in 2022/23 for each category is covered in the following narratives. The allowances for our asset health work spans across our NARM allowance and non-lead allowances.

Asset Health – Plants and Equipment and Valves and Civils (inc NARC)

507. The asset health categories of Plant and Equipment, Valves, and Civils are primarily addressed through our National AGI Renovation Campaign (NARC), and as a result, they are grouped together in this section.

508. Valves play a critical role in the National Transmission System (NTS), ensuring the safe flow of gas and providing necessary isolation for operational and integrity-related interventions. Together with associated plant, equipment, and structural integrity assets, it is imperative to proactively intervene to mitigate risks, avoid adverse impacts on NTS safety, operations, and availability, and ensure compliance with legislative requirements.

509. Plant and Equipment encompass both above and below-ground pipework and related assets, while Civil assets include site access, drainage, ducting, pipe supports, pits and pit covers, plinths, and security fences on National Gas Transmission AGIs. Valves include actuators and associated equipment for local, remote, or process-operated valves.

510. Additionally, some Plant and Equipment works fall under other investment programmes, such as Asset Health works at St Fergus and Bacton, as well as works delivered by Operations. Plant and Equipment spending is also associated with planned Cathodic Protection, Flow and Pressure Control, and Preheat works at AGIs, which have undergone feasibility and conceptual design studies and are scheduled for detailed design and construction in 2023. Further valve and structural integrity campaigns that do not align with the NARC delivery model are planned for Years 3 to 5, including the Non-Return Valve and Actuator campaign managed by Operations and a dedicated Structural Integrity campaign.

511. Our RIIO-T2 business plan encompasses a proactive intervention programme for these assets. The sites and assets included in the project scope have been surveyed, and interventions have been selected and prioritised based on risk assessment. This investment forms an integral part of our RIIO-T2 programme to manage network risk on our AGI assets, aligning with the NARM output as outlined in our business plan.

512. NARC has continued its momentum from previous years, facilitating accelerated asset health works across the NTS by bundling survey and delivery packages. This approach enables us to increase delivery volumes and drive operational efficiency, ultimately benefiting our customers and stakeholders.

513. Campaign Decision Panels (CDPs) play a vital role in the NARC decision-making process and project advancement, serving as a best practice model for broader campaigns. These panels are responsible for defining the scope and approving construction works outside of regular governance cycles, further enhancing efficiency and expediting delivery.

514. Our investments over the opening two years of the price control have resulted in a total of 248 interventions during the 2022/23 delivery year, split by the asset health sub themes in the table below. Of these, for year one investments, 13 were executed internally and 106 by external MWCs, for year two investments, 57 were executed by external mains work contractors and 72 internally. These investments were funded through baseline asset health allocations within the Plant and Equipment, Valves, and Civils themes.

Theme	**Sub-Theme**	**2021/22 Volume Interventions**	**2022/23 Volume Interventions**
AGIs	Above ground pipework	15	30
	Pipework protection	12	32

Valves	Actuators	8	22
	Flange	1	0
	Valve refurbishments and replacement	44	56
	Valve removal	1	3
Structural Integrity	Drainage	11	7
	Ducting	3	0
	Pipe supports	35	83
	Plinths	8	0
	Security fences and gates	10	9
	Site access	11	3
Pipelines	Pipeline, Coating and CP		3
TOTAL		**159**	**248**

Table 11 – NARC21 and 22 investments by theme

Delivery Strategy

515. We have made significant progress with the completion of comprehensive asset surveys and the selection of preferred scopes. To optimise efficiency and reduce overhead costs, the NARC investments are allocated within our business, considering the complexity of the works and identifying other potential efficiencies. Within this, the aim is to deliver more work in-house through Operations and National Gas Services and build this capability.

516. NARC works are strategically assigned to deliver most efficiently through National Gas Services (NGS) or tendered to external MWCs, depending on the size and nature of the project. NGS primarily focuses on refurbishment scopes using innovative techniques, while replacement scopes are tendered to external MWCs. Operations will also be involved in the self-delivery of additional campaigns that fall outside the NARC model, where they can execute less complex scopes more efficiently than MWCs. This can also be alongside major projects such as Flow and Pressure Control, Preheat, and Cathodic Protection for AGIs.

517. Our chosen delivery approach involves bundling interventions across Valves, Plant and Equipment, and Structural Integrity asset health themes at AGI sites. By creating these discreet bundles of work and aligning them with decommissioning efforts, we can achieve cost savings and maximise the utilisation of network outages. Tailored tenders are issued for each delivery strategy, distinguishing between internal delivery and MWC involvement.

518. The selection of sites delivered in the 2022/23 period focuses on Valves, Plant and Equipment, and Structural Integrity themes, prioritising sites with a high number of known defects and specific plant statuses. Our RIIO-T2 strategy aims to align NARC outage works with in-line inspections (ILI) Dig programmes and outage schedules, enabling efficient bundling, optimising outage schedules, reducing recompression requirements, and minimising customer disruption. Site surveys were conducted by the AGI team with support

from NGS depots for valve investigations and external contractors for tasks like Cathodic Protection Insulation Joints (CPIJ) investigations, 3D point cloud scanning, and feasibility analysis. Funding approvals were based on a comparison of delivery costs and the long-term risk-benefit analysis.

519. 54 site projects under the NARC campaign were successful completed in 2022/23, with 34 projects delivered by NGS and an additional 20 projects executed through external MWCs. This represents a substantial increase compared to the 30 site projects delivered in Year 1, demonstrating the campaign's growth and impact.

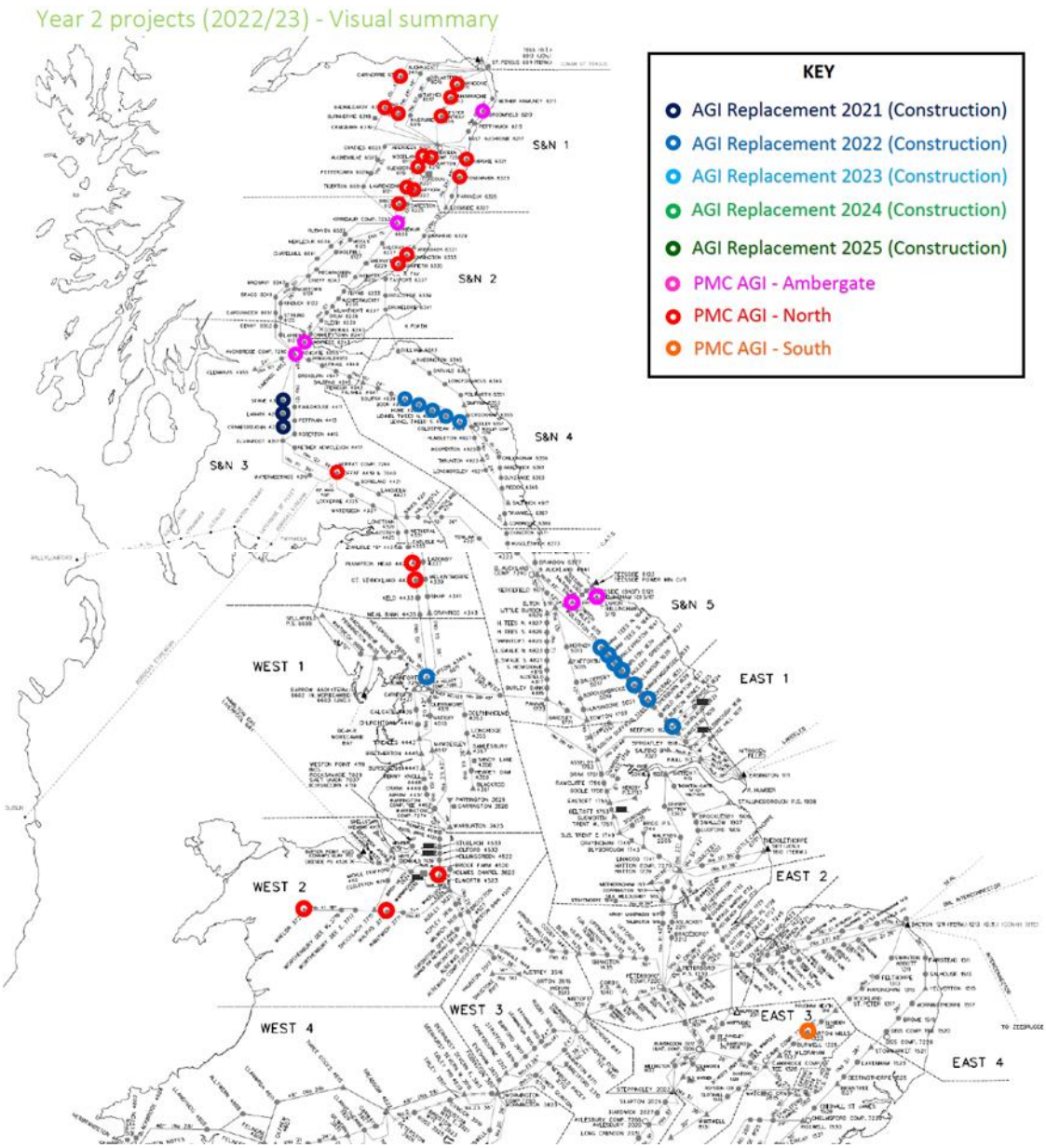


Figure 46 - Year 2 Projects (2022/23) – Visual Summary (Portfolio of Works)

NARC22 Highlights

520. At Lillington BV, we successfully employed a live 'Mothballing' technique to address high-risk defects, avoiding the need for a costly and complex double stopple, bypass, and pipe-through procedure. This involved removing pits across the site, eliminating the bypass downstream for critical valves, dismantling stem extensions and gearboxes, securing vent and sealant lines, conducting steel pipeline inspections (below/above 150mm over 2bar) as required, re-coating and burying redundant assets. Notably, these works were carried out live by our NGS team.

521. The benefits derived from this approach were significant:

- Cost reduction: The mothballing ECC cost was less than £0.5m, a considerable saving compared to the estimated £2.0m-£2.5m for the traditional pipe-through method.
- Reduced outage requirements: By implementing mothballing, the need for feeder outage, stopple, and bypass during the pipe-through process was eliminated.
- Environmental impact reduction: Mothballing eliminated the necessity to vent gas and subsequently reduced the requirement for recompression.
- Resource efficiencies: This leaner activity resulted in fewer supply chain demands and enabled internal delivery by our PMC team, utilising innovative refurbishment techniques.

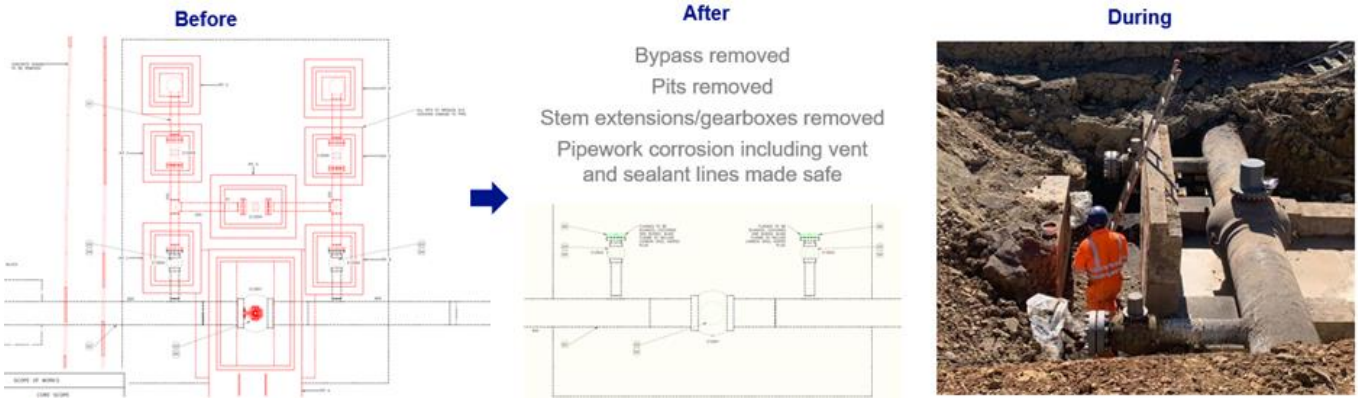


Figure 47 - Lillington BV 'Mothballing' technique – before and after

522. At Laurencekirk, we implemented pipe support innovations and conducted trials to reduce initial capital expenditure costs and future asset health spending. The works carried out included the following:

- Removal of 'duckfeet' concrete blocks and associated pipework, replaced with a single screwjack.
- Replacement of existing mainline concrete supports with galvanized steel blocks.
- Replacement of existing mainline steel supports with smaller galvanized split-steel pipe supports and iRod clips.
- Replacement of existing steel bypass screw-jack pipe supports with galvanized screw-jack pipe supports and iRod clips.
- Replacement of existing steel bypass low-level pipe supports with galvanized split-steel low-level pipe supports and iRod.

523. These works have yielded several benefits, including:

- Cost reduction: Galvanised steel can be ordered in bulk, resulting in cost savings compared to the expense of concrete pouring and curing. The installation process is quicker, further reducing labour and material costs.
- Faster and safer construction: The use of galvanised steel eliminates the need for concrete curing time, allowing for faster and safer construction. The smaller size of the components also reduces manual handling and lifting requirements.
- Increased whole-life cost: Galvanised steel has a longer lifespan than concrete and can be reused, resulting in reduced maintenance and replacement costs over the asset's lifetime.
- Reduced future corrosion spend: The incorporation of iRod clips instead of Neoprene rubber helps extend the life of pipework by eliminating metal-to-metal contact and water-trapping, reducing corrosion and subsequent spending in future asset health programmes.
- Reduced environmental impact: Concrete production generates significant CO^2 emissions and can have adverse effects on the environment, including soil erosion and water pollution. By minimising concrete usage, we are actively reducing our environmental footprint.
- Improved maintainability: The split steel design allows for easy dismantling, facilitating jetwashing and visual inspections of the pipework underneath the supports.
- Increased resource efficiencies: By implementing these innovations, we have streamlined activities, reducing resource and supply chain requirements. Eliminating the need for concrete curing reduces indirect project costs while enhancing the long-term structural integrity of the assets.

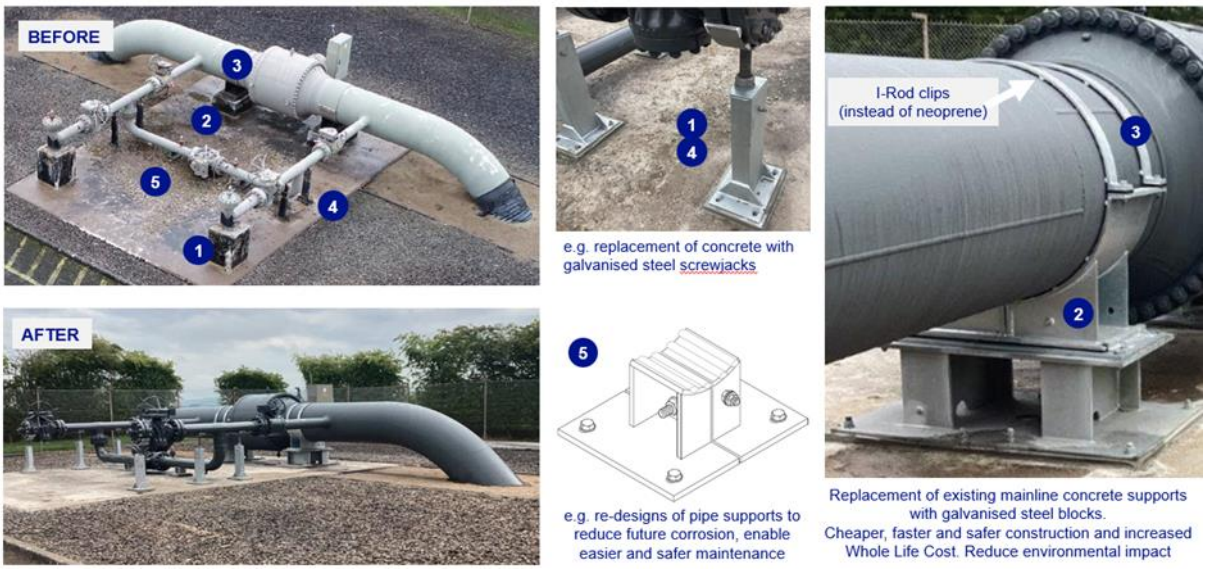


Figure 48 – Laurencekirk before and after implementation of pipe support innovations

524. We have successfully addressed the challenges at the Honiton Block Valve site by constructing a new valve chamber. Located along Feeder 14 (500NB) pipeline in Honiton, Devon, the previous arrangement presented several issues that needed to be resolved:

- Limited access: The existing 3no. pits did not provide adequate access for valve maintenance.
- Lack of vent and sealant lines: The mainline 01 valve lacked vent and sealant lines.
- Flanges on the pipeline side: Flanges were present on the pipeline side of the 100NB and 25NB vent valves.
- Removal of existing chambers: The removal of existing chambers had to be carried out while the pipework remained live, posing additional challenges.
- Potential corrosion: There was a risk of corrosion at the pit wall transitions.

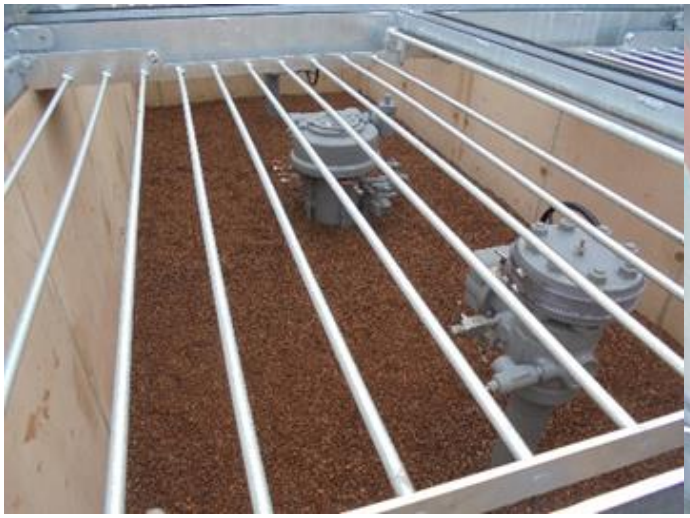
525. To address these issues, we completed comprehensive works during the feeder outage, which included the following:

- Chamber design: A new chamber ensured safe access for valve maintenance and optimal operation.
- Pit wall transitions: The pit wall transitions were removed, eliminating the potential for corrosion.
- New lids: we designed new lids with a focus on ease of access and compliance with security requirements.

526. By undertaking these works, we have improved the safety, accessibility, and functionality of the valve chamber at the Honiton BV site, ensuring the efficient operation and maintenance of the valves within the network.

Figures 49 and 50 - Valves Refurbs Honiton – Pre-Construction


Figures 51 and 52 - Valves Refurbs Honiton – During Construction

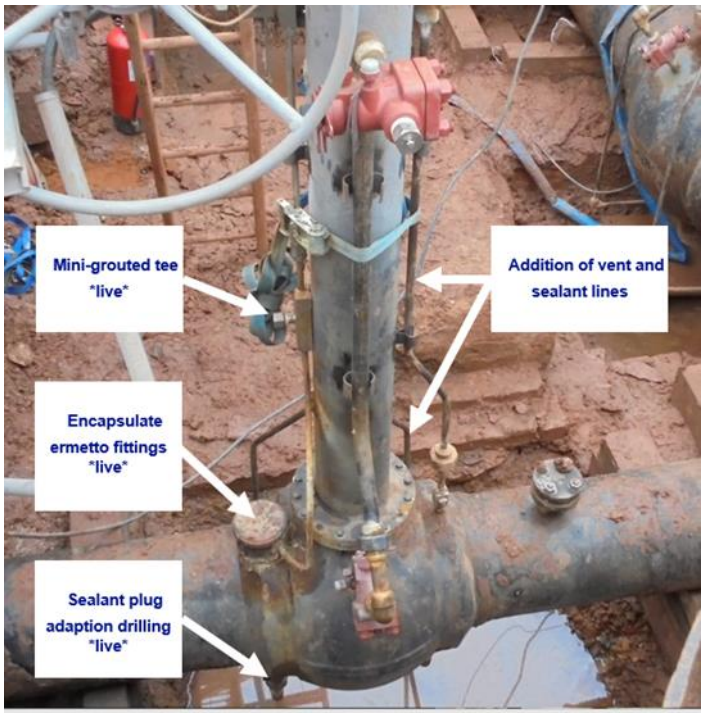



Figures 53 and 54 - Valves Refurbs Honiton – Completed/After

527. At the Aylesbeare site, we successfully completed valve refurbishments using innovative techniques carried out by NGS. The goal was to extend the life of the valve and avoid a complex outage on an offtake. The refurbishment works included the following:

- Adding sealant lines: In instances where sealant lines were missing, NGS performed live drilling on the valve to add the necessary lines. This ensured proper sealing and facilitated ongoing maintenance.
- 'Mini-grouted tee' and encapsulation: To enable sealant injection and ensure future maintenance, NGS implemented a 'mini-grouted tee' technique and encapsulated existing lines. This approach provided improved functionality and increased the lifespan of the valve.
- P11 inspections and repairs: As part of the refurbishment process, pits were removed, and thorough P11 inspections were carried out on the pipework. We promptly addressed any necessary repairs.
- Prevention of crevice corrosion: To mitigate the risk of future crevice corrosion at pit wall transitions, the pits were backfilled after inspections and repairs were completed.

528. Through these valve refurbishments at Aylesbeare, we have not only extended the life of the valve but also improved its performance and reduced the need for extensive outages. These efforts demonstrate our commitment to maintaining the integrity and reliability of our assets.



Figures 55 and 56 - Valves Refurbs – Aylesbeare During Construction

Figure 57 - Valves Refurbs – Aylesbeare Completion

Charlestown

529. At the Charlestown site, we successfully completed a valve and spool replacement project using Grouted Ts, following a similar approach to the works carried out at Aylesbeare. However, unlike the Aylesbeare project, no pits were removed as part of this undertaking since the valves were buried. In addition to the replacement works, we also conducted refurbishment activities on the stem seals to address any existing defects. These comprehensive efforts were undertaken to enhance the performance and integrity of the valves, ensuring the ongoing reliability and safety of our operations.

Figures 58 and 59 - Valve and spool replacement at Charlestown

Future NARC Development

530. Through the execution of NARC23 and our forward-looking strategies, we remain committed to maintaining the integrity, reliability, and safety of our assets while efficiently utilising resources to deliver value to our stakeholders and customers.

531. The NARC23 asset health portfolio encompasses a comprehensive range of works within the Valves, Plant and Equipment, and Structural Integrity themes, aligning with our proactive intervention programme outlined in the RIIO-T2 business plan. Through thorough site surveys and careful risk-based prioritisation, we have selected and planned interventions that address the specific needs and challenges of each asset.

532. Building on the successful implementation of NARC22, the NARC23 site projects have been meticulously developed throughout the 2022/23 period. These projects are being executed either internally or through external MWCs, with considerations given to the size and scope of the works. We are actively exploring additional campaigns to enhance the efficiency and effectiveness of our asset health interventions.

533. The sites identified for delivery in the upcoming 2023/24 period primarily focus on the Valves, Plant and Equipment, and Structural Integrity themes. These selections have been guided by

our Enterprise Asset Management (EAM) system, considering factors such as the current Inline Inspection (ILI) programme and the allocation of RIIO-T2 funding. This strategic alignment allows us to optimise recompression requirements and facilitate necessary works, such as those mandated by the Pressure Systems Safety Regulations (PSSR).

534. Our dedicated AGI team, with invaluable support from NGS depots and external contractors, conducted comprehensive surveys of the selected sites. These surveys involved various investigations, including valve assessments, Insulation Joint (IJ) inspections, 3D point cloud scanning, and feasibility analyses. The thoroughness of these surveys ensures accurate data collection and informed decision-making for the subsequent intervention activities.

535. As part of our continuous improvement efforts, we have also initiated discussions on developing survey and intervention strategies for future NARC developments, extending our planning horizon to NARC25. This forward-thinking approach aims to provide enhanced clarity and a more comprehensive, condition-based intervention plan for the long term.

Further Developments in NARC23-25

536. The application of i-rod technology to small bore pipework and vent and sealant lines has demonstrated significant benefits in reducing the need for future P/20 inspections and the replacement of vent and sealant lines. This innovative approach enhances the long-term integrity of the infrastructure, reduces maintenance requirements, and optimises operational efficiency.

537. To achieve procurement savings and cost reductions, we have implemented a separate civils sanction to identify opportunities for bulk pipe support replacements. This strategic approach enables us to leverage greater procurement advantages by placing bulk material orders, as opposed to ad hoc replacements aligned solely with NARC sites. By streamlining our procurement process, we can optimise cost efficiencies and enhance overall project delivery.

538. As part of our ongoing efforts to explore alternative materials, we are actively investigating the use of Glass Reinforced Plastic (GRP) pipe supports. Previously, stress considerations for different pipework restricted the adoption of GRP supports. However, advancements in technology and material properties now present an opportunity for us to evaluate the viability of GRP supports, which could offer improved durability, reduced maintenance requirements, and potential cost savings.

539. Our continuous pursuit of innovative solutions has led to the development of alternative isolation techniques, such as the Remote Techno Plug and BISEP tools. These techniques are particularly valuable in situations where traditional stoppling methods are impractical or where the use of these new tools proves to be more efficient. By expanding our toolkit of isolation options, we can optimise project execution, enhance safety, and improve overall project outcomes.

Asset Health – Compressor

540. The compressor machinery, comprising the gas generator, power turbine, and centrifugal compressor, plays a critical role in our gas turbine-driven compressor units. In 2022/23, we focused on several key investments related to these components.

Gas Generator

541. There are five different types of gas generator making up the fleet currently in operation across the National Transmission System. In addition, we hold spare gas generators to provide resilience to the operational units. There are 66 gas generators plus 10 spares of five different types making up the National Transmission System fleet. The gas generators are a combination of light industrial and aero-derivative gas turbines and are monitored and maintained routinely through a series of work and management procedures carried out by our operational field force. Gas generators provide heated and pressurized exhaust gas that drives the power turbine which then drives the compressor.

542. Gas generator major maintenance interventions are typically carried out every 25,000 consumed hours, unless the annual borescope inspection determines that condition has deteriorated to a point that early intervention is required. In 2022/23, we completed two gas generator overhauls out of 15 volumes in the Final Determinations plan, two further gas generator overhauls were initiated to be completed in 2023/24.

543. The Baker Hughes LM2500+ DLE fleet has experienced low utilisation, resulting in good condition of the installed engines. We have repaired and stored one engine using the compressor breakdown budget, and currently another spare engine is being overhauled and will be completed in 2023/24.

544. The Solar Titan DLE fleet has experienced a significant increase in utilisation over the past few years. These units play a critical role in supporting gas flows from the Milford Haven LNG terminals. In 2022/23, an overhaul project commenced for one Solar Titan unit at Churchover, and it is on track to be completed in 2023.

545. Within the SGT400 DLE fleet, the gas generators and associated assets at Avonbridge 1B and 2B are currently in a state of mothball. One unit will be overhauled at Nether Kellet in 2023/24, and the spare SGT400 DLE engine has commenced overhaul, which is scheduled to complete in 2024/25. The long lead time is due to supply chain issues for critical gas generator components.

546. Most of the SGT A-20 (Rolls-Royce Avon) fleet is in good condition following the overhaul of seven engines in the last three years of RIIO-T1, with two additional engines overhauled in 2021. Overhauls were completed for the engines at King's Lynn (Unit B) and Wisbech (Unit B) in 2022/23 while the engine at Wormington A is scheduled for overhaul in 2023. There is one additional Avon at Huntingdon unit B which is approaching the overhaul interval and damage has been discovered on two Avons at Peterborough.

547. No work was carried out on the SGT-A35 (Rolls-Royce RB211) gas generators due to all scheduled work in RIIO-2 being completed in 202122.

Power Turbine

548. Within the national fleet operating across the NTS, there are eight different types of power turbines. Additionally, we maintain spare power turbines to ensure operational resilience. Power turbines play a crucial role in converting the hot, pressurised exhaust gases from the gas generator into the torque needed to drive the compressor. Maintenance and overhaul requirements for power turbines, like other components of the machine train, are influenced by factors such as run hours, number of starts, and installed time.

549. During 2022/23, one EAS1 power turbine was overhauled at Kirriemuir A, with another overhaul planned for King's Lynn B in Summer 2023 which was deferred from 2022 due to component lead times. An ERB1 PT was also overhauled at Wisbech B in 2022.

Centrifugal Gas Compressors

550. Compressors are integral to the transportation of natural gas through the NTS. Each compressor is driven by either a dedicated high-voltage (HV) electric motor or a gas generator and power turbine. All NTS compressors are of the centrifugal type, predominantly single-stage but occasionally two or three stage where higher pressure ratios are required.

551. During 2022/23, work was completed on Nether Kellet unit A and Nether Kellet B compressors that failed in 2019 and 2020.

552. There was a dry gas seal failure on the compressor at Aberdeen unit A in 2021. This has now been replaced in 2022. The dry gas seal was proactively replaced on St Fergus unit 3A due to a trend of increasing Nitrogen consumption which would have resulted in an unplanned outage if left untreated.

Electric Variable Speed Drive Compressors

553. The electric compressor systems are equipped with high-voltage supplies, typically at 132 kV, 33 kV, or 11 kV. Frequency converters, known as variable speed drives, are powered through dedicated converter transformers, supplying variable frequency and speed to the high-voltage motor. Harmonic filters are often used to ensure compliance with electricity distribution network operator (DNO) connection agreement terms and conditions.

554. The national fleet includes two types of high-voltage motors operating on the National Gas Transmission System. These systems consist of either a six-phase Ex p synchronous motor coupled to a centrifugal compressor (as discussed above) or a motor in pipeline compressor (MAN MOPICO) configuration. MAN MOPICO units feature an integrated pipeline-mounted induction motor connected to compressor units at either end, utilising magnetic bearings.

555. The high voltage motor at Churchover was rewound and overhauled in 2022/23 to replace failed resistive temperature detectors (RTDs) on the motor stator which are required for DSEAR (Ex) compliance.

556. The high voltage motor for Lockerley Unit B was overhauled in 2022/23 following failure due to an earth fault on the motor stator. A comprehensive level 3 overhaul was undertaken on the entire MAN MOPICO unit as part of the repair process.

Asset Health - Cab Infrastructure

557. In RIIO-T2, our plan is to refurbish 30 Cabs across the National Transmission System and extend the life by 30 years, unless the unit is in the decommissioning plan for RIIO-T2 or RIIO-T3, in which case only safety and operationally critical work is carried out. The refurb addresses compliance issues specific to gas turbine compressor cabs and resolving plant status items related to asset health. To achieve this, we have developed Investment drivers as outlined below.

HSE Publication PM84

558. The HSE guidance note, known as PM84, along with the more recent BS ISO 21789 standard, addresses the risks associated with gas turbine enclosures. While most compressor cabs were constructed before the publication of these standards, the following scoped elements have been identified as measures to reduce risks: refurbishment of Cab Exhaust System, Air Intake System, Cab Ventilation System and Cab Structure (including Gas Detection).

Fire Suppression Systems

559. Fire suppression is the final element of the fire and gas system designed to protect the asset in the event of a fire. However, due to the age, condition, and design of some of our systems, they are no longer adequate and require investment to enhance their integrity.

Emission Sample Lines

560. Upgrades to emission sample lines are driven by Environmental Agency Legislation requirements for homogenous emissions sampling of gas turbines, ensuring compliance with the IED. These upgrades are necessary to achieve compliance and eliminate any non-compliance issues.

561. The following Cab Infrastructure works have been completed in 2022/23:

- Alrewas Units A, B and C - Minor refurb on the cab infrastructure. Door seals have been replaced. Corrosion and seal gaps between the inner and outer Cabs have been resolved. The corners of the Exhaust have been refurbished/reinforced to prevent future cracking of the square section of the exhaust ducting. Uncertified flexible hoses have been replaced at Alrewas A and B for compliance reasons. Pumps, spray heads and bottles have also been replaced due to failures and now being obsolete with no spares available.

- Hatton A - The Exhaust and the expansion joint have been replaced. Combustion Air Intake filter house has been re-painted to remove surface corrosion. The anti-ice dampers, door seals, roof ladder platform, vent fan junction box, corroded louvres and gas detectors have all been replaced. The roof has been repaired to prevent water ingress. Dehumidification system and roller shutter door have been installed to provide a supply of warm dry air through the gas turbine when not in operation to prevent moisture related damage. Uncertified flexible hoses, tubing, solenoids, and spray heads were replaced at Hatton for compliance reasons. Backdraft dampers and fire dampers were also replaced.

- Wormington Units A - Door seals were replaced, and any traces of corrosion on the compressor cabs were repainted with necessary remediation. The cab ventilation system was also addressed to maintain a cab temperature below 55°C. A similar intervention was to be carried out on Unit B, this was shifted to year four of RIIO-T2 due to outage complications.

- Cambridge A, B - Remedial works have been implemented on existing Exhaust Stack to address cracks within Flanges and implement corrosion treatment to enhance the asset life.

- Diss Units A, B and C - Traces of corrosion on the Compressor Cabs were addressed through repainting and remediation of any holes. The Cab roof membrane was relayed to prevent leaks, and expansion joint on the Exhaust was replaced to ensure leak prevention.

562. These comprehensive initiatives in Cab Infrastructure demonstrate our commitment to ensuring the safety and compliance of our gas turbine compressor cabs. By addressing compliance issues outlined in HSE publications and investing in fire suppression systems and emission sample line upgrades, we are actively enhancing the integrity and reliability of our cab infrastructure assets. These works not only contribute to the safety of our operations but also ensure compliance with environmental regulations, resulting in a robust and reliable gas transmission network.

Asset Health – Pipelines

563. The pipeline asset health programme delivers investment on the pipeline assets on the NTS that connect AGIs and terminals, aiming to maintain and improve their condition. Improving the lifespan of the current network is critical to maintaining low costs to consumers, as replacement of part of the network would entail extreme expense and a significant disruption to the UK economic. Throughout the programme, several techniques which measure degradation, integrity and mechanical characteristics are implemented together with any remediation regimes which could help in maintaining a safe, operational pipeline. These techniques are listed below:

- Pressure Systems Safety Regulations (PSSR) In Line Inspections (ILI): These inspections utilise advanced tools including Pipeline Inspection Gauge (PIG) to assess parameters

such as wall thickness, geometry and ground cover depth. The collected data informs our ILI Digs/Interventions Programme enabling targeted remediations where necessary. Concurrently, compulsory PSSR inspections ensure the integrity of our PIG Traps and other pressure containing vessels on our sites.

- In Line Inspection Digs: Excavations are carried out at specific pipelines locations identified as having features of interest such as corrosion or dents, during ILI inspections. These characteristics are categorised and prioritised with remediation actions undertaken as needed including re-coating or the use of epoxy filled repair sleeves.

- Closed Interval Potential Surveys (CIPS) and Interventions: CIPS surveys evaluate the health and integrity of our Cathodic Protection (CP) systems, which act as a secondary defence against corrosion. Any identified CP defects are carefully analysed, and interventions are applied to ensure compliance with safety regulations and maintain the effectiveness of the CP systems.

- Pipeline Impact Protection: This includes measures such as Reduced Depth of Cover (RDoC), River Crossings and Nitrogen Sleeves. These strategies are implemented in areas where the pipeline is closer to the surface than expected, such as in ditches that have been extensively cleaned or eroded over time. Remediation actions can involve compensations to landowners, installation of proactive measures like ditch boards or gabion cages and reinstatement of cover on riverbanks, or by.

564. Throughout 2022/23, a comprehensive series of inspections and interventions were conducted as part of the asset health programme:

- Pressure Systems Safety Regulations (PSSR) and ILI Runs - During 2022/23 a total number of 43 PSSR inspections have been carried out on PIG Traps, Heat Exchangers and Filters, 33 of which instigated necessary minor refurbishment works. These works were claimed in 2022/23 as work has been fully completed.

- ILI Runs - During 2022/23 National Gas performed a total of 15 in line inspections, covering a total length of 989km compared to 1032km completed in 2021/22. The inspections have been implemented on portions of pipeline which are driven by a risk-based approach, considering pipeline condition, criticality and performance of its corrosion prevention system.

- In Line Inspections (ILI) Digs - ILI Digs: Based on the ILI runs performed in 2020, and the historical defect run rate detailed in the RIIO-T2 Pipeline Engineering Justification Paper (EJP), National Gas projected a total of 54 defects requiring excavation within the 2022 calendar year. SME review of the 2020 ILI results determined the excavation of 45, which have been carried out and deferred six to 2023 (due to wider outage constraints on the NTS) and at the request of the SME, three have been removed from scope as no longer

required. For 2022/23, 45 have been claimed with an additional 12 which have been not claimed in 2021/22.

- Pipeline Impact Protection - Within the impact protection work category, we focused our Year 1 efforts on collating and reviewing asset and defect data (for over 300 identified defects) and carried out engineering feasibility studies and pre-construction surveys. This has supported the work undertaken in Year 2, with a total of 17 sites of reduced depth of cover have been remediated which includes 16 ditch board and one site where the ground level was raised in the field affected. Also, the Standard N2 Sleeve grouting approach has been completed with the standard design for sleeve grouting. River crossings paused as no contractor could be found because of concerns over design from river regulators and the contract type. There will be a new contracting strategy going forward to minimise these issues.

- Closed Interval Potential Surveys (CIPS) Interventions - During year 1, we completed 2,035 km of pre-CIP surveys to gather information about CP defects on the pipelines, some of which will need to be rectified before the CIPS can be fully carried out. This preparatory work enables us to understand the critical defects we need to rectify and any scrub or vegetation that we need to clear to complete CIPS efficiently and enables better landowner-engagement up-front. In 2023/23 approximately 586km of CIPS over 13 sections were claimed and an additional 2500km is expected to be retroactively claimed in 2023/24.

- Closed Interval Potential Surveys (CIPS) Digs - A total of 21 CIPS interventions were claimed, of which seven were completed in 2022/23 with the difference being previously carried out in order to investigate the formerly identified CP and coating defects, where this results in a confined defect resolution. We bundled up some of the ILI and CIPS interventions at the planning stage to ensure cost efficiency. These comprehensive inspections, interventions, and remediation efforts demonstrate our commitment to ensuring the health, safety, and reliability of our pipeline assets. By proactively implementing these techniques, we are able to effectively manage degradation, maintain operational efficiency, and mitigate the risks associated with pipeline infrastructure. This approach not only ensures compliance with regulatory obligations but also safeguards the interests of our customers and stakeholders.

565. Through the application of PSSR inspections and ILI runs, we gather valuable data to inform our decision-making processes and prioritize necessary interventions. This risk-based approach enables us to focus our resources on areas with deteriorating or poor conditions, reducing the potential for asset failures and minimizing operational disruptions. Additionally, our closed interval potential surveys (CIPS) play a crucial role in assessing the integrity of our cathodic protection systems, providing an essential layer of corrosion prevention.

566. Furthermore, our pipeline impact protection measures, including reduced depth of cover, river crossings, and nitrogen sleeves, serve to enhance the structural resilience and protection of

our pipelines. These interventions help prevent potential incidents and environmental impact, while also ensuring compliance with safety regulations.

567. By undertaking these measures, we aim to provide a reliable and safe pipeline network that meets the demands of our customers, maintains supply integrity, and contributes to the long-term sustainability of the energy industry. We remain committed to transparent reporting, effective risk management, and collaboration with regulatory authorities to ensure the continuous improvement of our asset health programme.

Asset Health – Electrical

568. The National Electrical Asset Health Campaign was initiated to review asset condition on a series of sites, agree prioritised condition-based interventions, tender, then deliver the works as a singular programme of works. These works entail differing interventions upon:

- High Voltage and Low Voltage switchgear
- Low voltage distribution systems
- Uninterruptible Power Supply (UPS) systems
- Battery charger systems and associated batteries
- Standby generator systems
- Power transformers
- Lighting systems

569. The tendering exercise and engagement with our framework contractors has necessitated a minor change in approach. We have split the work into two differing site work packages: Compressor Stations and Above Ground Installations (AGIs). The Compressor Station National Electrical Campaign is considerably larger than the AGI campaign, with the former due for contract award early in the next reporting period. The AGI National Electrical Campaign survey is complete but awaiting tender and award later in the next reporting period.

570. During 2022/23 we have been engaged in tendering activities for award of our major electrical asset health project. Market place intelligence and cost information has allowed us to refine our intervention plan. The information gained has also been provided to Strategy Teams to aid in development of RIIO-T3 plans.

571. We forecast that we will deliver less volumes on some interventions whilst delivering greater volumes of other interventions. There are a number of factors influencing this, some associated with costs in the marketplace and others more closely aligned to the technicalities associated with the investment and the outline assumptions on deliverability of work types that we have not previously undertaken on an asset health basis.

572. Cost returns from the contractors involved in the tendering process have been mixed; with some marginally favourable to our unit cost assumptions whilst others considerably more expensive than our original working assumptions.

573. Market place contractor capacity has proven to be problematic in some cases. Where smaller packages of work are considered better delivered by smaller contracting companies, we have been advised by those companies that their order books are at capacity. In addition, we have experienced our own capacity constraints with a number of vacancies in key departments necessary to ensure successful delivery. The UK labour market remains particularly competitive, but we continue to look for skilled electrical engineers to recruit into vacant positions.

574. We intend to risk trade among other Asset Health categories to provide a slightly greater allowance for our electrical programme of works than that awarded in the Final Determination.

575. An example of intervention issues faced has been the requirement to replace switchboards, rather than refurbish them. We had an initial plan to undertake major refurbishment of 10 of these. Upon survey and subsequent tendering discussions, it quickly became apparent that major refurbishment is not a feasible intervention for switchboards that are particularly aged (40-50 years old). The build standards and associated detailed work would entail mobilisation of workforce and equipment at an operational site similar to the panel build capabilities associated with a factory. The estimated cost margin would likely be marginal or negative whilst the project delivery risk (additional issues uncovered, time overruns, etc) would be greater. A decision was therefore made to increase the volume of switchboard replacements. A lesser volume of switchboard major refurbishments will be undertaken at two sites where the age of the failing equipment is far newer (circa 21 years). These will be reviewed at work completion to determine the usefulness of such interventions.

576. Based on the findings of our RIIO-T2 surveys we have re-evaluated our priorities and identified critical interventions that are necessary to ensure the reliability and integrity of our operations. Consequently, the selected electrical interventions are now projected to yield an estimated LTRB output of approximately £2.0m, which is lower than our initial target of approximately £6.0m.

577. Some minor electrical works are being undertaken by Operational teams. These projects tend to be less technically involved and are better suited to delivery by such teams. Examples of these projects include the replacement of battery systems, replacement of light fittings not entailing major civil works, and replacement of component parts of Uninterruptible Power Supply (UPS) systems.

578. In the next reporting year 2023/24 we expect to award the contract for our major electrical project; commence detailed survey and design for required assets. Some works are likely to be undertaken during latter parts of 2023/24 with the major works being forecast for 2024/25 and 2025/26. In addition, we intend to continue to progress minor electrical interventions with Operational teams.

Other Asset Health - Bacton site terminal redevelopment

579. Work in RIIO-T1 to develop strategic options for the future of Bacton terminal identified brownfield redevelopment as the preferred option and this was the basis for our RIIO-T2 business plan submission. Our RIIO-T2 deal requires us to carry out additional assessments and reconsider the options, before returning with a FOSR.

580. The FEED feasibility study during 2021 assumed a date of 2035 for cessation of all supplies through the Bacton UK Continental Shelf (UKCS) incomers, based on the 2020 Future Energy Scenarios (FES) report. As reported last year, the study produced a shortlist of four options. This did not include our previously recommended option of brownfield redevelopment, which the study had identified as unviable. The four shortlisted options had the same scope up to 2035, to maintain and repair existing assets.

581. Following our review of the options, CBA outcome and stakeholder feedback we checked the overall project direction and concluded that we needed to carry out further work before making the final option selection. Following discussion with Ofgem we therefore delayed our FOSR submission date. In July 2022 a revised FOSR submission date of February 2024 was agreed with Ofgem.

582. As all the options were leading us to asset health risk management out to the 2030s, we concluded that we needed to understand this risk in more detail. Over the last year we have carried out detailed remnant life studies, plus surveys to assess the effectiveness of the cathodic protection (CP) system; the reports for these are currently being produced. Excavations are underway at specific locations to confirm whether there is any below ground corrosion. The CP surveys also support the scoping of the baseline Asset Health funded CP Rectification work. To reflect this, costs are split based on an estimate that 45% of the total will be aligned to Terminal Redevelopment funding and the rest to Asset Health, Plant and Equipment funding.

Figures 60 and 61 - Excavations underway at Bacton to facilitate buried pipework inspections

583. Our contingency option, in case the asset condition surveys identify anything of significant concern, is partial greenfield site extension. We have engaged in preliminary application discussions with Norfolk Council, regarding additional land acquisition to the South West and East of our existing Terminal boundary.

584. We have re-engaged our contractor to review their FEED report to reflect the findings from the latest studies and any significant changes in FES. All work is on track for FOSR submission in February 2024 or earlier. The total spend to the end of 2022/23 includes 45% of the CP investigation costs, as mentioned above, and costs incurred in the RIIO-T1 period.

585. From the stakeholder discussions around planning assumptions and use of FES, we concluded that we should seek further detail about future supplies at Bacton. We have worked with the relevant stakeholders to explore whether this information can be broadened, including proposing that non-disclosure agreements be put in place. However, none of these were taken forward by the other parties.

586. As we progress with the Bacton site redevelopment project, we are ensuring that we consider the ongoing developments with hydrogen and the evolving energy landscape. This will ensure that whatever we do at Bacton keeps the range of future energy need opportunities open.

587. During 2022, two needs cases were identified that were not known at the time of the RIIO-T2 submission. The incidences of dust in gas flows via the Interconnector to Europe initiated work to consider the installation of filters on the NTS feeders entering Bacton Terminal. We submitted our EJP for Bacton Terminal Filtration Enhancement in the January 2023 re-opener window for the benefit of the interconnector Fluxys.

588. Assessment of pressure protection systems at Bacton Terminal identified that there is high risk of over-pressurisation from upstream suppliers at three of the incoming pipelines. There is a need to improve the protection systems, reducing the risk so that it is as low as reasonably practicable (ALARP). To remove the risk as soon as possible and to comply with Health and Safety Executive (HSE) requirements a suitable protection system must be in operation by August 2023. To achieve this date, work has already commenced on site prior to any funding request being submitted, representing spend at risk. This has been discussed with Ofgem, who have advised that a cost submission should be made via an Asset Health re-opener window.

589. Throughout all the above activities we have completed a number of stakeholder engagements, primarily one-to-ones with key stakeholders. We have replanned our regular key stakeholder one-to-ones, to join with the Operational meetings led by the SO, so that all plans and issues can be discussed with stakeholders at the same meeting. We have replanned our newsletters to be a minimum of two per year, with higher frequency when there are significant events. We also continue to offer the opportunity for stakeholder site visits. For the Terminal Redevelopment investment, we are proposing to hold an Options Workshop as part of the final option selection process, to brief the stakeholder community on our work to enhance the previous information and seek their views. This will be followed by a Stakeholder Playback Webinar following FOSR submission. We will plan future webinars and workshops for key stages of the project when the selected option timescale has been confirmed.

Other Asset Health – King's Lynn Subsidence

590. On 31st March 2022, we submitted a close-out report for the King's Lynn Subsidence project rather than a full Re-opener requesting further allowances, as investigation and analytical modelling undertaken with baseline allowances had concluded that there is no longer a subsidence driven needs case.

591. This was followed by a Basic PCD report submitted to Ofgem on the 31 July 2022.

592. The final spend was £0.4m against baseline allowances of £1.2m. This means the unspent portion of the baseline allowances is £0.8m.

593. We are currently awaiting the PCD assessment by Ofgem which was to follow the submission of the Basic PCD report.

Other Asset Health – Stopples

594. Stopples, an effective intervention technique enabling intrusive operations while keeping the plant live, have been implemented at Longtown and Lockerbie. These projects commenced in the final stages of the 2022/23 period and are scheduled for completion in the upcoming 2023/24 year. As part of our ongoing efforts, we have also explored alternative isolation methods, including the utilisation of Remote Techno Plug and BISEP tools, which will be

incorporated into projects starting in 2023. These developments and design enhancements reflect our commitment to advancing operational efficiency and ensuring the seamless execution of future interventions

Other Asset Health – GRAID

595. The GRAID robotic platform was designed and built to inspect unpiggable transmission assets during live gas flow conditions and has previously been funded under the NIC and recently the NIA mechanisms. The larger NIC project concluded in November 2018 with a fully working and trialled proof of concept solution.

596. Following that, an additional innovation project was commissioned to both improve the accuracy and quantity of data that the robot could collect from the onboard sensors. The project concluded in 2022 but the team have experienced some challenges using the new acoustic resonance technology on the robot due to the ultra-sensitive sensors picking up background 'noise' from the robot interfering with the received sound waves. This ultimately meant that the pressure of the gas would need to be above 80 bar for the reliability in the data to improve – this pressure is not seen on our above ground installations and so an alternative sensor package is required for the robot.

597. Throughout 2022/23 we have been liaising with interested parties to understand how best to resolve the sensor challenges and how to enable GRAID to become a commercial system for future use. These discussions plan to complete in 2023/24 to enable us to deploy the robotic platform in the final two years of RIIO-T2 once the access points are in place.

598. The parallel activity of designing and building robot access points across the NTS has continued through the period. In November 2022 the GRAID Strategy Paper was approved by the Gas Transmission Investment Committee. The paper summarised the progress to date and importantly sought to confirm the commitment to continue with the construction activities whilst in parallel, work on the robot sensor improvements. The paper also provided an overview of how the NTS sites were prioritised for robot access using a variety of metrics including; consequence of failure, defects, cathodic protection score and overall site age. This has provided a list of 48 possible locations which will need to be further developed, reducing the list to those that can be delivered in RIIO-T2. This is now with Gas Construction who will be delivering the connection locations.

599. In summary, due to the challenges experienced, there was no business spend in 2022/23 on GRAID. We are working with interested parties on the adaptions needed to make the robot ready for inspections and are progressing with our plans to build robot access points.

XII. Non Operational Capital Expenditure (TO and SO)

TO non-operational Capex

600. In 2022/23, our RIIO-T2 Non-Operational Capex (TO) spend is £9.4m (excluding Small tools, equipment, plant and machinery - STEPM), which was £10.6m below 2022/23 allowances of £20.0m.

601. Cumulatively, our spend of £31.9m (or £24.5m excluding a prior year one-off property charge) is £9.5m below allowances of £41.4m.

602. Our spend on IT (TO) programmes continues to track lower that previously forecast and is accountable for the majority of the underspend against Year 2 allowances (£8.6m) as the business has focused more on system planning actions to both determine the best possible solution and to maximise our spend efficiency. This additional planning, in a period of much business change. has had a knock-on impact on the timing of several programmes.

603. Our 2022/23 spend of £2.2m on vehicles and property was £1.8m lower than allowances.

604. However, spend on IT (TO) programmes, together with vehicles and property (excluding one-off costs incurred in 2021/22) are expected to recover across the remaining RIIO-T2 period. Delivery of elements of our RIIO-T2 IT programme are closely interwoven with delivering our separation from National Grid. With the core activity for separation reaching a peak over years 3 and 4 of RIIO-T2, we expect our RIIO-T2 deliverables to similarly gather pace and hence recover to forecast levels. As such, all Non-Operational Capex (TO) spend forecasts remains broadly in line with RIIO-T2 allowances. However, initial feedback from our operational teams regarding the commercial EVs is that the range is poor and cannot be used for more than local operational requirements. Our vehicles are used for longer distances and need to react to potential emergencies, therefore a lot of commercial AFVs currently on the market are not suitable and could pose a substantial risk to operation. We continue to review options in this area.

605. In 2022/23, spend of £0.3m has been applied against our submitted Non-Operational Capex Uncertainty Mechanism. These are the first costs incurred in RIIO-T2 against this allowance category.

606. For RIIO-T1 Non-Operational Capital Expenditure, we have incurred a credit of £3.1m of unfunded costs in 2022/23, partly offsetting a prior year spend of £4.9m. These costs, now cumulatively totalling £1.8m, relate to the implementation of a new ERP system (SAP4 Hana), which is often referred to as MyFinance.

SO non-operational Capex

607. In 2022/23, non-operational SO Capex was £13.0m, which was £12.1m lower than our Year 2 allowances. Cumulatively, our RIIO-T2 spend is £27.9m against allowances of £48.8m.

608. This variance was principally driven by lower spend in IT Capex, with this programme of work progressing at a slower rate than was previously forecast. This progress mirrors that described above in the TO non-operational Capex section, where additional time is being taken by the business as it attempts to both optimise the chosen solutions and indirectly drive efficient spend.

609. Currently our RIIO-T2 SO Capital Expenditure forecast remains in line with allowances. As described above in the TO non-operational Capex section, RIIO-T2 activity is expected to ramp up in parallel with separation delivery gathering pace, hence we expect to close the gap to allowances over the remainder of the period.

610. There were also £2.8m of unfunded costs incurred in 2022/23 for RIIO-T1 Capital Expenditure (SO) projects, all relating to SO Non-Operational Capex RIIO-T1 work for MyFinance. This was in addition to a £1.4m spend in 2021/22, resulting in a cumulative cost of £4.2m for unfunded RIIO-T1.

IT and Telecoms

611. Work on our RIIO-T2 investment plans is now well underway. We have delivered the initial phase of our Data and Insights platform, a platform that will enable us to deliver a comprehensive view of NGT's data across the organisation and to external stakeholders. We have delivered a development instance of the Digital Asset Management solution that will transform our Enterprise Asset Management (EAM) capability, enabling far greater flexibility and agility as the programme is delivered.

612. As NGT's IT estate is refreshed, key drivers being flexibility and extensibility. The future shape and scope of hydrogen's key role in decarbonisation is not yet fully known but all of the solutions that we have delivered in 2022/23, and are designing in 2022/23, have these key drivers in mind to ensure that they can both deliver for NGT and consumers now, and in the future.

<u>Commercial, Regulatory & Markets</u>

613. We have converted a number of services to our new microservices architecture in the Gemini solution as part of our Sustain Plus programme, and these are now moving into testing. The new interfaces and screens being developed for Gemini through Sustain Plus will help to reduce the barriers to entry for new disruptive market players, helping to refresh the competitive tension within the gas market as wholesale prices reduce from their peaks over the last twelve months.

614. We continue to maintain regulatory compliance with UNC, regulatory requirements, and GT Licence through changes to Gemini that unlock value for industry participants, resulting in lower costs for participants, and ultimately consumers. There were several significant changes made last year and we will continue to work with industry via the Transmission Workgroup to manage future changes effectively and with agility in conjunction with the Sustain Plus programme.

Optimised System Operations

615. Within the Gas Control Suite (GCS) we have worked with our stakeholders to understand the current appropriate scope of CNI. Taking an approach that is both ambitious and prudent, we are working to remove data items from CNI data repositories, with their attendant restricted audience and, where possible, move to the Data and Insights platform, helping to unlock the value of that data. Within the GCS, we have also rationalised the application estate and are reducing the number of virtual machines used, enabling us to safely minimise the environmental impact of running the suite. We will be continuing to invest in our core infrastructure as part of our RIIO-T2 commitments.

616. The Safety and Compliance programme is a continuous delivery programme managing improvements to the suite of SO systems, and key changes were made in the power platform space enabling improved analytics and network analysis, improved reporting, and process improvements. These deliverables will continue with iterative enhancements to SNAP (shared network analysis) and service continuity deliverables around the GSO space.

617. The asset base for NGT extends across Great Britain. Ensuring that we can securely communicate with those assets in a timely manner is an absolute requirement for enabling the safe and secure operation of the network. We have successfully delivered a move of services to a new satellite to enable the service to continue as the old one reached its end of life. This was completed without service impact, despite NGT being informed at reasonably short notice that the satellite was failing. We are reaching the final stages of the Request for Proposal (alongside a requested Uncertainty Mechanism re-opener for telemetry) that we have been running for other site connectivity, again ensuring that our solutions are market tested.

Market & Customer Insights

618. Our Customer Relationship management tool is being developed to support rationalisation and automation of TO managed processes and further enhancements and automation of workflows in SO. This will improve our customer self-service capability and provide customers with unified, timely and continuous access to relevant information.

619. This will provide a more transparent and seamless process for users, as well as enhancing the overall digital experience for both our customers and wider stakeholders. So far, we have

implemented changes to automate the CSAT/SSAT survey process and enhanced data quality to provide a robust reporting suite.

620. To further support customers and stakeholders, we have continued our planned investment in New Information Provision this financial year and developed enhancements to support data availability including a new custom download tool, improved data discoverability through user interface and reporting enhancements, and data visibility improvements via the creation of a Gas Transmission data portal, to help our stakeholders use the information that is available. These key enhancements are all due to be completed by July 2023.

Operations Enablement

621. We have successfully delivered the first phase of enhancements to develop our Workforce Management systems with go-live in July 2023. We have also mobilised a further investment to migrate some of our Asset Protection processes to a new platform to improve the information we gather about 3rd parties and the process through which we gather it, ultimately supporting our objective to become more proactive in identifying and managing risks.

622. Within our enterprise resource planning tool, we have kept the system current in order to avoid the build-up of technical debt whilst also simplifying the technical landscape by reducing complexity. Improvements have taken place to financial processes, controls and information used to drive business performance.

623. In our hosting environment we have delivered a unified and secure Azure Platform which has removed shared infrastructure redundancy between cloud environments and improved public cloud security posture from 57% to 71%. We have established a Cloud Finops practice and Cloud Transparency dashboard which will improve resource tagging quality, reduced the time to bill to the business and provided customised dashboards for each business unit. The hosting carbon footprint has been reduced by~110 tonnes/month.

624. In our Local Area Network (LAN) we have carried out works to Wi-Fi, Voice and vSTIG to manage our technical debt and keep systems current.

625. As part of our Wide Area Network refresh, we have upgraded the core vSTIG to meet security and maintain operational performance.

Small tools, equipment, plant and machinery (STEPM)

626. In 2022/23, total STEPM Capex was £2.0m, which was £2.6m lower than our allowances of £4.6m. This variance was largely driven by lower spend in Strategic Spares and in Small Equipment Plant and Machinery, with both programmes continuing to track lower than the expected rate of spend.

627. Our spend in the first two years of RIIO-T2 has totalled £6.1m against allowances of £9.3m, with our currently RIIO-T2 Capital Expenditure forecast remaining in line with allowances.

Non-Operational Property

628. Non-operational property is made up by the core estate excluding any operational sites such as compressor stations etc. Following separation from National Grid, the core estate now includes the dedicated NGT floorplate in National Grid House (NGH, Warwick), the Warrington Archives and a workspace in Victoria, London.

629. In 2022/23, we saw non-operational property expenditure increase from £1.1m in 2021/22 across TO and SO to £1.8m, as we complete work delayed due to the pandemic. We are also seeing workspaces being updated for new ways of working to support a hybrid working model, as well as work to ensure the NGT floorplate at NGH is suitable for a standalone business. Note, costs such as those related to installing security gates at the floorplate entrance would have been incurred by National Grid and would be separate to any T2 allowances.

630. The overall RIIO-T2 total spend in 2022/23 was £1.5m for TO and £0.3m for SO. This includes projects funded directly and indirectly including the EV chargers project. The RIIO-T2 indirect property allowance for GTO and GSO for 2022/23 is £3.1m.

631. The EV chargers project is directly delivered by Gas therefore not part of the indirect RIIO-T2 funding available to property core estate.

Vehicle Fleet

632. This has been another challenging year for the procurement of commercial vehicles to replace our ageing fleet. The vehicle manufacturing industry continues to be impacted by significant delays due to the global shortage of semiconductor microchips, as well as the impact of the Russia/Ukraine conflict on vehicle supply chains.

633. We have managed to procure some vehicles sooner than expected, but they were not operational until after April 2023, therefore are not included on the 2022/23 RRP data tables. This includes 20 Ford Rangers currently being converted, 17 Toyota Hilux and 27 Ford Transits due in 2023/24.

634. This year we have officially received, receipted, and sent into operations four vehicles – two of these are Electric Vehicles (Nissan eNV200) and the other two are Toyota Hilux 4x4s.

635. In 2022/23 we implemented telematics devices into our commercial vehicle fleet (started in October 2022 and ended in March 2023), with the intention of being able to understand how our vehicles are utilised, daily mileage and whereabouts, not just for operational reasons but to analyse the data and see if any vehicles can be moved to Alternatively Fuelled Vehicles (AFVs). We are seeking the help of our Telematics system providers to help identify which vehicles could potentially move across to AFVs in the future.

636. The feedback that we are getting from our operational teams regarding the commercial EVs is that the range is poor and cannot be used for more than local operational requirements. Our vehicles are used for longer distances and need to react to potential emergencies, therefore a lot of commercial AFVs on the market are not suitable and could pose a substantial risk to operation.

637. NGT infrastructure for EV chargers needs to expand into all compressor sites and depots to make EV adoption more feasible and workable for operational requirements. The focus from a commercial fleet perspective for NGT is to procure operationally suitable vehicles to allow us to meet our operational and licence obligations.

638. Due to the delays in vehicle procurement, we have underspent against RIIO-T2 allowances to date, but significant planning has gone into the vehicle replacement programme up until the end of the RIIO-T2 period. To counteract the vehicle manufacturer delays and the urgent requirement to replace ageing vehicles, we are going to order vehicles covering two years of the planned replacements. We will continue to work with vehicle manufacturers to understand lead times for new vehicles and plan our replacement programme around this.

639. We are working with GDNs on Hydrogen Vehicle trials by looking at the best sites or areas to have a Hydrogen refuelling station that will have enough of a demand for the fuel – we can then trial a suitable Hydrogen vehicle once available.

XIII. Other Costs

640. Other Costs includes Cyber IT and OT, Opex and Capex (Table 6.9), Physical Security Opex (Table 5.7) and Capex (Table 6.6). This chapter also reports on Customer Funded Diversions (Table 4.15).

Other Costs TO

641. In 2022/23, our Other Costs (TO) Capex is £58.5m, which was £51.0m below PCD adjusted allowances of £109.5m. This was driven by underspends in Physical Security Resilience (£5.7m), Cyber Resilience IT (£3.1m), Cyber Resilience OT (£39.7m) and Other (£2.5m).

642. Cumulatively for RIIO-T2, our Other Costs (TO) Capex is £90.1m, which is £75.4m below PCD adjusted allowances of £165.5m, driven by underspends in Physical Security Resilience (£9.6m), Cyber Resilience IT (£5.8m), Cyber Resilience OT (£56.9m) and Other (£3.1m).

643. For Other Costs (TO) Opex our spend in 2022/23 was £15.1m, which was £6.4m below Year 2 allowances of £21.5m. This was driven by underspends in Cyber Resilience IT (£2.4m) and Cyber Resilience OT (£4.2m), slightly offset by an overspend in Physical Security Resilience (£0.2m).

644. Cumulatively for RIIO-T2, our Other Costs (TO) Opex is £24.4m, which is £10.3m below allowances of £34.7m, driven by underspends in Physical Security Resilience (£0.6m), Cyber Resilience IT (£4.1m) and Cyber Resilience OT (£5.6m).

645. All variances are a result of additional planning and scoping works on these programmes, which have resulted in a delay to planned early year RIIO-T2 spend. Cyber Security is a key area of spend across RIIO-T2, as we continue to implement our strategy around mitigating cyber threats to critical systems and achieving compliance with the NISD EU Directive. Investment in this area continues to increase from RIIO-T1, however below the expected rate as we continue to focus on proof of concept and scalability. Our latest view also includes an adjusted risk-reduced approach to completing all planned works through the use of multiple outages following lessons learned on completed works to date.

646. PSUP is also a critical programme in RIIO-T2 and additional time has been spent evaluating alternative methodologies with the aim of delivering the most economic and efficient solution across the site portfolio. Lot 1 main site works are progressing well with Lot 2 main site works now in the development stage.

647. Our (TO) Other Costs forecast remains broadly in line with RIIO-T2 allowances.

648. For RIIO-T1 Other Costs Capital Expenditure, we have incurred £1.0m of unfunded costs in 2022/23, and cumulatively a total of £6.8m in RIIO-T2. These costs are primarily related to PSUP RIIO-T1 (£5.3m), with the balance supporting Cyber Resilience (£1.5m).

Other Costs (SO)

649. In 2022/23, our Other Costs (SO) Capex is £0.3m, which was £2.3m below 2022/23 PCD adjusted allowances of £2.5m. This was driven by an underspend on our Cyber Resilience IT programmes.

650. Cumulatively for RIIO-T2, our Other Costs (SO) Capex is £2.0m, which was £8.1m below PCD adjusted allowances of £10.1m, again driven by lower Cyber Resilience spend in 2022/23.

651. Our RIIO-T2 forecast for this programme remains broadly in line with allowances.

652. There were no unfunded costs incurred in 2022/23 for Other Costs (SO).

653. Other Costs (SO) Opex spend was £1.4m, which was £0.6m below allowances of £2m. Cumulatively spend was £3.4m, slightly higher than allowances of £3.3m. This spend all relates to Cyber IT.

Cyber Resilience Information Technology (IT)

654. The overall NGT business cyber strategy is to eliminate, and where not achievable, reduce our cyber risks through pragmatic and timely means.

655. This is the second year of performance reporting for the new category of Cyber IT, noting we have provided ongoing progress updates to the Competent Authority, alongside regular Network and Information Systems Regulations (NIS) advisory sessions.

656. Our Cyber IT PCDs were specified as a common shared function National Grid Group led programme of work at a time when we were organisationally part of the National Grid Group. We have delivered on our Year 2 regulatory commitments, as detailed in our periodic PCD Reports. These reflect the status of progress as reported by NG Group who remain responsible for delivery of these shared function NG Group PCDs on behalf of the affected entities (gas and electricity transmission, System Operator and Transmission Owner entities).

657. The sale of a majority stake in NGT to a consortium of Macquarie Asset Management and British Columbia Investment Management Corporation completed on 31 January 2023. This sale and the associated steps to organisationally separate NGT from the NG Group does not adversely impact delivery of the Cyber IT PCDs and associated risk reduction and CAF compliance; the NG Group security team continues to deliver and report on the Cyber IT PCDs that they are responsible for under a Transitional Service Agreement (TSA) between National Grid plc and the separating NGT entity. This ensures continuity while we stand up our own cyber capability independent of NG Group.

658. In the 2022/23 financial year, Cyber IT expenditure of £3.7m was attributable to NGT, being under the TSA for the second half of the year.

659. Full details of the Cyber IT expenditure for 2022/23 is contained within the January 2023 and July 2023 PCD status reports as submitted on a confidential basis.

Cyber Resilience Operational Technology (OT)

660. The overall NGT cyber strategy is to eliminate, and where not achievable, reduce our operational technology (OT) cyber risks through pragmatic and timely means. This is framed by our objective to comply with the Cyber Assessment Framework (CAF) and align with relevant external standards, in particular IEC 62443.

661. We continue to provide Price Control Deliverable (PCD) reports to Ofgem with granular details on progress alongside our Network and Information System (NIS) advisory sessions and annual NIS self-assessment. These reports provide performance detail on scope, cost, time and quality. Bi-annual Cyber OT PCD reporting will become annual reporting in 2024.

662. In the 2022/23 financial year, £55.8m has been spent on delivering our RIIO-T2 Cyber OT activities.

Physical Security Capex

663. Our network is subject to a multitude of security threats, which are continually evolving and often increasing in sophistication and persistence. The Physical Security Upgrade Programme (PSUP) is a government mandated initiative to enhance physical site security with all works closely evaluated by DESNZ.

664. In 2014, we worked with BEIS (Department for Business, Energy and Industry Strategy - predecessor of DESNZ) and the Centre for Protection of National Infrastructure (CPNI) to identify a number of gas transmission sites as PSUP based on UK Govs' pre-defined criteria.

665. These enhancements were split into three phases. Phase One was completed in March 2018, Phase Two, which included PSUP on 20 sites was completed March 2022. Total spend on project closure in 2022/23 was £0.7m.

<u>Physical Security Capex – New Sites, Phase Three</u>

666. As part of the review of sites in 2014, nine shared sites were classified as requiring PSUP solutions to be delivered in RIIO-T2. In this case shared sites are sites owned by third parties that contain assets owned by NGT.

667. All of these sites contain NGT owned assets of significant footprint that drive the requirement to upgrade to DESNZ and CPNI standards.

668. In RIIO-T2, NGT elected to undertake the role of Principle Designer (PD) under the Construction Design Management Regulations (CDM) 2015.

669. This has been done to ensure that we are in control of survey and design output, ensuring it meets the required specifications set out by DESNZ. This has also resulted in cost efficiencies.

670. Total spend on Phase Three in 2022/23 was £8.1m compared to a spend of £1.2m in 2021/22. All sites are Baseline Funded and are linked to a PCD output. Spend was later than the planned allowance phasing to ensure that a comprehensive design and tender package could be produced to provide scope clarity and greater cost certainty.

671. Costs up to March 2023 were £9.2m against a forecast of £8.8m. Total costs for Lot One are £8.0m and £1.3m for Lot Two.

Phase Three Lot One

672. The first four sites are now in delivery and are 70% complete with construction completion scheduled for July 2023.

673. Efficiencies have been made by bringing the CDM design role in-house, competitive tender through our Physical Security and Design Services Framework with further savings being made through advanced procurement of long lead items and design.

674. In 2022 it was envisaged that the fencing on these four sites could be re-utilised and enhanced by retrofitting a modification to the palisade fence line coupled with installation of security services around the existing site infrastructure. This innovative approach has been successful and has reduced the overall construction costs and minimised demolition requirements.

Figure 62 - Innovative fence retrofit fence upgrade solution at Barrington AGI

Figure 63 - New security tower and cabinet at Barrington AGI

Figure 64 - Installation of control cabinet pre-built off site to reduce on-site working time

Phase Three Lot Two

675. There are five sites currently going through the process of detailed design with construction starting in January 2024 and completion phased through-out July and August 2024.

676. All works will be competitively tendered and awarded in November 2023.

677. With these sites it is not viable to incorporate the same retrofitting modifications due to the specification required however the design is making considerations for alternative technologies and fence line design to reduce overall costs without impacting security capability. This is through straightening the fence perimeter line to reduce the quantity of cameras required and the use of thermal imaging cameras to mitigate the need for additional perimeter detection technology.

678. In some instances, we are considering in the design, the use of cam-post technology where appropriate to remove the need for installation of concrete bases and towers. This is primarily to avoid areas where there is exposure to manually released gas, which will reduce overall costs but is not suitable for all security camera positions.

Physical Security Capex – Asset Refresh

679. The Asset Refresh Programme is targeting the upgrade of both Technology and Hardware assets at legacy Integrated Security Solution (ISS) sites. This programme of works is delivering upgrades to key items and equipment to ensure continued compliance with DESNZ and CPNI standards as well as ensuring that the optimum solution is installed now that technology systems may have improved.

680. The programme consists of delivering upgrade works across 37 gas transmission sites, however two of those sites have been separated into a major asset health upgrade project due to the size and complexity of these sites. Therefore, the total main Asset Refresh programme consists of 35 sites.

681. In addition to the upgrade of Technology and Hardware, there is also a requirement to replace obsolete software to maintain communications with the Security Control Centre (SCC).

682. We have completed conceptual designs for the 35 sites and are currently progressing through a competitive tender process for the most efficient delivery. Works are to be split across multiple lots geographically on a detailed design and build basis.

683. Where possible we are pursuing opportunities to bundle Asset Refresh and Cyber OT works, to deliver cost and operational efficiencies.

684. Advanced procurement of long lead items has also provided benefit with significant cost savings, as has an innovation to move to a single server technology from a multi-server configuration.

685. Significant challenges to this programme of works include supply chain capability to deliver the volume of works required and the increase in costs we have experienced. We had envisaged that there may have been an opportunity to make cost savings by delivering elements of works in-house, however in many cases this is not feasible due to the scale and complexity of the works required.

686. With the requirement to remove obsolete software and move to a new system, this has resulted in a requirement to consider upgrading additional technologies that are no longer compatible but are essential to ensure compliance to DESNZ and CPNI specifications.

687. In 2022/23, we have spent £1.2m for advanced procurement and conceptual design with the programme now in delivery.

Physical Security Capex – Major asset health upgrades

688. The major asset health upgrades are also being executed as part of the asset refresh works, albeit via a separate investment sanction. These works are centred on upgrading elements of the security systems at two terminals.

689. Works delivery is being split out by supply chain resource and by utilising our in-house delivery teams.

690. Work to upgrade the perimeter fence technology at one site is complete and upgrades to hardware at the other site is also complete.

691. The remaining works to Technology, Hardware and Physical Security such as vehicle and pedestrian gates across both sites is now to be delivered by our Physical Security framework suppliers.

692. There is a works overlap opportunity, where NGT Physical Security and Cyber OT are also delivering works which are being combined for optimal efficiency.

693. Spend in 2022/23 is £0.3m compared to no spend in 2021/22

Physical Security Opex

694. The intent of the Enhanced Physical Site Security solution is to deter, delay, detect and gather evidence of unauthorised access to our sites. This not only dictates the type of equipment installed as part of the solution, but also our management of the assets through their asset life.

695. Enhanced Physical Site Security service and support services commence at the point of operational completion of the Enhanced Physical Site Security solution. At National Gas Transmission Sites these services are provided by the National Grid Security Control Centre.

696. The Physical Security estate operational expenditure is split between ‘fixed’ and ‘variable’ charges billed to sites currently supported by the UK Security Control Centre. UK Physical Security ‘fixed’ charges consist of non time sheeting staff, central procurement costs, and the maintenance for shared assets (e.g. the security assets in the physical SCC).

697. The second part of the UKPS Opex budget is the ‘variable’. This is the work that is completed, hardware procured and services delivered to a specific site.

698. Our expenditure for 2022/23 was £6.2m compared to an Ofgem allowance of £5.9m. Our updated forecast for the five years is unchanged, as the nine total ISS sites are forecast for this period.

Customer Funded Diversions

699. We can be required to divert sections of our pipeline network due to Integrity issues with the pipeline or requests from third parties.

700. Diversions requested by third parties enter the process via our plant protection team. Early engagement on these schemes is important since it may be possible for third parties to avoid the requirement or minimise the extent of any diversion. Our pipeline design and construction specialists work closely with the plant protection team to ensure we understand the needs of customers and explain options to them as early as possible ideally at the scheme feasibility stage.

701. Under the agreements we have with landowners for our pipelines there may be existing liabilities or obligations such as 'lift and shift' or 'loss of development' clauses which may require that we fund costs associated with a pipeline diversion or compensate for loss of development. For major infrastructure development, typically road and rail, requests to divert are covered by legislation which requires that statutory undertakers such as NGT are compensated.

702. During 2022/23 we completed two diversions for HS2, these being TX26 (Pipe Ridware) and TX28 (Great Haywood) both diversions are F21 in the Staffordshire area. In addition, we advanced the development of customer diversions which are due to take place over the next four years. The coordination of pipeline outages for proposed diversions feeds into the wider network planning systems to ensure workload across the Network is deliverable whilst still meeting security of supply obligations.

<u>High Speed Two (HS2)</u>

703. We have been working with HS2 since 2012. The final diversions for HS2 Phase 1 were completed during summer 2020, we continue to work with the HS2 team to complete land related activities prior to internal closure for this phase.

704. For HS2 Phase 2A, between Birmingham and Crewe, eight diversions are required. Three of these diversions were completed in 2022, two planned in 2023 and three in 2024, in line with the HS2 project requirements.

705. The five diversions planned, two for 2023 and three in 2024 have been stopped and deferred for a minimum of two years by HS2 as part of their wider cost deferment as instructed on them by the Government. It's expected, subject to confirmation, that the remaining Phase 2A diversions will reconvene post April 2025.

706. We will complete TX35 diversion which was planned for a 2022 completion but due to unforeseen ground conditions will be completed in 2023. This project is not part of the Phase 2A deferment.

Figure 65 - TX35 launch shaft excavation works as of May 2023.

707. The Phase 2B diversions and the deferred Phase 2A diversions are expected to take place between 2025 and 2030.

National Highways – Lower Thames Crossing (LTC)

708. Two significant pipeline diversions are required to enable the Lower Thames Crossing scheme in a congested area for highway and utilities infrastructure. During 2022/23, work has continued in completion of the Detailed Design, supporting the Highways Scheme development consent order (DCO) and wider multi utility programme to ensuring that the National Gas Diversions are deliverable within the wider Lower Thames Crossing Scheme and all dependencies are clear. The Diversions are expected to take place during 2024/25.

A47 National Highways, North Tuddenham to Easton Improvements.

709. We are going out to tender for a MWC who will deliver the diversion of Feeder 3. It's anticipated the diversion works will start in late summer and be completed in April 2024. A change in design driven by the Contract Partners has caused us some delay in starting this project but we are still aligned to the overall Highways delivery programme.

A164 East Riding of Yorkshire Council

710. We are now on site with our MWC who are progressing with site establishment, access and setting out activities. The anticipated forecasted completion off the diversion is 29 September 2023, this aligns to the Councils programme of works for the A164. Diverting F29 is via an open cut method.

Figure 66 - Showing site establishing and ground works for A164 Diversion

Brentwood Retail Diversion

711. Detail design for the diversion of a section of feeder 18, between Stapleford Tawney and Horndon near Brentwood, is concluding. The detail design for this diversion started in July 2022 and has taken longer than anticipated due a lack of development design maturity by the Customer. The targeted timescale to complete the diversion had been October 2023 and as such a MWC tendering process was started earlier this year. However, the Customer has experienced delays in obtaining necessary planning consents for the development and a late discovery that sections of a Thames Water sewer pipelines are to be crossed by the diverted gas pipe need to be replaced prior to the gas pipe diversion, have put the targeted dates at risk. We are in communication with the customer to understand the status of site readiness and will revise the program accordingly to deliver the committed diversion which is likely to be in 2024.

A66 National Highways duelling system

712. There are ongoing DCO issues for National Highways that are delaying the scheme start, we are continuing finalising detailed design and tender preparations to engage the supply chain. It is anticipated that works will be done during 2024 but this is subject to National Highways overcoming their current DCO difficulties.

National Highways A358

713. The A358 improvement scheme contacted us in 2017. The preferred road scheme has now been agreed, we've engaged with the Highways team to complete design for the required diversion.

714. The proposed new road crosses two NTS feeder pipes, known as Feeder 14 and Feeder 20, and our initial assessments showed that both of the feeders needed to be diverted. Following these initial assessments, a feasibility study took place to plan the various diversion routes, and options for both of the feeders were evaluated between May and July 2022.

715. Therefore, a new Quantitative Risk Assessment (QRA) for the section of pipework and associated concrete sleeve was conducted in November 2022 which showed that the pipe was safely able to remain untouched despite the proposed work.

716. Following the QRA output, it was agreed with National Highways that only Feeder 14 needed a diversion and as such the design for feeder 14 only is to be progressed further. A conceptual design for feeder 14 was concluded in January 2023. Procurement of Detail Design services for feeder 14 diversion is currently underway. The timescale for required diversion remains 2026, although the customer has indicated to expect potential slippage.

Diversion Development – Other

717. Three proposed Diversions for Cheshire East Councils A500 widening scheme, proposed West Winch Housing Access Road (WWHAR) are making steady progress with plans being put in place for works over future years.

718. We are working on a new customer portal that will enhance the users experience by providing quicker estimates to diversions, standard design templates, improved communication between customer and us. This development is in the build stage and should be ready for acceptance testing later in the year for roll out during 2023/24.

XIV. Network Operating Costs (Direct Opex)

TO Direct Opex

719. In 2022/23, Total Direct Opex costs were £36.7m, £0.5m above allowances of £36.2m. PSUP Opex is being covered in Other costs in XIII Other Costs section. The breakdown of costs is as follows:

- Planned maintenance represents £19.8m of the total cost, which was £6.3m below allowances of £26.1m
- Unplanned Maintenance (Faults) were £8.1m, £3m above allowances of £5.1m
- Therefore, the net maintenance costs were £3.3m below allowances
- Operational Property costs were £8.8m, £3.8m above allowances of £5m.

720. Cumulatively Direct Opex costs were £72.8m, £0.2m above allowances of £72.6m. Planned Maintenance related to £42.2m of cumulative spend, £10.1m below allowances and Unplanned Maintenance was £14.7m, £4.5m above allowances. Operational Property costs were cumulatively £15.8m, £5.7m above allowances.

721. Reduced Planned Maintenance costs were driven by a broad mix of factors including the following:

- Increased capitalisation of labour costs due to greater involvement from Gas Operations in delivery of the capital programme
- Capitalisation of costs associated with Marker Post replacements
- Continued labour cost savings through reduction in agency staff costs across Operations, plus control and governance around both overtime usage and operating within headcount mandates
- Procurement efficiencies year on year, improved cross-team working, insourcing where possible and a focus on productivity (through increased work order completion and utilisation on project work) have also contributed to savings
- Improved cost visibility (via focused reporting on key cost lines) has also contributed to Opex savings, providing actionable insights over cost allocations and timesheet compliance
- Costs associated with planned inspections will also be influenced by the grade/level of the technicians they were conducted by, and how intrusive the required inspections were (e.g. visual or functional inspection). These metrics are currently not quantifiable.
- Planned maintenance costs have reduced year-on-year by £2.6m driven by the above factors, with increased capitalisation of labour costs being the predominant factor.

722. Savings on Planned Maintenance were offset by increased Fault Maintenance costs:

- The higher fault costs were primarily driven by an increase in DSEAR defects and higher than expected levels of unplanned Line-walking.

- High levels of Valve related defects were also resolved, having identified issues following the standard 1-2 yearly checks on these assets. This was further influenced by resolution of a backlog of defects built up since Covid-19 disruptions
- To safe-guard assets against prior year's winter resilience risks and network criticality requirements, additional expenditure was incurred for strategic spares and non-routine maintenance to mitigate breakdown risks
- These factors have also contributed to higher year-on-year Fault related costs (£1.5m increase)

723. Operational Property costs were £3.8m above allowances, driven by significant year-on-year increases in Utility costs (own use electricity costs for the day to day running of the network).

- The increases in unit costs have been significantly above the average rate of inflation
- Winter rates increased year-on-year by 84% on average (Oct 22-Mar-23), with a 54% increase on average for the Spring/Summer period (Apr 22-Sep 22)
- Electricity usage has not increased substantially versus prior years, with the increase in cost against allowances (and year-on-year) attributable to the high energy prices experienced throughout 2022/23.
- The cost of electricity is expected to reduce within 2023/24 vs 2022/23, however, this is contingent on increased stability in the global market

SO Direct Opex

724. Total SO direct controllable Opex costs for 2022/23 were £22.8m (£24.7m in 2021/22), which is £6.8m lower than the RIIO-T2 allowance of £29.6m. This has been driven by new ways of working and ensuring the GSO is ran efficiently, operating headcount mandates and relying on permanent staff rather than agency heads. There has been a number of vacancies across the teams during 2022/23 resulting in further savings against allowances. It also reflects lower Market subscription costs and Xoserve costs.

725. When compared to 2021/22, 2022/23 spend was £2m lower largely reflecting lower Market subscriptions (£0.9m) and Xoserve costs (£0.4m). More detail can be found in the table narrative for 5.4 and 5.5.

726. Spend in the RIIO-T2 period now totals £47.5m compared to a cumulative allowance of £58.9m.

XV. Indirect Opex

727. In 2022/23, total Indirect Opex Costs (across TO and SO for Business Support, Closely Associated and Quarry and Loss) were £85.0m, compared to a total allowance of £94.1m.

728. The majority of this saving (£7m of the £9.1m) is driven by Business Support Opex costs across TO and SO. Following separation, NGT have stood up new business support teams for Finance, HR etc. As a result, there have been a number of vacancies throughout the year whilst these teams are recruited for. Whilst vacancies are being filled, 2022/23 was favourably impacted by reduced costs over the year. The new teams are being set up in a way to drive efficiencies and are correctly sized for the new organisation.

729. Cumulatively total Indirect Opex Costs were £167.1m against allowances of £187.5m.

TO Business Support Opex

730. TO Business Support costs were £27.3m for 2022/23 which is £4.2m lower than the allowances. Cumulative spend was £56.4m compared to allowances of £63.4m. Standalone NGT functions were established at the start of the financial year with a large number of vacancies, providing savings against allowances. The new support function teams are being set up with an efficient operating model, ensuring they are right sized for a standalone gas business. The move away from National Grid has also resulted in lower group allocations (although these continued until legal separation). One function where we have seen an increase in costs is IT, driven by the new TSA contracts in place between NGT and National Grid.

731. When compared to the previous year costs are £1.9m lower, reflecting lower CEO costs (£2.2m), Property costs (£1.6m), Procurements costs (£1.2m), Finance costs (£1m), partly offset by higher IT costs (£4.8m). For more details please see table narrative for 5.1 and 5.5.

SO Business Support Opex

732. SO Business Support costs were £18.3m for 2022/23 which is £2.9m lower than the allowances. Cumulative spend was £35.7m compared to allowances of £42.9m. Standalone NGT functions were established at the start of the financial year with a large number of vacancies, providing savings against allowances. The new support function teams are being set up with an efficient operating model, ensuring they are right sized for a standalone gas business. The move away from National Grid has also resulted in lower group allocations (although these continued until legal separation). One function where we have seen an increase in costs is IT, driven by the new TSA contracts in place between NGT and National Grid.

733. When compared to 2021/22 costs were £1m higher reflecting a £3.8m increase in IT costs, largely offset by lower Property costs (£1.2m), CEO costs (£1.1m) and Finance costs (£0.5m). For more details please see table narratives for 5.2 and 5.5.

TO Closely Associated Indirect Opex

734. TO Closely Associated costs were £26.2m for 2022/23, which is £1.4m lower than allowances. For the RIIO-T2 period spend so far is £48m, £5.6m lower than allowances. Year-on-year increases in costs (£4.3m) related to vehicle costs (fuel and lease costs) and operational training have slowed down variances to allowances, and whilst vacancies are being filled, 2022/23 was favourably impacted by reduced costs over the year.

SO Closely Associated Indirect Opex

735. SO Closely Associated costs were £6.4m, which is lower than allowances of £8.9m. This is largely due to lower CNI spend in 2022/23 (£3.0m). Cumulatively spend is £15.6m compared to allowances of £17.9m. When compared to 2021/22 spend was £2.8m lower largely due to IT costs. For more details please see table narrative for 5.2 and 5.5.

Quarry and Loss

736. Quarry and Loss costs were £3.8m for 2022/23 which is £2.5m higher than allowances of £1.3m, largely due to the increase in Drainage claims. Year-on-year volumes of drainage claims have moved from 200 in 2021/22 to 266 in 2022/23.

737. The additional sites and costs were down to two factors, the increased workload from the FM28 jobs (South West drainage works and compensation) and the backlog we are still working through from Covid. This also accounts for the increase in cost and we have pushed to get as many jobs through to completion. Therefore Phase 1, 2 and 3 works have been completed on many of these jobs.

738. There were no major provision releases or increases in 2022/23.

Appendix I – Totex Table

Totex Summary

TO/SO	TIM	Cost Cap	Cost Cost Area	Cap/Op	Cost Cat	Unit	2018/19 prices RIIO-T2 2022	2023	2024	2025	2026	
Transmission Owner												
Actual / Forecast Totex												
TO	TIM	Act/Fi net	Cost	Load Related	Capex		£m	7.5	10.9	21.4	57.0	2.3
TO	TIM	Act/Fi net	Cost	Non-load related	Capex	Compressor emissions	£m	16.8	26.5	27.1	57.3	32.1
TO	TIM	Act/Fi net	Cost	Non-load related	Capex	Asset Health	£m	44.9	65.5	91.8	121.9	127.0
TO	TIM	Act/Fi net	Cost	Non-load related	Capex	Other Non-load	£m	43.5	46.4	22.8	53.7	36.7
TO	TIM	Act/Fi net	Cost	Non-operational capex	Capex		£m	31.4	8.6	16.5	14.0	24.0
TO	TIM	Act/Fi net	Cost	Other	Capex		£m	31.7	59.6	79.6	56.5	13.4
TO	TIM	Act/Fi net	Cost	Indirect	Opex		£m	59.6	69.1	69.2	62.0	60.1
TO	TIM	Act/Fi net	Cost	Network operating costs	Opex		£m	41.2	42.8	57.5	48.3	32.7
						Total		**276.6**	**329.3**	**385.8**	**470.7**	**328.4**
TO	Non-T	Act/Fi net	Cost	Non-TIM Totex Memo		Total	£m	26.2	57.7	-	-	- *NOTE: Non-TIM memo line added as per RIGs log item 250*
Allowances												
TO	TIM	Allwn net	Cost	Load Related	Capex		£m 18/19	2.0	2.9	2.4	2.0	1.7
TO	TIM	Allwn net	Cost	Non-load related	Capex	Compressor emissions	£m 18/19	12.2	34.7	59.7	20.6	1.1
TO	TIM	Allwn net	Cost	Non-load related	Capex	Asset Health	£m 18/19	80.6	105.7	104.2	65.2	77.8
TO	TIM	Allwn net	Cost	Non-load related	Capex	Other Non-load	£m 18/19	19.2	28.6	24.7	21.3	20.4
TO	TIM	Allwn net	Cost	Non-operational capex	Capex		£m 18/19	26.1	24.6	22.0	20.0	18.9
TO	TIM	Allwn net	Cost	Other	Capex		£m 18/19	56.7	109.5	99.8	3.2	1.9
TO	TIM	Allwn net	Cost	Indirect	Opex		£m 18/19	62.6	63.8	62.2	54.1	52.2
TO	TIM	Allwn net	Cost	Network operating costs	Opex		£m 18/19	42.4	42.1	42.0	43.7	40.2
						Total		**301.6**	**412.0**	**416.9**	**230.1**	**214.2**
Performance vs Allowance												
TO	TIM	variar net	Cost	Load Related	Capex		£m 18/19	5.5	7.9	19.0	55.0	0.7
TO	TIM	variar net	Cost	Non-load related	Capex	Compressor emissions	£m 18/19	4.6	- 8.2	- 32.6	36.7	31.1
TO	TIM	variar net	Cost	Non-load related	Capex	Asset Health	£m 18/19	- 35.7	- 40.2	- 12.4	56.7	49.2
TO	TIM	variar net	Cost	Non-load related	Capex	Other Non-load	£m 18/19	24.3	17.7	- 2.0	32.4	16.4
TO	TIM	variar net	Cost	Non-operational capex	Capex	Non-operational capex	£m 18/19	5.3	- 16.0	- 5.6	- 6.0	5.1
TO	TIM	variar net	Cost	Other	Capex		£m 18/19	- 24.9	- 49.9	- 20.2	53.3	11.5
TO	TIM	variar net	Cost	Indirect	Opex		£m 18/19	- 3.1	5.3	7.0	7.9	7.8
TO	TIM	variar net	Cost	Network operating costs	Opex		£m 18/19	- 1.1	0.7	15.5	4.6	- 7.6
						Total		**- 25.0**	**- 82.7**	**- 31.1**	**240.6**	**114.2**
System Operator												
Actual / Forecast Totex												
SO	TIM	Act/Fi net	Cost	Non-operational capex	Capex		£m 18/19	16.2	16.7	31.4	56.3	51.2
SO	TIM	Act/Fi net	Cost	Other	Capex		£m 18/19	1.8	0.3	-	-	-
SO	TIM	Act/Fi net	Cost	Indirect	Opex		£m 18/19	28.7	26.2	23.8	28.8	26.8
SO	TIM	Act/Fi net	Cost	Network operating costs	Opex		£m 18/19	24.7	22.8	21.7	25.8	23.6
						Total		**71.4**	**66.0**	**76.9**	**110.9**	**101.6**
Allowances												
SO	TIM	Allwn net	Cost	Non-operational capex	Capex		£m	23.7	25.1	34.2	26.7	15.7
SO	TIM	Allwn net	Cost	Other	Capex		£m	3.1	5.1	4.2	-	-
SO	TIM	Allwn net	Cost	Indirect	Opex		£m	30.8	30.3	29.7	30.6	30.3
SO	TIM	Allwn net	Cost	Network operating costs	Opex		£m	29.3	29.6	29.4	29.2	28.6
						Total		**86.8**	**90.1**	**97.6**	**86.5**	**74.6**
Performance vs Allowance												
SO	TIM	variar net	Cost	Non-operational capex	Capex		£m	- 7.5	- 8.3	- 2.8	29.6	35.4
SO	TIM	variar net	Cost	Other	Capex		£m	- 1.3	- 4.9	- 4.2	-	-
SO	TIM	variar net	Cost	Indirect	Opex		£m	- 2.0	- 4.1	- 5.9	- 1.9	- 3.4
SO	TIM	variar net	Cost	Network Operating Costs	Opex		£m	- 4.5	- 6.8	- 7.8	- 3.3	- 5.0
						Total		**- 15.4**	**- 24.1**	**- 20.7**	**24.4**	**27.0**

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Appendix II – Published Outputs

739. No output and associated RRP table currently exists for Incremental Capacity. An output will be created upon submission of the WGN (or any other) FIOC uncertainty mechanism reopener.

740. The PARCA termination value for 2022/23 was £0m.

Customer and Stakeholder Satisfaction Scores

Customer and Stakeholder Satisfaction Survey Scores				Actual	Actual	Fcast	Fcast	Fcast
				RIIO-T2				
			Unit	2022	2023	2024	2025	2026
Survey Results								
Customer Satisfaction								
Incentives	Customer Satisfaction Survey Score	CSPt	Score	8.6	8.6	8.5	8.5	8.5
Stakeholder Satisfaction								
Incentives	Stakeholder Satisfaction Survey Score		Score	8.5	8.7	-	-	-

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Gas Constraints

Gas Constraints

	Revenue Streams	Licence Terms	Entry/Exit	Units	Actual 2021/22	Actual 2022/23	Projection 2023/24	Projection 2024/25	Projection 2025/26
Constraint management revenues	Sale of Non-obligated Entry Capacity (incl accelerated release)	RNOEC	Entry	£m	1.9	2.7	-	-	-
	*(RNOEC*0.14)*		Entry	£m	0.3	0.4	-	-	-
	Sale of Non-obligated capacity forming accelerated release	RAREnCA	Entry	£m	-	-	-	-	-
	*(RAREnCA*0.14)*		Entry	£m	-	-	-	-	-
	Locational sell actions	RLOC	Entry	£m	3.3	1.2			
	Physical renomination incentive charges	RLOC	Entry	£m	-	0.0			
	Total RLOC		Entry	£m	3.3	1.2	-	-	-
	Sale of Non-obligated Exit Capacity	RNOExC	Exit	£m	**8.8**	**20.6**	-	-	-
	*(RNOExC*0.14)*		Exit	£m	1.2	2.9	-	-	-
	Any further revenues derived by the licensee that the Authority directs to include	RADD		£m	-	-	-	-	-
	Total CM Revenues (with 14% scaling)			£m	4.9	4.5			

Constraint management costs	**Licence Terms**	**Entry/Exit**	**Units**	Actual 2021/22	Actual 2022/23	Projection 2023/24	Projection 2024/25	Projection 2025/26
Operational buying back of entry capacity	EnCMOpC	Entry	£m	-	-			
Locational buy actions	EnCMOpC	Entry	£m	-	1.2			
Turnup or turndown contracts	EnCMOpC	Entry	£m	-	-			
Total EnCMOpC		Entry	£m	-	1.2	-	-	-
Operational Buying back of exit capacity	ExCMOpC	Exit	£m	-	-			
Offtake flow reductions	ExCMOpC	Exit	£m	-	-			
Total ExCMOpC		Exit	£m	-	-	-	-	-
Total CMOpC			£m	-	1.2			
Total ExBBCNLRA	ExBBCNLRA	Exit	£m	-	-	-	-	-
Investment constraint management costs (entry)	EnCMInvC	Entry	£m	-	-	-	-	-
Investment constraint management (exit)	ExCMInvC	Exit	£m	-	-	-	-	-
Total CMInvC			£m	-	-			
CMOpPM	**CMOpC-ExBBCNLRA-[Total CM Revenues]**		**£m**	- **4.9**	- **3.3**			
		Variation to the Constraint Management target	**CMOpDTt**			-	-	-
Constraint Management incentive revenue (CMIR)	**0.39*(8.5-CMOpPM)-CMInvC**		**£m**	**5.2**	**4.6**			

The Constraint Management Cost Allocation Rules (RIIO-2)
Entry Capacity Constraint Management costs will consist of (a) the costs incurred in respect of any Constraint Management actions taken in relation to Entry Capacity (including those related to capacity management relating to the surrender of Firm Entry Capacity) and (b) the costs incurred in respect of any payments made to gas shippers or DN Operators in exchange for agreeing to offtake gas from the NTS at National Grid's request and in respect of any costs incurred in undertaking any other commercial or physical actions to manage Entry Capacity, including the costs of any locational actions.

Exit Capacity Constraint Management costs will consist of (a) the costs incurred in respect of accepted offtake reduction offers (as defined in the Network Code) and (b) the costs incurred in respect of any Exit Capacity Constraint Management actions taken (including those related to Exit Constraint Management Charges and NTS Exit Capacity surrender charges) (as defined in the Network Code) and in respect of any costs incurred in undertaking any other commercial or physical actions to manage Exit Capacity.

Revenues	Capacities	Derivation of Revenues
For terms RNOECt and RNOExCt, this revenue shall be "derived by the licensee" from sales of the respective non-obligated capacities that feed into the CCM incentive. For the avoidance of doubt, the derivation of these revenues here will take account of applicable storage discounts, but exclude discounts from Shorthaul and charges associated with the Revenue Recovery Charge. The licensee shall record in this pack how the derivation of this revenue has been met in accordance with these principles.	RNOECt	Includes... Excludes...
	RNOExCt	Includes... Excludes...

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