



Gas Transmission

Our Performance: 2021/2022

nationalgrid

National Grid Gas Transmission

Our Performance for 2021/22

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I. Foreword from Jon Butterworth

1. At National Grid Gas Transmission, we are proud to play a crucial role in meeting the country's energy needs. Delivering gas to industries of all shapes and sizes, and heating homes whenever it is needed, 365 days a year.
2. Gas is an integral part of the UK's energy mix. It is gas that helps meet energy demand by underpinning the intermittency of renewable sources like wind and solar – in the depths of winter and height of summer alike. This is what we do today and is what we are going to do for the foreseeable future. Gas in all forms, including the incredibly exciting possibilities provided to us by hydrogen technologies, will be an important component of the energy mix as we move toward Net Zero by 2050.
3. We understand the importance of good stewardship of the country's gas network. We are focused on delivering crucial investments to the network – fulfilling our requirements and going beyond them wherever possible. Our objective is to deliver a reliable, fit for purpose network that maximises efficiency and gives our customers exactly what they need.
4. We don't take our role for granted. We seek to earn our return rather than assume we deserve it. To do that, we need to understand our role in the energy sector – we want to listen and learn from our customers and stakeholders to enable us to continuously improve.
5. But we also know that this is a challenging time for individuals, businesses and society at large. The cost-of-living crisis – and how energy costs are contributing to it – is something at the top of everyone's minds, including ours. That is why we are driven to ensure we deliver value for money with the services and investments we undertake which benefits the whole of Great Britain. Ultimately, we want to minimise our impact on customers' bills, which we are pleased to have been able to achieve in this reporting year.
6. In addition to delivering the needs of today, we are continuing our work in preparing for a network that enables Net Zero through low and zero carbon gases. It is vital that we are in position to make ready the network for such gases as and when needed.
7. We look forward to continuing to work as closely as we do now with our stakeholders and Ofgem, particularly as it relates to the re-opener projects and as we look slightly further ahead to the next price control period. We are already well underway with our planning in this space and will be able to provide more detail in the near future. For now, our focus is on meeting our commitments and ensuring we deliver a reliable and resilient network.

II. Executive Summary for 2021/22

8. 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.
9. The 2021/22 financial year has marked the beginning of the new RIIO-T2 price control period for National Grid. Whilst the overall regulatory framework maintains the same principles as its predecessor, there are a number of additional complexities that regulate our operations of the National Transmission System (NTS). For example, the introduction of the Project Assessment Process to justify major asset health and compressor investments. We have adapted our operations accordingly to these new requirements.

Operational Context

10. From the start of the RIIO-T2 period we have witnessed unprecedented global and economic turbulence, with the ongoing impacts of the Covid-19 pandemic, and more recently, the Ukraine-Russia conflict being felt across the world. This has led to a significant rise in energy prices which is being felt across the industry and society.
11. Post pandemic global gas demand bounce back, coupled with historic low European stocks caused a significant rise in wholesale gas prices to over three times higher than 2020/21 prices. This was exacerbated by the threat of war before Russia invaded in February 2022.
12. These conditions are also creating a number of operational complexities which we continue to meet, such as lower than anticipated demand during Covid-19 lockdown restrictions, atypical flow patterns as we export more gas to the continent to replenish EU Storage and more recently to replace Russian supply. In addition, with Shippers/Suppliers exiting the market primarily during FY22, all these elements have increased our activity in our residual balancing role. Under these difficult operating conditions, we continue to meet the needs of our customers and look for ways we can support the wider gas industry.

Performance Overview

13. Against the challenging backdrop outlined above, we have delivered steady progress against our RIIO-T2 commitments, putting the necessary plans and processes in place to deliver the outputs our customers and stakeholder have told us they value most.
14. We have focused our efforts on further refining our portfolio of works in our three consumer priority areas, ensuring that detailed surveys have been completed that allow us to tender for and package our work in the most efficient way possible.
15. The additional planning and surveying steps that we are taking have meant that physical delivery in year one of the price control has been slower than we would

have liked in some areas. However, this approach allows us to have a clearer understanding of the investment needs which will lead to more efficient outcomes and value for money for our customers and stakeholders.

16. The preparatory works that we have conducted this year will allow us to accelerate delivery in subsequent years, and we are therefore forecasting to deliver our outputs in full across the RIIO-T2 price control.
17. Our RIIO-T2 year one output incentive performance has been positive with achievement of our performance targets in most areas delivering customer and consumer benefits. We have continued to explore different strategies and processes for improving performance in this area which we will embed over the remainder of the RIIO-T2 period.
18. Overall, our Totex spend in 2021/2022 was £364.4m compared to allowances of £395.0m (in 2018/19 prices). Over the RIIO-T2 period we are broadly forecast to spend to allowances.
19. Under the difficult circumstances of high energy prices, we are doing everything that we can to help support our customers. An example of this is with our Transmission charges that came into effect in October 2021, we deferred £45m of revenue to reduce charges for that year and to smooth out charge levels over future years. We also raised a modification proposal that was subsequently implemented to mitigate the revenue volatility related to Transmission charges.
20. Our employees have been shocked and saddened by the recent events in Ukraine and we have felt compelled to offer our support to our counterparts in the Ukrainian energy sector. In March this year, we therefore mobilised a 'Help for Ukraine taskforce', in collaboration with the gas distribution networks (GDNs), Ofgem and BEIS, to coordinate donations of critical materials and equipment required to keep the gas flowing. We hope that our action can help restore some of the infrastructure required to reinstate warmth and power, and we will continue to offer our skills and knowledge however we can.



Figure 1: Assembly of plant and generators at our Ambergate site ready to donate to Ukraine

Consumer Priority Delivery

21. In 2021/22 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](#) summarises our performance against each individual price control deliverable (PCD) and incentive that sit within the consumer priority areas.
22. We were on target with all but one of our outputs that sits within the **meeting the needs of consumer and network user's** priority area. In 2021/22 we continued to build upon the progress we have made in previous years in improving our customer satisfaction rating, achieving a score of 8.63 against a baseline of 7.90. This has increased by 0.46 compared to last year's score of 8.17 and has continued the increase seen over the last five years. Customer feedback highlighted that we continue to communicate more effectively and deliver timely and thorough responses in our engagement.
23. We have also had particular successes in our demand forecasting, maintenance and constraint management incentives, where we have achieved our incentive scheme targets. This performance has helped to drive added value for our customers and stakeholders by providing timely and quality information and avoiding constraints to give our customers access to the network. It is worth noting that we exceeded our linepack incentive scheme target under the residual Balancing incentive scheme, but we did not achieve our targets on the price element of the residual balancing incentive scheme.
24. Achieving this level of performance against the backdrop of increasing market volatility, continues to be a challenge. The current global economic and market conditions, including where Shippers and Suppliers have exited the market, have

created an increased requirement for us to enter the market earlier and more frequently to balance the system. During 2021/22 gas prices increased circa three-fold, and as a result, we have had to take residual balancing actions on 252 days compared to 201 days in 2020/21.

25. This year we have raised a number of modifications to the uniform network code (UNC) to help mitigate the risks to industry of suppliers and shippers exiting the market. The utilisation of one of these modifications has helped to reduce the impact on the market and therefore reduce costs for our customers and consumers. We continue to work with the industry to identify further potential areas of improvement.
26. In 2021/22 we have facilitated the delivery of 100% of gas requirements for customers and made good progress against our outputs related to the **maintaining a safe and reliable network** consumer priority. This includes deliverables associated with our Cyber information technology (IT) and Cyber operational technology (OT) programme of works.
27. For some of our PCDs in this priority area; notably asset health and physical resilience, we have delivered lower volumes of works than anticipated. This has been a strategic decision to focus our efforts on developing our strategies to optimise efficient delivery, looking for opportunities to package works and apply innovative thinking to drive value for our customers and stakeholders.
28. We have progressed with the development of major projects at Bacton and King's Lynn, using the first year of the price control period to refine our options and scope of works for delivery in subsequent RIIO-T2 years. At King's Lynn this process of further analysis has enabled us to determine that the level of subsidence and associated integrity risks were within acceptable tolerances. We submitted our re-opener submission to Ofgem in March 2022 proposing that the PCD had been partially delivered with alternative specification, and that we will return the unused portion of baseline allowances for this project to consumers.
29. We recognise the critical role that National Grid has to play in helping the UK achieve its ambitious environmental targets set out at COP26. In the first year of the new price control we have made positive steps in progressing the outputs that contribute to the consumer priority area of **delivering an environmentally sustainable network**. In 2021/22 we have performed well against baseline targets for our environmental incentives and greenhouse gas emissions (GHG) incentive. Our GHG venting performance has improved by 9% compared to last year, with 2021/22 being the lowest venting year in the last 10 years. This level of performance has been supported by a number of strategies including the compressor inhibiting trial which saved circa 200 tonnes of venting by identifying and temporarily isolating compressor units that were not in use over the summer period.
30. The compressor emissions projects that ensure our assets are compliant with the Industrial Emissions Directive (IED) have all been progressed throughout 2021/22 as part of the agreed Project Assessment Process. For Wormington, King's Lynn,

St Fergus and Peterborough and Huntingdon we have been focussing on developing the Final Options Selection Reports (FOSR) that will outline the solutions for achieving emissions compliance.

31. We also have compressor emissions projects in physical delivery at Peterborough and Huntingdon and Hatton. At Hatton, this year we have received planning permission for installation of a new unit; we have commenced site establishment works; and construction of the new compressor has progressed at our suppliers off site facilities.

Innovation

32. In 2021/22 we have continued to focus on innovation, with a particular emphasis on projects that can facilitate our 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 Gas Transmission 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.
33. This year, we have undertaken 17 new network innovation allowance (NIA) projects and sanctioned a further eight NIA projects. These include a number of Hydrogen related projects such as HyDew which is a desktop study looking at the theoretical impact that different hydrogen blends could have on the hydrocarbon dew point and water dew point within conventional gas mixtures.
34. The projects in delivery provide a good base for the following years in RIIO-T2 with a pipeline that can be accelerated utilising the contractual templates developed and guided by the early project findings.
35. New for RIIO-T2, the strategic innovation fund (SIF) provides us with the opportunity to apply for additional funding for key large-scale transformational research and development activities. This fund is competitive across the energy networks and in 2021/22 National Grid were successful in securing 10 Discovery bids. The 10 successful bids were for what the fund terms 'Discovery Phase' projects and were largely focussed on the projects that support our net zero ambitions.
36. A third innovation funding stream from RIIO-1, the Network Innovation Competition (NIC), awarded Gas Transmission £9.7m in November 2020. The funding was for the construction of an offline hydrogen test facility for hydrogen testing as part of the FutureGrid programme. The facility is being built at RAF Spadeadam from a range of decommissioned assets, to create a representative transmission network capable of running blends of hydrogen up to 100% at NTS pressures.

37. 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.

Net Zero

38. Solving the decarbonisation challenge is one of the biggest challenges of our time and National Grid has a crucial role to play in enabling a clean energy system whilst minimising the cost of this transition to consumers.
39. We are exploring transporting hydrogen as an alternative to natural gas in the National Transmission System (NTS) to decarbonise heat, power, transport, and industry by 2050.
40. Project Union is our flagship project which explores transitioning to a 100% Hydrogen Transmission System. Specifically, by repurposing existing transmission pipelines through a phased approach. A circa 2,000km hydrogen backbone would be created, representing around 25% of the UK's current natural gas transmission pipelines by the early 2030's. The next steps are to undertake feasibility studies to inform the requirements of developing Project Union
41. The new 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. In 2021/2022 we undertook eight new UIOLI projects with six projects being carried forward into 2022/2023.

Financial Performance

42. Overall, our Totex spend in 2021/2022 was £364.4m compared to allowances of £395.0m (in 2018/19 prices). The underspend against allowances is predominantly associated with TO opex, SO capex and opex, offset in part by higher than forecast expenditure against load related capex, non load related capex, TO non-operational capex and other capex.
43. Across RIIO-T2 our like-for-like Totex is planned to be £2,198.3m against an allowance of £2,178.7m. This results in a forecasted spend above allowances of £19.6m. Over the RIIO-T2 period we plan to invest circa £1.35bn of capex across our overall business which will further increase when we agree the final options and costs 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.
44. In relation to our portfolio of reopener uncertainty mechanisms set out in our 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 Cyber costs and decision on the option selection for our Western Gas Network project within our Totex and allowance forecast for this year's RRP.

45. Our Final Determination allowances provided an efficiency challenge of over £150m against our business plan. In order to address this challenge National Grid explored a number of efficiency proposals, whilst ensuring we could deliver our commitments during the price control.
46. A significant proportion of additional efficiencies for National Grid Gas were identified through National Grid Group-wide initiatives such as Project Evolution, which brought centralised functions into individual business units and leveraged benefits from new centralised IT systems invested in during the end of the previous price control and during year one of RIIO-T2.
47. The above efficiencies were combined with a new National Grid Gas operating model, which was designed to ensure delivery of our RIIO-T2 commitments. During 2021/22 we have been carrying additional vacancies with recruitment campaigns underway, but these vacancies have contributed to our performance for year one.
48. We have also been targeting continued improvement in our customer and commerciality approach to ensure further focus on cost consciousness across our management teams. This will help us to meet or exceed budgets and ensure cost recovery processes are optimised. We are also continuing to explore further efficiency opportunities and are looking to implement new and innovative approaches in how we will deliver our asset health, investment and maintenance plans. Examples, include new contracting strategies, bringing activities in house to utilise existing capabilities, and changes to how we scope and deliver our investment projects.
49. The impact of the above group-wide initiatives, organisation changes and customer and commerciality opportunities have started to be seen in our actual costs for 2021/22 and we have included these in our budget for 2022/23 and future forecasts. As we explore further potential efficiencies, we will update our position against the current revised forecast set out in this document.
50. More information about our financial performance for 2021/22 can be found in section X. Totex (TO and SO).

Consumer Bill Benefit

51. Using our indicative calculation, in 2021/22, the portion of the consumer bill attributable to National Grid Gas was approximately £7.30. This is a decrease compared to 2020/21 where the National Grid Gas portion of the domestic consumer gas bill was £7.72. This reduction is driven by changes in the overall gas demand and the level of exit transmission charges.

Key Risks and Looking Ahead

52. There are a number of risks and issues resulting from the continuing conflict in Ukraine which has added further uncertainty to the global gas market. There are impacts both in our operations and more generally in our role. For example, operational challenges include unpredictable summer gas flow patterns that require adjustment to the way that we operate the network to accommodate these evolving conditions. Although we are not immune to these global events, we will manage the impacts as effectively as possible to ensure that we continue to deliver for our customers and ultimately consumers. In order to achieve this, we will continue to work closely with the Department for Business Energy and Industrial Strategy (BEIS) and Ofgem to mitigate potential risks and we have begun discussions to prepare for the forthcoming winter period.
53. In addition, the current high summer flows of gas to Europe is impacting our ability to take outages. This has resulted in a change to the compressors we are utilising and has increased their use as compared to pre current global events. We therefore need to, and have rephased work in order to achieve maintenance schedules that ensure network reliability levels. This needs to be carefully managed and is subject to the uncertainty of future gas supply and demand patterns.
54. In terms of investments, we are beginning to experience extraordinary cost increases due to the combined issues of: pandemic related manufacturing and material shortages, the Ukraine-Russia conflict, energy price increases and reduced availability of suppliers. This is resulting in increased equipment, material and labour costs which were not factored into our original business plan submission to Ofgem. These increases are already being realised on projects in delivery, for example at Hatton there has been cost increases of over 30% on steel piping between November 2021 and June 2022. As these market conditions persist, we are anticipating that this trend will continue and that we will see costs and material shortages impact our projects for the foreseeable future. For example, procuring services, contractors and suppliers are moving away from fixed price contracts to quotations with short acceptance timescales. This is due to the challenges they face in supplying raw materials, in some cases low stock and high demand, which can limit placing orders. We are liaising closely with our suppliers to proactively manage these risks where possible.
55. Part of our role is to purchase gas from the open market for own use gas and electricity and gas that cannot be accounted for. Against the backdrop of such a volatile market it is likely that shrinkage costs will continue to increase in 2022/23, however we will aim to continue to deliver consumer value by mitigating the exposures to high/higher prices.
56. Looking ahead, our key areas of focus for 2022/23 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 Bacton site redevelopment and the Compressor Emissions projects.

57. We will look to ramp-up delivery of investments in key areas such as asset health and develop our extensive portfolio of reopener Uncertainty Mechanism submissions. 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. There are a number of FOSR submissions that we will be progressing for delivery in 2022/23 including Wormington, St Fergus, King's Lynn and Peterborough and Huntingdon.
58. We will continue our work to support the development of regulations that allow for the progression of low carbon and renewable gases with networks. We are proud to support the energy and heating needs of consumers and industry today and are focused on delivering future net zero commitments. We know that success in achieving this ambitious agenda, in a way that works for consumers and stakeholders requires real collaboration and partnership across our industry and with the communities we serve.
59. The regulatory and policy landscape needs to evolve at pace to support the activities needed to drive a timely transition. Over the last 12 months we have seen extensive policy developments to further this ambition, including the publication of the Hydrogen Strategy, Heat and Buildings Strategy, Net Zero Strategy, Industrial Decarbonisation Strategy and the British Energy Security Strategy (BESS)¹. The UK Government has set ambitious targets that demonstrate the aspiration for hydrogen and has signposted future policy decisions. The long-term role of the natural gas network in maintaining critical security of energy supply in both the transition and enduring states must also be recognised, as described in the BESS "gas is currently the glue that holds our electricity system together and it will be an important transition fuel".
60. We are working closely with BEIS, Ofgem and other stakeholders to develop potential short-, medium- and long-term framework options. Timely development of this is critical if the hydrogen and natural gas networks are to fulfil their essential role as the UK transitions to Net Zero.
61. It is also clear from our future of gas engagements that our stakeholders support the development of hydrogen. We've heard from our customers that hydrogen transmission is critical to enable them to deliver their decarbonisation strategies. Therefore, we are working closely with stakeholders right across value chain to develop our plans, ensuring we deliver a programme that will enable lowest cost, least disruption decarbonisation of energy for consumers.
62. On a separate note, in March 2022, National Grid Group announced the acquisition of a 60% equity stake in National Grid Gas Transmission and National Grid

¹ [British Energy Security Strategy](#) published in April 2022

Metering by the consortium comprising Macquarie Asset Management and British Columbia Investment Management Corporation. Subject to regulatory approval, the acquisition is expected to be completed within the next reporting year. This will result in National Grid Gas Transmission becoming a standalone business.

63. 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.

A handwritten signature in black ink, appearing to read 'Jon Butterworth', is centered on the page.

Jon Butterworth (President, National Grid Gas Transmission)

Performance Summary

64. The table below summarises spend and allowances (baseline and uncertainty mechanisms) for 2021/22 and for the five Year RIIO-T2 period.
65. 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	FY22 Totex Spend (£m, 18/19 prices)	FY22 Allowance (£m, 18/19 prices)	Cost vs Allowance (£m, 18/19 prices)	5 Year Totex Forecast (£m, 18/19 prices)	5 Year Allowance (£m, 18/19 prices)	Cost vs Allowance (£m, 18/19 prices)
TO Load Related Capex	7.5	4.4	3.1	83.9	79.0	4.9
TO Non- Load Related Capex	121.6	118.4	3.2	780.9	722.0	58.9
TO Non- Operational Capex	31.4	27.9	3.5	119.1	123.3	(4.2)
TO Other Capex	35.9	33.8	2.1	215.2	204.0	11.1
TO Opex	96.6	119.9	(23.3)	558.7	592.3	(33.6)
TO Totex	293.0	304.4	(11.4)	1757.7	1,720.7	37.1
SO Capex	20.0	26.8	(6.8)	149.1	140.2	8.9
SO Opex	51.4	63.8	(12.4)	291.5	317.8	(26.3)
SO Totex	71.4	90.6	(19.1)	440.6	458.0	(17.5)
Total	364.4	395.0	(30.6)	2198.3	2,178.7	19.6

Table 1 – Summary of 2021/22 and five-year forecast spend and allowances

66. In 2021/22 our Totex spend was £364.4m compared to allowances of £395.0m. The underspend against allowances is predominantly associated with TO opex, SO capex and SO opex, offset in part by higher than forecast expenditure against load related capex, non-load related capex, TO non-operational capex and TO other capex.

67. Over the five-year RIIO-T2 period, Totex is forecast to be broadly in line with allowances at £2.2bn.
68. Totex forecast and allowances include some spend for uncertainty mechanisms. Spend and allowances for Western Gas Network project are included in the table above as the needs case has been approved. The 2021/22 Totex spend for asset health work at the St Fergus terminal is also included, but the allowances not 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 successful would increase the total Totex spend and allowances over the RIIO-2 period to £3.1bn. Further information can be found in RRP table 8.10.
69. A further breakdown of the key variances is detailed below.

TO Totex Overview

70. TO Capital Expenditure for 2021/22 was £196.4m against total allowances of £184.6m. Capital Expenditure for the five-year period is forecast to be £1,199.1m against allowances of £1,128.4m:
71. Load Related Capital Expenditure was £7.5m against allowances of £4.4m in 2021/22. Of this, £2.4m relates to Western Gas Network Upgrade against £2.4m of allowances expected under the relevant Uncertainty Mechanism. There was £4.2m incurred on unfunded projects, principally Felindre VSD project, which accounts for the majority of the forecast overspend versus allowances across RIIO-T2.
72. Non-Load Related Capital Expenditure was £121.6m, £3.2m higher than allowances. This includes £16.4m of expenditure at St Fergus, the subject of a future Uncertainty Mechanism submission for which no allowances have yet been reflected in 2021/22 or in the RIIO-T2 forecast. This results in expenditure of £13.2m below allowances on other Non-Load Related Expenditure. Generally, the lingering effect of COVID-19, higher surveying requirements and recruitment of new personnel have delayed investment in 2021/22, notably in Asset Health schemes. Asset Health spend was below forecast in 2021/22, primarily across Compressors and Pipelines. Bacton Site Redevelopment Feed spend was £5.7m below forecast, driven by the extended review of future strategy, with remaining variances across Stopples, Recompression and GRAID primarily phasing across the RIIO-T2 period. Hatton Emissions spend was £9.2m higher than forecast, which reflects timing of expenditure within the RIIO-T2 period. RIIO-T2 spend remains principally in line with allowances, except for the King's Lynn Subsidence UM where £0.8m of allowances are forecast to be returned and expenditure on RIIO-T1 Non-Load Related Capital Expenditure, principally on Peterborough and Huntingdon compressor works.
73. Non-Operational capex spend was £31.4m in 2021/22, £3.5m above allowances. This includes the purchase of four sites at a cost of £7.4m. In 2021/22, £4.9m of unfunded costs have been incurred, primarily relating to the

implementation of a new Enterprise Resource Planning (“ERP”) system. IT programmes spend was lower than allowances in 2021/22, which reflects additional planning processes being necessary to determine the best and most efficient solution. Expenditure across the RIIO-T2 period is expected to be broadly in line with allowances.

74. TO Other Capex expenditure was £35.9m, £2.1m above allowances. The underspend against allowances across Physical Security Resilience, Cyber Resilience OT and Non-Operational Capex (inc. IT) reflects additional planning processes being necessary to determine the best and most efficient solution, notably in IT programmes. RIIO-T2 forecast spend of £215.2m is £11.1m higher than allowances, primarily reflecting spend carried over from RIIO-T1. In respect of Cyber Resilience OT, spend less than forecast for Years 1-3 UIOLI is expected and as such £32.6m of allowances are expected to be returned.
75. TO opex costs were £96.6m against allowances of £119.9m. Direct opex was £4.1m lower than allowances, with lower maintenance costs driven by reduced use of agency staff and procurement efficiencies, offset by higher fault costs caused by higher than expected levels of Linewalking and costs associated with prolonged severe weather, notably winter storms across Northern England and Scotland. TO Business Support costs and Closely Associated Indirect costs were £4.9m and £5.8m lower than allowances respectively with new ways of working and ensuring all teams are correctly resourced. TO opex is expected to be £33.6m lower than allowances across the RIIO-T2 period, reflecting the ongoing impact of the factors noted above.

SO Totex Overview

76. SO capital expenditure in 2021/22 capex in the SO was £20.0m, was £6.8m lower than allowances. This was primarily driven by IT capex and Cyber Resilience, partly due to additional planning processes being necessary to optimise chosen solutions and drive efficient spend. The RIIO-T2 forecast expenditure is expected to be £8.9m higher than allowance, reflecting RIIO-T1 spend carried over. There has been £1.4m of unfunded costs have been incurred in 2021/22, primarily relating to the implementation of a new ERP system.
77. SO opex costs were £51.4m in 2021/22, £12.4m lower than allowances. This was primarily due to new ways of working and ensuring teams are correctly resourced rather than being reliant on contractors, which positively impacted both direct opex and business support costs. Closely Associated Indirect costs are broadly in line with allowances. SO opex is expected to be £26.3m lower than allowances across the RIIO-T2 period, reflecting the ongoing impact of the factors noted above.

Return on Regulated Equity (RoRE)

78. Return on Regulatory Equity (RoRE) is calculated as part of Regulatory Finance Performance Reporting (RFPR), published in August 2022.

79. At a notional gearing, the combined 2021/22 National Grid Gas TO and SO operational RoRE was 4.76%. This reflects a 1.18% reduction compared to 2020/21, largely driven by the reduced RIIO-T2 Allowed Equity Return. The 2021/22 debt and tax performance reduce the combined RoRE to 2.96%, with financing costs being adversely impacted by the current high levels of inflation.
80. The current forecast result in an operational RIIO-T2 RoRE of 4.86%, predominantly reflecting Totex outperformance (0.11%) and incentive revenue (0.41%), partly offset by BPI (0.19%).

Allowed Revenues TO and SO

81. The Allowed Revenue for NGGT TO in 2021/22 was £981.01m; however, only £938.06m was recovered through charges. Consequently, NGGT TO under-recovered by £42.94m for 2021/22, generating a 'Kt' in 2022/23 Allowed Revenue. The main driver for this under-recovery is the deliberate £45m deferral of TO Entry Revenue from 2021/22 to 2022/23, in an effort to support our customers by smoothing out charge levels over future years.

Revenue Term		(£m 2021/22)
Calculated Revenue (as published)	$R_t^* \times PI_t^* / PI_{2018/19}$	840.45
AIP adjustment term (as published)	ADJ_t^*	0.00
Adjusted revenue (as published)	$ADJR_t^*$	840.45
Legacy Allowed Revenue	LAR_t	19.82
K Correction Factor	K_t	120.73
Allowed Network Revenue	AR_t	981.01
Collected Regulated Network Revenue	RR_t	938.06
(Under) / Over recovery		(42.94)

82. The final Allowed Revenue for NGGT SO in 2021/22 was £198.14m. However, October 2021 charges were based on the May 2021 'Charge Setting' PCFM, with an Allowed Revenue of £204.07m. The Allowed Revenue reduced by £5.93m between the May 2021 PCFM and the November 2021 Published PCFM, due to amendments to 'Kt' and 'LART'.
83. Recovered Revenue for 2021/22 was £205.24m, resulting in an over-recovery in the PCFM of £7.10m against the final Allowed Revenue (£198.14m). However, NGGT SO only over-recovered by £1.17m in comparison to the Allowed Revenue used to set charges (£204.07m), with the total over-recovery of £7.10m primarily driven by the amendments to 'Kt' and 'LART'.

Revenue Term		(£m 2021/22)
Calculated Revenue (as published)	$SOR_t^* \times PI_t^* / PI_{2018/19}$	207.20
AIP adjustment term (as published)	$SOADJ_t^*$	0.00
Adjusted revenue (as published)	$SOADJR_t^*$	207.20
Legacy Allowed Revenue	$SOLAR_t$	(5.58)
K Correction Factor	SOK_t	(3.48)
Allowed Network Revenue	$SOAR_t$	198.14
Collected Regulated Network Revenue	$SORR_t$	205.24
(Under) / Over recovery		7.10

Table 2: Outputs and Incentives Performance

Meeting the needs of consumers and network users				
Our Output	Description	Output Type	2021/22 Target	2021/22 Performance
Customer satisfaction	Undertake annual satisfaction survey with our customers	ODI-F	7.90/10	8.63/10
Stakeholder satisfaction	Undertake annual satisfaction survey with our stakeholders	ODI-R	7.4/10	8.54/10
Quality of Demand Forecast	Deliver accurate day ahead demand forecasting (D-1)	ODI-F	8.98 mcm average forecast error	8.52 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	12.37 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	95% of NG driven customer impacting works aligned with customer outages	95% of NG driven customer impacting works aligned with customer outages
	Minimise National Grid driven changes to maintenance planning	ODI-F	11.67 days change	0 changes initiated by NG
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 and price performance measure (PPM) target	ODI-F	<2.8 mcm average daily change	2.0 mcm average daily change
	Meet residual balancing price performance measure (PPM) target	ODI-F	Difference 1.5% of SAP	Difference 1.8% 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

Maintaining a safe and resilient network				
Our Output	Description	Output Type	2021/22 Target	2021/22 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.	Slower than anticipated ramp up in 2021/22, in aggregate, on track to deliver 5 year output
Cyber resilience OT	Deliver cyber resilience programme related to Cyber Operational Technology	PCD UIOLI	Deliver Year 1 PCD deliverables	Year 1 cyber programme complete
Cyber resilience IT	Deliver cyber resilience programme related to Cyber Information Technology	PCD	Deliver Year 1 PCD deliverables	Year 1 cyber programme complete
Physical resilience	Deliver physical security upgrades at sites designated as Critical National Infrastructure (CNI).	PCD	Deliver PSUP requirements by 2026	Slower progress against year 1 deliverables as we further develop delivery strategy and identify efficiency opportunities. On track for 5 year output
Annual Network Capability Report	Publish annual ANCAR document	LO	Publish report for 2021/22	Published 29th June 2021
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 2021- Jan 2022. Report published Oct 2021
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. Further investigation is needed on the condition of below ground pipework to inform final options selection.
King's Lynn subsidence	Delivery of Re-opener submission	PCD	Delivery date 31/03/2022	Close-out Reopener submission delivered. Subsidence needs case driver no longer valid so no request for major project funding at this time

	Our Output	Description	Output Type	2021/22 Target	2021/22 Performance	
Delivering an environmentally sustainable network	Greenhouse gas emissions (venting)	Meet greenhouse gas emissions venting targets	ODI-F	<2,897 tonnes for 21/22	2,061 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 2021/22	3,506 GWh £205.9m	
	Annual Environmental Report	Publish an Annual Environmental Report	LO	Publish Oct 2022	On track for submission Oct 2022	
	Deliver our Baseline Environmental Incentive targets		Reduce operational transport emissions	ODI-F	12% reduction in operational transport emissions against baseline level of 1748 tCO ₂ e	0.2% increase in operational transport emissions to 1751.25 tCO ₂ e
			Reduce business mileage emissions	ODI-F	3% reduction in business mile emissions against baseline level of 1608 tCO ₂ e	62.3% decrease in business mile emissions to 605.89 tCO ₂ e
			Reduce office and operational waste recycling	ODI-F	52% of office and operational waste recycled	87.4% recycled
			Reduce office waste	ODI-F	3% reduction in office waste against baseline level of 54.6 tonnes	54% decrease in office waste; 28 tonnes recycled
			Reduce office water use	ODI-F	3% reduction in water use against baseline level of 7,380 m ³	76.98% decrease in water use to 1,699 m ³
			Increase the environmental value of non-operational land	ODI-F	1.4% increase in natural capital valuation against baseline level of £32.92m	2.2% increase in natural capital valuation
			Increase the biodiversity net gain on new network projects	ODI-F	N/A	Not triggered in 2021/22
	Redundant assets	Decommission 80 redundant assets/asset sites, five customer sites and four compressors	PCD	Delivery date Mar 2026	5 Redundant Asset outputs have been physically delivered in year 1. 3 outputs are no longer redundant due to an external customer impact All remaining outputs 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 no later than Aug 2022, as agreed with Ofgem. 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 no later than Jan 2023, as agreed with Ofgem. 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 and reopener dates of Jan 2023 and Jun 2025 respectively	
	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 no later than Jan 2023, as agreed with Ofgem. 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/or our five-year output commitment

Amber – Missed annual output but met our five-year output/successful achievement of annual output but missed our five-year output

Green – Successful achievement of an annual output and our five-year output commitment

III. Operational Context

84. As the sole owner and operator of the Gas Transmission network in Great Britain, National Grid 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 2021/2022 is contextualised by the continued evolution of the operational challenges the business has faced during the financial year.
85. During 2021/2022, we have facilitated the delivery of 100% of gas requirements for customers. Achieving this level of performance requires us to continually adapt to the changing use of the network by our customers. These requirements are becoming increasingly influenced by global markets and the continued decarbonisation of the economy. Due to record lows of storage stock levels in Europe, the geopolitical situation developing and a global shortfall of gas, there was a change in how the market was operating, with gas prices increasing three-fold. European gas prices higher than UK gas prices drove a West to East operation of the gas network, with export flows through the European interconnector during the winter period.
86. Coronavirus has had an impact on gas demand in 2021/22, as there have been various lockdown variations between England, Wales and Scotland. New hybrid ways of working have added further complexity and variability to gas demand during this period. Larger impacts on demand are linked to gas prices and the driver to supply European markets/fill EU storage via the interconnectors at Bacton.
87. The most significant impact on the GB gas market from these global events has been the sharp increase in gas prices, with the average System Average Price (SAP) increasing from 45 p/th in 2020/21 to 158 p/th in 2021/22. The SAP prices were on average circa three and a half times the price in 2021/22 compared to the previous year. This price rise follows a prolonged period of price stability and therefore represents a significant change for our consumers.

SAP	2021/22	2020/21	2019/20
	SAP p/th	SAP p/th	SAP p/th
Average	158.0	45.0	29.5
Min	47.0	21.0	18.0
Max	505.5	77.0	43.0

Table 3 - Average SAP from 2019/20 - 2021/2022

88. The increased price was due to a range of global market drivers, including storage stock levels in Europe, uncertainty of Russian gas and availability of gas worldwide. The impact of the increased gas prices has led to some shippers exiting the market, leading to continued growth of linepack swing, which increases the challenges of operating the gas network. Shippers are responsible for balancing

their portfolios which in turn should result in a balanced network where supply matches demand, if those shippers are no longer active then this leads to an imbalance and a higher linepack swing. If the network is imbalanced then National Grid Gas is responsible for balancing by acting as the residual balancer. We continue to operate the network in the most efficient and safest way possible given these additional challenges.

89. The highest daily gas demand seen this year was 367 mcm on the 25 January 2022. This was 88% of the highest demand experienced in 2020/21 (415 mcm). This particular winter was characterised by milder weather suppressing demand and could have been further curtailed by economic drivers due to the high gas prices.
90. In terms of the lowest demand days, five of the bottom 10 demand days featured in the summer of 2021/22. The lowest demand was 104.7 mcm/d on 13 June, compared to 121.8 mcm/d in 2020/21. This is the lowest demand we have seen in the past 10 years.
91. Supply into the UK remained diverse, although there was a reduction in UKCS which was balanced by increased Norwegian flows and LNG. The number of LNG cargoes received into the UK increased from 153 in 2020/21 up to 167 in 2021/22. Although a large number of cargoes have been delivered, concerns remain regarding LNG heading towards Asia (China, Japan and South Korea) and the subsequent impact this will have on driving up market prices in the UK and Europe.
92. Although overall supplies have been similar to 2020/21, it has been a challenging year operationally to meet customers' requirements, due to the variability in the day-to-day operation of the network. In particular, exports were seen at Bacton during Winter 2021/22, which typically are not seen during this time of the year. This has resulted in a change in the way we operate and has put an emphasis on West to East transmission and the assets required to manage that direction of flow. This has been driven primarily by geopolitical events, the price differential between UK and mainland Europe and policies implemented by European countries to maintain minimal stock levels ahead of winter 2022/23. The price differential, based on the day ahead prices, peaked at 69.1 p/th versus ZEE2 and 55.6 p/th versus TTF3 with European prices being higher than NBP in both instances.
93. In addition, within day profiling remains an ongoing issue impacting system operability, due to the NTS and associated contractual rules being designed for flat supply and demand profiles. The differential between supply and demand balance across the day results in linepack swing. High linepack swings stress the system and require significant system operation to ensure sufficient pressures are maintained to keep continuous flow of gas to demands. In 2021/22, the average linepack swing was the highest in the past 20 years and the maximum linepack

² The Zeebrugge Hub (ZEE) is the natural gas physical trading point in Zeebrugge, Belgium

³ The Title Transfer Facility (TTF) is a virtual trading point for natural gas in the Netherlands

swing of 41.15 mcm on 29 November 2021 was a record. Although this was higher than the 1 March 2018 (previous record which occurred during the 'Beast from the East' weather event), which saw a linepack swing of 39.2 mcm, it was not as operationally challenging in comparison due to different operational conditions, such as opening linepack, minimal linepack position and demand.

94. Not only did 2021/22 have a record high linepack swing on a single day but also on average, the highest linepack swing during both winter and summer months. Linepack swing is a function of supply and demand flow variations within the gas day, which can be driven by a number of factors including outages, demand changes such as the effect of wind on power or market prices. In 2021/22, as well as greater global market uncertainty impacting Shipper flows, we have seen higher gas prices leading to disruption in the Shipper and Supplier market. Both factors have further impacted linepack. Figure 2 shows average daily linepack swing since 2001/02 with increase in linepack swing both over summer and winter periods.

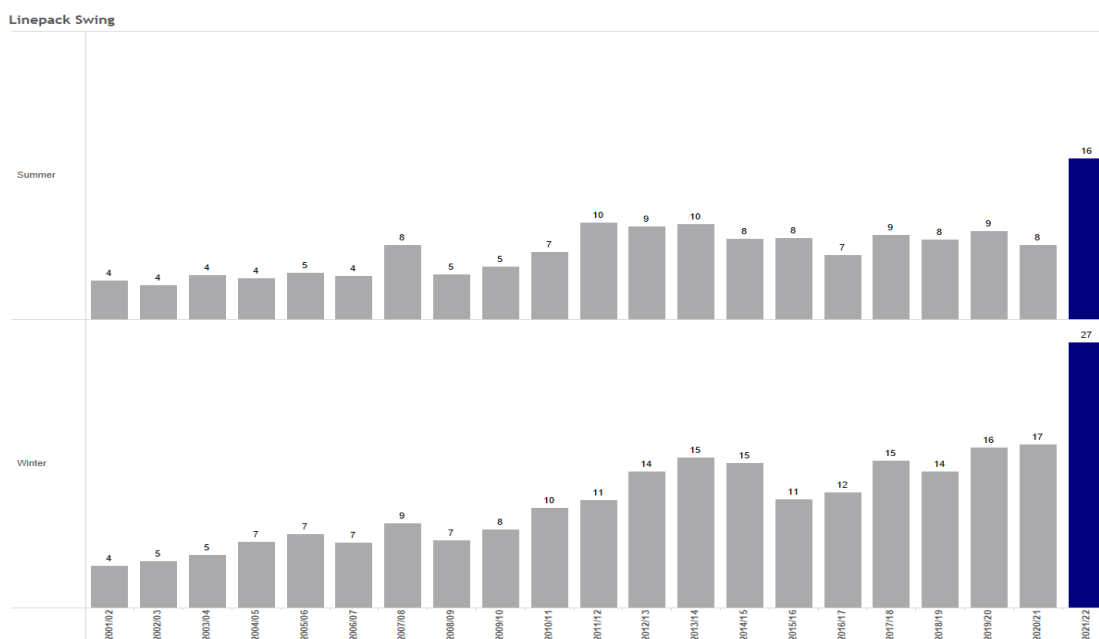


Figure 2: Chart showing average daily linepack swing since 2001/02

IV. Consumer Priorities

95. Through the development of our RII0-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 an environmentally sustainable network
96. These priority areas focus on the delivery of outcomes that our customers and stakeholders have told us that they value the 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 and have been used in our assessment of our 2021/22 performance.
97. We have continued to implement a number of 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 2021/22 performance against these key outputs is outlined further below.

V. Meeting the needs of consumers and network users

98. 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.
99. 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. Our commitment to customer and stakeholder satisfaction has been recognised with improvements in satisfaction scores in both of these areas. Customer feedback highlighted that we continue to communicate more effectively and deliver timely and thorough responses in our engagement.
100. In summary we have met our outputs in this area, with the exception of not meeting the residual balancing price performance measure (PPM) target. This is discussed further in the 'Residual Balancing' section below. Meeting the needs of consumers and network users outputs not discussed in the below section are covered in XII. Non Load Related Capital Expenditure.

Digitalisation Strategy and Action Plan

101. 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.
102. In 2007 we launched our data sharing platform and since then we have continued to work with stakeholders to expand the data sets available, which now include publication of data in near real-time and other timeframes.
103. 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 the Department for Business, Energy and Industrial Strategy (BEIS), 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've rebuilt our core National Grid Gas Transmission (NGGT) data sharing platform (MIPI) and its front end to provide clearer visuals and easier to use Application Programming Interface (API) feeds for direct access to data, as well as proactively publishing new data.
 - We've laid solid Data Management foundations: adopting best practices, training data practitioners, and creating data catalogues
 - We've consolidated our key asset management systems and datasets, providing a unified understanding of our assets health and condition.
 - We've adapted our organisational structure, bringing together data experts from across the business to establish a dedicated Data Team, a multidisciplinary team which supports our agile product model and value stream delivery, a centre of excellence for all things data and a driving force in our delivery of digital transformation.
104. In order to ensure we fully consider the needs of the subset of our stakeholders that are active users of our data, we have developed a number of data user personas. We have broken our Digitalisation Strategy down into four focus areas. Our organisational structure is aligned to these focus areas, allowing us to maximise the efficiency with which we deliver the components of the strategy.
105. Examples of the types of work we have delivered within the 2021/22 reporting year include publishing new data sets using the Data Decision Making Approach and Industry Data Triage processes in line with customer business case e.g. near real time physical National Transmission Linepack to compliment the supply and demand.
106. In 2021, we have used feedback from customers and stakeholders to develop and publish new data sets using the Data Decision Making Approach and Industry Data Triage processes. This includes publication of the near real time physical National Transmission Linepack to compliment the supply and demand data that is already published

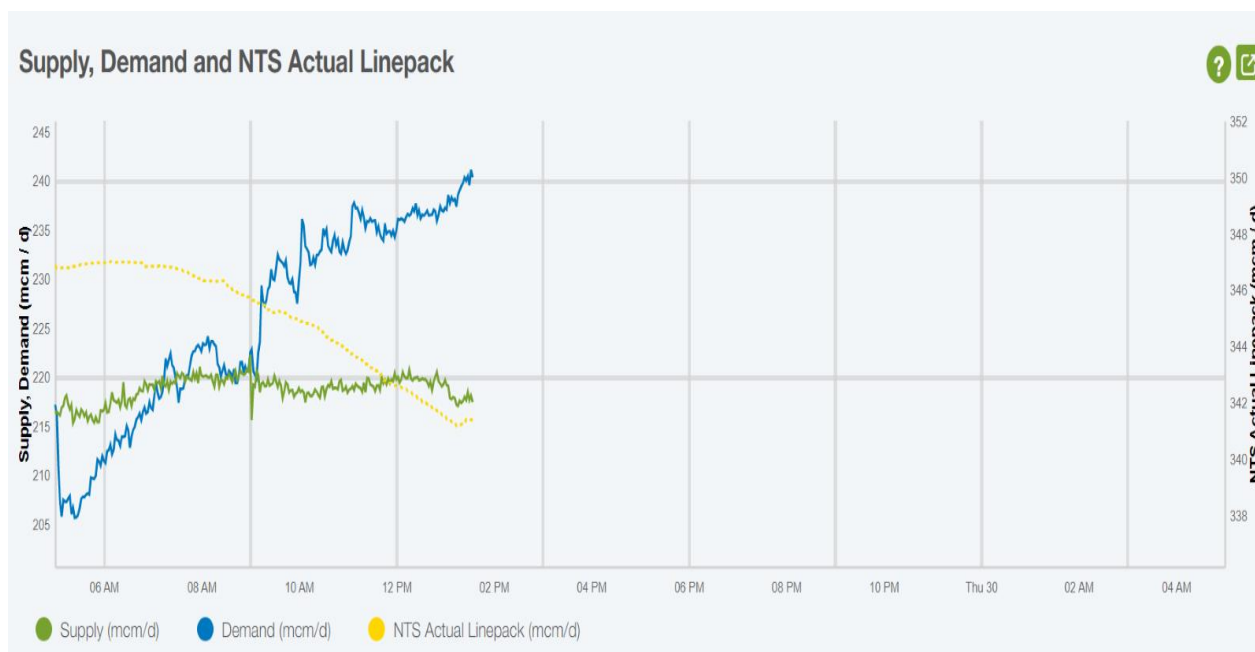


Figure 3: Example of near real time physical National Transmission Linepack data

107. In addition, the 'Information and What Data is available' webinar, provided visibility to our customers and stakeholders of the types of data sets available in the public domain. Insights gained at this webinar can be used to drive improvements of data discovery and usability.
108. There is additional work to be done in the coming years, and the Gas Transmission Digitalisation Strategy published March 2022 sets out how we will approach using data and digitalisation to deliver benefit for our stakeholders and society. The Digitalisation Strategy and Action plan can be accessed using the below link, this will provide further details of progress and future areas of work.

<https://www.nationalgrid.com/gas-transmission/about-us>

Customer and Stakeholder Satisfaction

109. The RIIO-T2 price control recognised the need to encourage network companies to drive improvements in the quality of customer service through customer satisfaction surveys. Therefore, the financial incentive for the Customer Satisfaction Survey remains.
110. Under RIIO-T2, the decision was made that high-quality engagement for stakeholders should be considered business as usual and therefore should not be incentivised financially. A reputational incentive for Stakeholder Satisfaction has replaced the financial ones for the stakeholder survey and the stakeholder engagement incentive scheme.
111. In 2020/21, the COVID-19 pandemic led to an unprecedented step change in how organisations engage and serve their customers and stakeholders. This continued into 2021/22 due to the continuation of the pandemic and subsequent further restrictions imposed across the nation. New ways of engaging have become more

embedded, and whilst we are still learning and finding new and better ways to engage, we have settled into an effective hybrid approach that uses both face-to-face and virtual methods of engagement. This allows flexibility for our customers enabling greater attendance and participation. We ask for feedback regularly on our methods of engagement and are enjoying being able to welcome people back into meeting rooms for more face-to-face engagement if that is their preferred approach. Many of our events are still virtual and we are constantly evolving the way we arrange these and carry out the events so that we reach as far ranging an audience as possible and so that each and every individual can have their voice heard.

112. For CSAT, our response rate remained the same at 38%, but fell further for SSAT from 38% in 2020/21 to 22% in 2021/22. The reduced SSAT response rates can be attributed to a significant amount of online surveys, which usually draw a lower response than telephone interviews. Although there was a reduction in our overall response rate, in 2021/22 we were able to target a larger number and range of stakeholder contacts through focussed virtual events such as Shaping the Gas Transmission System of the Future. This meant that despite the lower response rate, the actual number of responses received was higher than in 2020/21. The responses received gave us some good quality feedback which allowed us to obtain valuable insight to improve future events.
113. In 2021/22 we achieved a customer satisfaction score of 8.63 against a baseline of 7.90. This has increased by 0.46 since last year's score of 8.17 and has continued the increase seen over the last five years. All but two of the nine service areas saw increases in their scores this year and those that saw declines were only slight and had their scores impacted quite significantly by just one or two low scores.
114. 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. The scores and volumes for both Day to Day Account Management and our 'Events' area jumped up this year and the feedback supporting the increases tend to focus on open communication and responsiveness as the key drivers. Another material increase was that of the Maintenance survey area which saw an increase of 0.74. Feedback for this area highlights good communication and flexibility in our response.
115. There has been significant focus on improving customer experience amongst all teams, particularly around communication. The positive feedback received illustrates the high effort made amongst teams and individuals with a large number of contacts specifically praising the ease and speediness of communication.
116. Our CSAT survey this year has focused on gaining feedback for specific service experiences as opposed to the more general question asked in RIIO-T1 and this has enabled more specific qualitative feedback which will be used in 2022/23 to make further improvements to the customer experience.

117. The stakeholder satisfaction score was 8.54 against a baseline of 7.40, an increase of 0.12 from the 2021/22 score of 8.42. This continues a year-on-year increase since 2017/18. We have been able to maintain the increases since 2018 despite the continued challenges of the COVID-19 restrictions.
118. This year we paid particular attention to the interactions that respondents have across multiple service areas to ensure that our teams were communicating internally to provide the best possible service to the customer. We recognise that we are a big organisation and that it can sometimes be difficult for each customer to have one point of contact. In recent years we have strived to allocate each customer a relationship owner and for our teams to share best practice and work together to provide quick and satisfactory resolutions. This year more than ever, those efforts are reflected in the scores and in the qualitative feedback and we will continue to work this way in order to provide the best possible customer experience.
119. The questionnaire was reviewed and changed this year to keep it as short and succinct as possible and to encourage as much participation as possible. Whilst the response rate remained the same for Customer, we received a lot of qualitative responses which allow us to understand the reasoning behind the scores that individuals give. This is fed back immediately to the teams involved for them to act on and follow up with the customer. We saw an increase in the number of scores of nine and ten from last year across both customer and stakeholder satisfaction, from 45.6% to 54.2% which continues the increases we have seen in recent years.
120. We saw an increase in the number of customers and stakeholders that agreed with our statement that National Grid listens to views and acts on them. Only 3% of respondents disagreed with this statement and the remaining 20% were either unsure or neither agreed or disagreed. Whilst this is one of the best responses we have had to this question, we recognise that there is still more to do to demonstrate how we are acting on feedback.
121. 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 provided 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.
122. We have completed another year of our Net Promotor Score (NPS) Programme. The purpose of this survey is to help us understand how we can continually improve our senior customer relationships in a strategic context. We achieved a score of +25. More than ever our customers have told us they value strategic engagement with us, particularly as we navigate the journey to Net Zero. This is something that we continue to prioritise to ensure our strategic priorities are aligned with that of our customers.

Stakeholder engagement culture

123. 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.

Shaping the gas transmission system of the future

124. After the success of the engagement events in 2020 and as part of our RIIO-T2 commitment, we again held a series of interactive webinars in 2021. 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 there were over 1100 participants across all the events (this number includes those that attended more than one event) 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.
125. Over the last 12 months we've held numerous events from webinars to consultations, debates to site visits covering all our strategic priorities. These have covered topics such as the Future of Gas, Digital Strategy, Road to Net Zero, the Future of Heat and many more. All of these activities provide opportunities for us to understand our customers better whilst developing meaningful relationships.

Independent User Group

126. We have successfully transitioned our Independent User Group (IUG) to focus on how we manage our day-to-day business and evolve the IUG's role.
127. In 2021/2022 we presented a wide range of topics to the IUG, including Net Zero, Responsible Business, Network Capability St Fergus PCD, Charging Reform, Methane Emissions, Digital Strategy, Bacton PCD, Project Union and much more. We've had positive engagement receiving 75 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. As well as this, we've had full commitment from the rest of the business with just under 40 of our colleagues presenting/attending the meetings throughout the year and a minimum average of two senior executive representation attending the meetings demonstrating senior leadership commitment.

Demand Forecasting

128. The national demand forecasts published by National Grid 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.
129. 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 moved to a reputational incentive scheme with a corresponding Licence Obligation to report annually on our performance.
130. The provision of timely and accurate forecasts aids in ensuring efficient operation from both a physical and commercial perspective, ultimately reducing operating costs which directly impact on end consumers gas bills. National Grid strives to continually optimise its forecasting processes, to deliver greater accuracy and increase customer and ultimately consumer benefit.
131. From a demand forecasting perspective, 2021/22 proved to be another challenging year as the global pandemic continued and GB gas prices rose circa threefold, alongside other geopolitical events leading to volatility and changes in both gas demand usage and supplies (which impacts demand).
132. This uncertainty and volatility in the global gas markets has impacted supplies and demands and therefore demand forecasts as global market pressures have changed some of the more standard behaviour and increases the challenge of forecasting new behaviour against historical market relationships.
133. Power Station gas usage continues to be unpredictable, with new sources of electricity from renewable generation and increased capacity from electricity interconnectors impacting the variability and accuracy of gas for power.
134. These larger electricity capacity variables have had more days with a larger effect on demand changes and has resulted with 14 days this year showing a greater than 40 mcm change from the previous day, an increase from 11 last year. The most extreme of these daily demand changes was 76.75 mcm compared to 71.8 mcm last year. Although the day-on-day average change in demand remains high, it decreased slightly to 12.59 mcm from 12.67 mcm in 2020/21.
135. In 2021/22, the weighted average error on the D-1 incentive was 8.52 mcm against a target of 8.98 mcm (Fixed target of 8.35 mcm + storage adjuster of 0.6305 mcm). The weighted average error has increased this year from 8.20 mcm in 2020/21. The associated incentive revenue for 2021/22 is £0.174m, compared to £1.11m in 2020/21 under the previous RIIO-T1 scheme.
136. The D-2 to D-5 incentive weighted average error was 12.37 mcm in 2021/22 against a target of 13.70 mcm. The weighted average error has decreased from 13.52 mcm in 2020/21. There is no associated incentive revenue for 2021/22 as this scheme was amended to reputational only under RIIO-T2, this compares to £0.13m in 2020/21 under the last year of RIIO-T1.

137. During 2020/21 we made a significant investment for the internal development of improved demand forecasting capability models, as the existing models were becoming outdated and changes to the market variabilities were not scalable. Additionally, the models were developed and owned by a third party, therefore, changes to improve the existing models were time consuming and costly. To continue to provide accurate demand forecasting to the industry we completed a £0.33m investment to deliver an IT solution to provide a Machine Learning (ML) platform to improve the accuracy of the predicted models in demand forecasting.
138. Throughout 2021/22 we have embarked on several activities to drive improvements in the accuracy of our demand forecasts, including but not limited to:
- Process improvements - Supply forecasting. New methods developed for predicting deliveries into the network, further analysis and automation has been developed specifically regarding Norwegian flows.
 - Process improvements - The project to develop inhouse demand forecasting models continues to enable ongoing agile development of algorithms in reaction to the changing energy markets. We have focussed initially on improving the model that predicts gas demand for power, but the current energy market continues to be challenging and therefore development of our models will continue to be an area of focus. The improvement to the Power Station model were extended to cover the longer period of D-2 to D-5, forecasting further out creates more challenges with volatility in the commercial market and fluctuations in the expected renewable generation and interconnector nominations becomes materially more difficult to accurately forecast.
 - Staff development - We also continue to prioritise ongoing staff development and process improvements to both demand and supply forecasting, such as new processes with Gassco outages to better forecast Vesterled and Langeled deliveries, refinements to existing LNG forecasting with global route tracking for delivery times and price indicators.
139. We will continue to look to how the new data models can continue to be utilised in future years as it provides flexibility to add future new data sources and support inhouse amendments, which will be timelier with reduced costs to develop and implement improved models, saving staff time from manual work. We will continue to assess and review the ability for automated data acquisition for the ML platform to enhance modelling accuracy.

Maintenance

140. The Maintenance Incentive Period runs from 1 April to 31 October, to align with the summer outage plan.
141. 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, National Grid may 'call' one or more 'Maintenance Days' in accordance with the UNC.

142. 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.
143. 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 National Grid to the agreed maintenance plan

Use of Days - Maintenance days (Valve Operations)

144. 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 Remote Valve Operations (RVO).
145. Due to the COVID-19 pandemic and government social distancing requirements, all RVO activities were risk assessed and cancelled against the Summer 2021 Maintenance Plan (2020/21). Therefore, it was a priority to complete all RVO activities in 2021/22, 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.
146. This element of the new RIIO-T2 incentive scheme is downside only (£500,000 collar). In 2021/22 we outperformed our target of 11 days or less and therefore no financial downside was triggered.

Use of Days - Maintenance days (excluding Valve Operations)

147. 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 RVO).
148. This is a new element to the RIIO-T2 scheme. For 2021/22 the incentive included 133 days of customer impacting works, of which 127 were aligned to customer outages. This demonstrates that 95% of customer impacting works (excluding RVOs) were successfully aligned with customer outages against a target of 75%.
149. This element of the RIIO-T2 scheme has a capped upside and collared downside (+/-£500,000). In 2021/22 we achieved the maintenance use of days target and therefore reached the £500,000 upside performance cap.

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

150. 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.
151. This element of the RIIO-T2 scheme is downside only (£500,000 collar). In 2021/22 we outperformed our target of 11.67 days or less, making no changes to the plan and therefore no financial downside was triggered.
152. The Maintenance Day Changes scheme includes any maintenance days called; it is not limited to RVOs. In total, there were 154 days (inclusive of 133 days in the Use of Days – Maintenance Day (excluding Valve Operations) of planned maintenance in 2021/22 compared to 131 days in 2020/21.
153. This increase, driven in part by a higher volume of impacting works in the RIIO-T2 period, led to an updated benchmark for changes of 11.67 days in 2021/22, which is 7.25% of all Maintenance Days and Advice Notice Days¹ called. This compares to a benchmark of 9.49 days in 2020/21.
154. We expect to see this trend to continue with increased maintenance activities throughout the RIIO-T2 period, as we continue to increase investment expenditure and routine works in line with our investment plan. In 2021/22, there were zero changes initiated by us during the maintenance period. This is the same as in 2020/21.
155. This demonstrates the conscious effort that has been made to minimise change, despite a large number 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 customer requirements.
156. This performance was primarily delivered by several continued improvements to our planning processes, including a continued increase in customer face-to-face meetings (COVID-19 compliant) with renewed engagement at least eight weeks prior to the planned maintenance affecting them, allowing us to capture any changes to customer outages earlier.
157. Minimising the use of Maintenance Days throughout 2021/22 has ensured a reduced impact to our customer's operations through National Grid taking on additional risk via increasing the alignment of works, saving approximately £12.5 million² in potential lost operation time revenue. This provides a better value service for our customers and the wider energy industry.
158. As we now utilise a long-term planning process to review all maintenance work for customers across the entire price control period, in order to minimise Maintenance

Days Notices across all activities. This improved, long term planning process allows us to review work requirements that will impact customers in advance. This long-term proactive approach over the year-on-year reactive process allows us to align works more easily and minimise Maintenance Days Notices. Having the wider earlier focus allows an increase in site survey time and prep work for internal sanctions, which in turn will allow earlier communications with the customers to lock in and agree a strategy to support alignment notices.

159. Our annual review of the 2021/22 maintenance programme will be published on our website from 1 June 2022 at:

<https://www.nationalgridgas.com/data-and-operations/maintenance>

Entry and Exit Capacity Constraint Management

160. The Capacity Constraint Management Incentive is designed to drive National Grid 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 2021/22 Constraint Management Incentive scheme performance was £4.9m.
161. On 1 Oct 2020 the Charging Review was implemented, following the approval of UNC0678A in May 2020. This introduced a “postage stamp” pricing structure for capacity products and a revised set of reserve prices. There was a significant increase in capacity revenues as a consequence of these new charges, and some changes observed in Shippers’ capacity product usage. The primary change was that Shippers looked to align their capacity bookings more closely with their gas flows. As a result of this change, only revenue from the Oct 2020 – Mar 2021 period of the 2020/21 reporting year is considered directly comparable with 2021/22, so a further comparison has been provided in this narrative, to highlight year-on-year changes in the Apr-Sept and Oct-Mar periods.
162. The RIIO-T2 price control, which took effect for the 2021/22 reporting year, altered the revenue which we report on, and the revenue that we retain through the Constraint Management Incentive. Under the RIIO-T1 price control, revenue from all within day sales plus any non-Obligated sales were included in the Constraint Management Incentive. In RIIO-T2, only 14% of Non-Obligated Capacity revenue is included the Constraint Management Incentive calculation, and the sharing factor applied to revenue retained by National Grid has reduced from 44.36% to 39%. Unless stated otherwise, all capacity revenues in this narrative are stated

prior to the 14% and 39% factors being applied. When combined, the 2021/22 sharing factors have the effect of £1m generated revenue equating to circa £55k incentive scheme revenue. In 2020/21, the sharing factor of 44.36% had the effect of £1m generated revenue equating to circa £444k incentive scheme revenue.

163. A further difference between the RIIO-T1 and RIIO-T2 Constraint Management Incentive is the removal of revenue from the following capacity products, which as a result are not detailed in this narrative:

- Entry Interruptible Capacity
- Exit Off-Peak Capacity
- Daily Obligated Entry Capacity
- Daily Obligated Exit Capacity
- System Entry Overrun Charges

164. 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 Operational Buying Back of 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).

Non-Obligated Entry Capacity

165. In reporting year 2021/22, revenue from Non-Obligated Entry Capacity was £1.94m. In 2020/21 the revenue for the same products was £2.16m (2018/19 price base). The year-on-year net reduction in revenue between reporting years is due to a £0.39m reduction in revenue from Long Term Non-Obligated sales offsetting a £0.17m increase in revenue from Short Term sales.

166. For Short Term Non-Obligated Entry Capacity, the increase in revenue was due to higher capacity prices following the Charging Review implementation. There was a 62% reduction in Short Term Non-Obligated Entry Capacity purchased between 2020/21 and 2021/22, but a 45% increase in revenue generated.

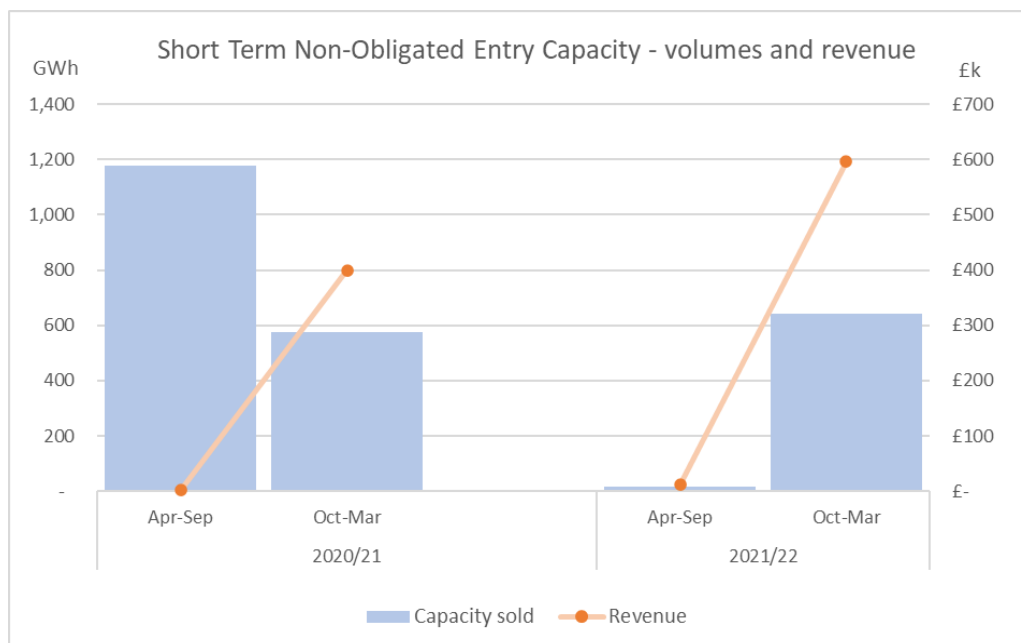


Figure 4: Short Term Non-Obligated Entry Capacity sold and revenue

As illustrated in Figure 4, there is a significant difference between the level of change year-on-year for this product, when comparing the two six-month periods:

- In the Apr-Sept period, in 2020/21 there was 72 times more Short Term Non-Obligated Entry Capacity sold through six times less revenue generated than in the same period in 2021/22. In 2021/22, for the Apr-Sept period, there was only one bid allocated for Short Term Non-Obligated Entry Capacity. In 2020/21 there were 328 bids allocated for this product. Of these 328 bids, 60% of the total volume was at Bacton UKCS. Second to this, with just over 30% of the total volume, was Teesside. The remaining 10% of volume of bids for this product in 2020/21 were split between Isle of Grain and Murrow. The one purchase of this Capacity type in 2021/22 was at the (increased) reserve price, following the “postage stamp” change, of 0.0717 p/kWh, whereas, in 2020/21 the average price sold for all of this Capacity type was 0.0001 p/kWh.
 - In the Oct-Mar period, 12% more Short Term Non-Obligated Entry Capacity was sold in 2021/22 compared to 2020/21, though due to an increase in the reserve price this generated 43% more revenue in 2021/22. The average price paid for this product in this period in 2020/21 was 0.0696 p/kWh, compared to 0.0928 p/kWh in 2021/22.
167. For Long Term Non-Obligated Entry Capacity, volumes purchased across the two reporting years are almost identical, but the revenue generated in 2021/22 was 22% less than that in 2020/21.

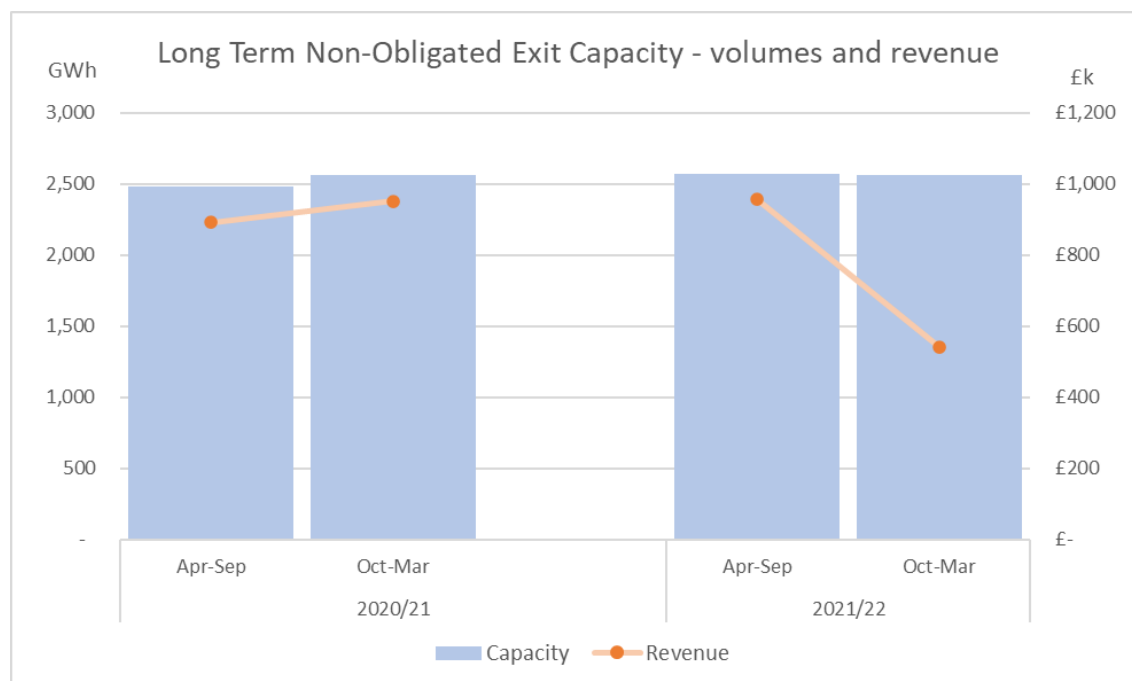


Figure 5: Long Term Non-Obligated Entry Capacity sold and revenue

168. As illustrated in Figure 5, sales of this product have been largely consistent year-on-year and all sales have been at either the Cheshire Storage site or Murrow Entry point, though there has been a notable reduction in revenue generated since Oct 2021:

- In the Apr-Sept period, there was just 4% additional capacity purchased in 2021/22, compared to 2020/21. This was due to 500,000 kWh/d purchased at Murrow, which was not purchased for the same period in 2020/21. This led to a 3% increase in revenue for this period year-on-year.
- In the Oct-Mar period, the same amount of capacity was purchased in both reporting years, though 46% less revenue was generated in 2021/22. This was due to a reduction in the reserve price applicable for Cheshire Storage site, which accounted for the majority of sales. The reserve price was reduced following implementation of UNC0727 on 1 Oct 2021, which increased the capacity reserve price discount for storage sites to 80%, from 50%.

Non-Obligated Exit Capacity

169. In 2021/22, revenue generated from Non-Obligated Exit Capacity was £8.85m, compared to £4.25m (in 2018/19 prices) in 2020/21. The increase in revenue is largely attributable to the Short-Term sales, which in 2021/22 generated revenues of £6.91m, compared to £2.93m in 2020/21. Revenue from the Long-Term sales was £1.93m in 2021/22 compared to £1.32m in 2020/21.

170. For Short Term Non-Obligated Exit Capacity, sales increased by 123% from 2020/21 to 2021/22, with revenue increasing by 136%.

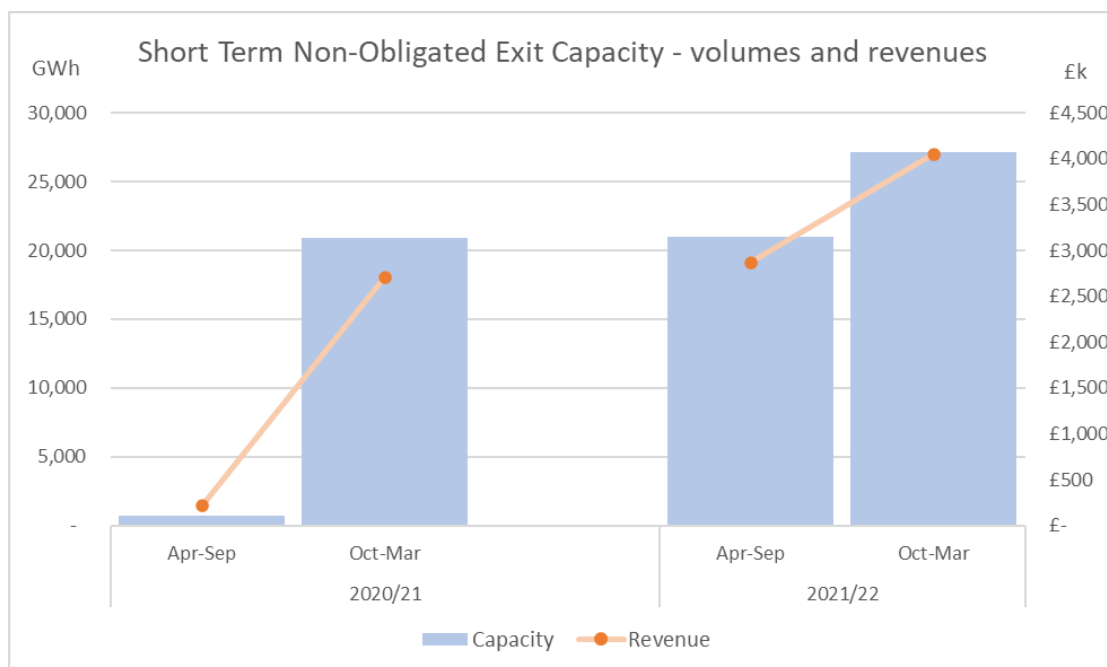


Figure 6: Short Term Non-Obligated Exit Capacity sold and revenue

171. As illustrated in Figure 6, the most notable year-on-year changes to Short Term Non-Obligated Exit Capacity have been in the Apr-Sept period, for both volumes and revenue.

- In the Apr-Sept period, there was 31 times more Short Term Non-Obligated Exit Capacity purchased and 13 times more revenue generated in 2021/22 than in 2020/21.
- In 2020/21 the average price paid was 0.0324 p/kWh, in 2021/22 the average price paid was 0.0154 p/kWh, which explains the relationship between volume and revenue increases year on year.
- In the Oct-Mar period, there was 30% more Short Term Non-Obligated Exit Capacity sold and 49% more revenue generated in 2021/22 compared to 2020/21. The average price paid in 2020/21 was 0.0149 p/kWh, and the average price paid in 2021/22 was 0.0173 p/kWh.

172. For Long Term Non-Obligated Exit Capacity, the capacity purchased across the two reporting years has not changed significantly, though the revenue generated has increased by around 46% between 2020/21 and 2021/22.

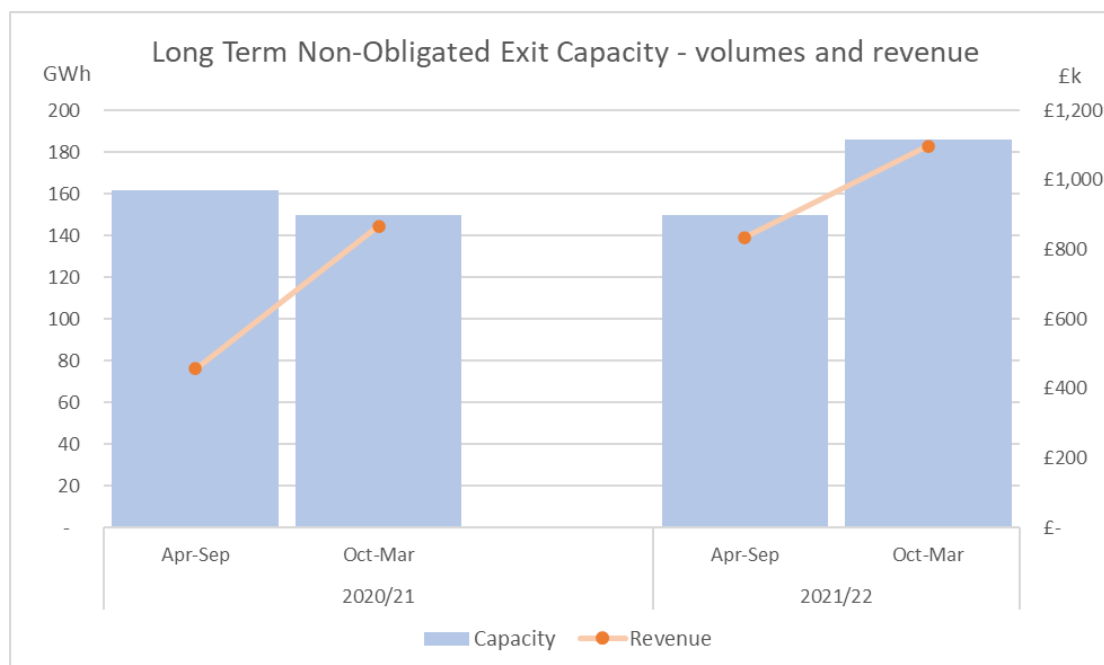


Figure 7: Long Term Non-Obligated Exit Capacity sold and revenue

173. As illustrated in Figure 7, the most notable year on year change is to the revenue generated in the Apr-Sept period.

- In the Apr-Sept period, there was 7% less Long Term Non-Obligated capacity purchased in 2020/21, but an 82% increase in revenue in 2021/22 compared to 2020/21. The average price paid in 2020/21 was 0.0051 p/kwh, whereas in 2021/22 the average price was 0.0198 p/kwh due to the increased reserve prices following implementation of the Charging Review on 1 Oct 2020.
- In the Oct-Mar period, 24% more Long Term Non-Obligated Exit capacity was purchased, and 27% more revenue generated in 2021/22 compared to 2020/21. For this period in both reporting years, the capacity price paid for this product was the same across all Shippers, although increased in 2021/22; with the capacity reserve price being 0.0198 p/kWh in 2020/21 but 0.0211 p/kWh in 2021/22.

174. One of the main factors for the revenue increase for Short Term Non-Obligated Exit Capacity has been the sales at Bacton BBL Interconnector Point. No revenue was generated at this Exit point in the 2020/21 reporting year.

- Aggregation of the Bacton Exit Baseline (UNC0785A) was consulted upon by Ofgem and led to a Licence change effective from 15 Dec 2021, at which point a pro-rated amount of Firm capacity was made available to each of BBL and Interconnector Exit points, based on their respective Technical Capacities. This was an interim measure until a system solution was implemented to allow competing auctions, on 1 Mar 2022.

- Short Term Non-Obligated Exit Capacity was first allocated at Bacton BBL Interconnector Point on 8 Jun 2021. There were then no further allocations until 3 Aug 2021 and this release continued, with consistent capacity allocations, through until 14 Dec 2021, inclusive. Capacity allocation of this product recommenced on 30 Dec 2021 through to 3 Jan 2022. The release of Short Term Non-Obligated Exit Capacity was to support GB export flows, which were not seen over the winter 2020/21 period, and which were driven by NBP:TTF market price differentials at that time.
 - I. During the Apr-Sept 2021 period; £0.8m of revenue was generated from the allocation of Short Term Non-Obligated Exit Capacity release at Bacton BBL Interconnector Point.
 - II. During the Oct-Mar 2021/22 period; £1.3m of revenue was generated from the allocation of Short Term Non-Obligated Exit Capacity release at Bacton BBL Interconnector Point.

Capacity constraint risk management

175. 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. The commercial risks are then 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 to any extent whilst recognising that some maintenance is based on legal requirements and other maintenance is required to ensure continued operation of the asset(s). Across Gas Transmission, proactive management and communication of all physical works requirements and the potential commercial and physical impacts are considered. This is essential to ensuring the right decisions are made for our customers. 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.
176. In 2021/22 we managed an emerging entry constraint on the network using commercial tools. In Jan 2022, 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 10 and 11 Jan 2022.
- On 10 Jan, we saw instantaneous flows of around 880 GWh. On 11 Jan, we saw instantaneous flows of around 935 GWh. Baseline capacity at Milford is 950 GWh/d.
 - For both gas days, there was no Interruptible Entry Capacity sold that could be scaled back, and there was no Firm Entry Capacity to withhold from Short Term auctions, as all Firm Entry Capacity had been sold in the Long-Term auctions.

- Buy Back of Firm entry capacity was considered less efficient in this situation due to the high levels of Firm entry capacity booked and therefore had the potential to incur significant costs without effecting the required physical flow change.
- Locational Sell Actions were taken on both 10 and 11 Jan, which generated £3.6m and achieved the required physical flow reduction.
- On the days following 10 and 11 Jan, we saw continued high entry flows at Milford Haven, with the highest instantaneous flow on 12 Jan of 944.3 GWh. Further constraints were mitigated by an effective operational strategy and an increase in demand which helped alleviate pressures in the area. The operational strategy included maximising compression to move gas away from the area, and on 11 Jan agreeing lower operating pressures with DNs to support us in running compression harder.
- On both 10 and 11 Jan 2022, there was no need to carry out counter locational (buy) actions, to maintain wider system balance.

Supporting our customers

177. 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 the Shipper community understand and participate in capacity auctions and provide them with a contact point for any capacity-related processes. Throughout the year, we used several different approaches as a means of raising awareness and offering support, all with the objective of managing network capacity in a more efficient way.
178. In 2021/22, we presented at several Operational Forums on capacity-related topics:
- In Jun 2021 we provided information on Bacton Interconnector Point Exit; Non-Obligated Capacity release; detailing what had happened when there was a capacity release issue on 8 June 2021.
 - In Sept 2021, we provided insights into UNC0745S – Mandatory Setting of Auction Bid Parameters and provided details of this change to the Short-Term GB Entry/Exit Capacity auctions. The change meant that from 1 Oct 2021, customers would need bid parameters in place for both Bid Price and Bid Capacity or would be unable to submit a bid in the auction. The objective of this change was to prevent capacity bidding errors and an extensive communication strategy was followed which resulted in no customer impact as a result of the implementation.
 - In Nov 2021, we presented the Commercial Tools that are available to us in the event of a forecast or actual constraint; with full details provided on Capacity Scaleback, Withholding Firm Capacity, Locational Actions, Capacity Buybacks and Offtake Flow Reductions.

- In Jan 2022, we presented in relation to the interesting days at Milford Haven, described above. We provided information on the South Wales network and what constitutes a capacity constraint, bringing together the physical and commercial situation and considerations at the time. We also provided information on the Locational Actions carried out on 10 and 11 Jan 2022.
 - In Jan 2022, we also presented on the Bacton Exit Capacity position, and the approach being taken with respect to release of Firm Exit Capacity following the Licence change on 15 Dec 2021 to aggregate the Bacton Exit IP Baseline. We explained the interim approach in place to pro-rata the amount of Firm capacity made available to each of BBL and Interconnector Exit points, based on their respective Technical Capacities. We also provided an update on the system solution to support competing auctions, planned for implementation on 1 Mar 2022.
179. We have provided material relating to specific “interesting days” throughout the year. This has given industry the opportunity to ask questions and enhance their understanding of how and why we have used any commercial and operational tools to prevent and/or manage capacity constraint situations.
180. Daily, we provide support to customers on all aspects of capacity, via our email account and phonenumber. 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.
181. We have further improved our Constraint Management educational pack and used this in presentations to specific customers and stakeholders who have asked for a better understanding of how we manage the network, and what a capacity constraint is. The pack explains how we forecast and manage a constraint situation, the terms used, tools employed and how decisions are made to limit the commercial risk whilst ensuring the overarching safe and efficient use of the network.
182. We have continued to develop our Frequently Asked Questions (FAQ) and Capacity Guidelines documents throughout the year, responding to customer query themes by expanding the content of these comprehensive go-to documents. These are published on our website, and we take opportunities such as Operational Forums, to raise awareness of these documents with our customers. We continue to evolve the content as we receive further feedback, or where we identify a trend in customer queries.

Residual Balancing

183. The aim of the Residual Balancing incentive scheme is to incentivise National Grid’s residual balancing activities in two ways:
- The Linepack Performance Measure (LPM) incentivises NGG to minimise differences in linepack volumes between the start and end of each gas day. This is to ensure that any system imbalances within the day are resolved, and

that any associated costs are levied across those system users responsible for that day's imbalance.

- The Price Performance Measure (PPM) evaluates the impact NGG has on the market in its Residual Balancing role by measuring the price range of its trading actions compared to the System Average Price (SAP). This incentivises the System Operator to minimise the impact it has on market prices.
184. The LPM element for 2021/22 achieved a daily average linepack performance of 2.0 mcm/d over the year, compared to the 2.8 mcm/d incentive target. This was slightly worse than the level for 2020/21 (which was, on average, 1.5 mcm/d). LPM was better than the target of 2.8 mcm/d on 268 days during the year (73% of days), a decrease compared to 2020/21 (311 days, 85% of days).
185. The PPM element achieved an average price spread of 1.8% of SAP, compared to the 1.5% incentive target. This represented a decrease in performance on the 2020/21 value of 0.77%. We took residual balancing actions on 252 days (69%) compared to 201 days (55%) in 2020/21, representing an increase in the number of days we were required to enter the market to encourage balancing.
186. On the days when we took balancing actions, the average price spread was 2.7%, compared with 2.0% in 2020/21 and 1.8% in 2019/20. Although the average spread has increased against a more challenging environment with prices circa three times higher than last year, we believe that this still demonstrates value for customers. Multiple factors have been identified, which when combined created the more challenging backdrop for balancing, namely increased Linepack swing and Shipper behaviour. The NTS now accommodates much wider system imbalances in supply and demand throughout/during a gas day, presenting a more challenging environment for Residual Balancing to operate efficiently in. As a result, we continue to enter the market earlier and more frequently particularly during challenging periods.
187. Shipper behaviour continues to have a substantial impact on balancing the NTS especially on weekends and holidays. We continue to engage with these shippers to understand the changing drivers behind habitually leaving an imbalanced position. Some shippers have indicated they aren't setup to effectively balance or respond to our balancing actions outside of standard office hours. They've also provided insights into the challenges UIG has on their balancing activities. We are incorporating this learning into our trading strategies.
188. In 2021/22 we continued to manage the risks posed to the system both within the day, whilst also adopting a proactive approach by using trend analysis and forecasting to assess the future risk to the NTS.
189. Increased price volatility across global gas markets has presented challenges to Residual Balance trading over the year, particularly in our ability to maintain a narrow price spread.

VI. Maintaining a safe and resilient network

190. 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.
191. In 2021/22 we have made good progress against our outputs in this priority area. 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.

Safety

192. The safety and health of our workforce, the public and our assets remains an integral part of how we work at National Grid 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

193. The overall Gas Transmission lost time injury frequency rate (LTIFR) for 2021/22 was 0.11. This rate was made up of five lost time injuries (LTIs) which comprised of three contractor incidents and two National Grid incidents. The incidents were linked to falls from height, struck by moving objects and manual handling. These events have been, or are in the process of being, investigated with new control mechanisms implemented and shared learning taking place. Whilst this is an increase in LTIs in comparison to 2020/21, a change in our organisational structure means that construction activities are now included in these statistics. These incidents would previously have been reported through our Capital Delivery Directorate.
194. There was one process safety High Potential Controllable Event (HPCE) which was categorised as a serious (tier 2) incident. In total there were 10 High Potential Controllable Events in Gas Transmission of which three had a dual classification of LTI and HPCE. As with our LTI events all investigations have been, or are in the process of being, completed with new control mechanisms implemented and shared learning taking place.
195. There were no public safety injuries attributable to Gas assets or operations in 2021/22.
196. Throughout 2021/22 we have focussed on a number of initiatives to promote and encourage safety and wellbeing at National Grid. These include:

- GT Safety Ambition - We have designed a Safety Ambition specific to Gas Transmission which focusses on 'Safe every day' and supports progression to a proactive safety maturity whilst ensuring we maintain legal compliance. This ambition sets the strategic direction for the RIIO-T2 framework and associated safety and health plans – focus within these plans will be aligned to four target areas:
 - I. Keeping our assets and processes safe every day
 - II. Demonstrating safe behaviours every day
 - III. Supporting health and wellbeing every day
 - IV. Improving safety every day
- Ongoing management of COVID-19 – There has been a sustained focus on COVID-19 throughout the Pandemic ensuring that robust mechanisms were in place to support the health and resilience of our teams. Following the Government setting out their 'Living With COVID' plans, a review of controls was completed to ensure that appropriate management remained. We continue to monitor guidance.
- Safety Management Systems - Safety and Health initiatives have been, and will continue to be, delivered to ensure that we are equipped to operate as a standalone organisation. Work has been ongoing to deliver an appropriate handover and transfer of National Grid contracts and systems as we progress towards sale completion. As an example, we now have our own Incident Management System which is managed locally. In 2022/23 work will begin to ensure we have a simple and effective suite of SHE Management standards. As part of this work, a full review and update to the safety management systems will begin to ensure simplified relevant systems are in place.
- Fatigue Management – Increasingly fatigue in employees has been recognised as a hazard. Fatigue can result in slower reactions, reduced ability to process information, memory lapses, absent-mindedness, decreased awareness, lack of attention, underestimation of risk and reduced coordination. It can lead to errors and accidents, ill-health and injury, and reduced productivity. As such a fatigue risk management standard was produced and a gap analysis completed. Initial review suggested good compliance with few areas for collective and individual improvement. Opportunities to share best practice across departments have been identified. Focus will continue into 2022/23.

197. In addition to the above we have completed a number of safety focussed projects throughout the past year including:

- Re-enforcement of safety roles and responsibilities – delivery of a back-to-basics programme with a suite of e-learning produced

- Introduction of revised processes to ensure action and learning notifications are delivered in a timely manner
- Delivery against a process safety improvement plan
- Creation of new leading process safety risk control indicators
- Improvements to our operational competency processes
- Design of a corrosion management process
- Embedding of a simplified setting to work process

Network Asset Risk Metric (NARM)

198. For RIIO-T2, the Network Asset Risk Metric (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.
199. 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. The 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.
200. In 2021/22 we have spent £45.43m on work delivering NARM outputs (A1 Unique Identifiers (UIDs)). We have undertaken a dry run using the new NARM RRP template provided by Ofgem, using NARM long term monetised risk benefit (LTRB) values delivered during 2021/22, and a revised forecast of the NARM position at the end of RIIO-T3 based on planned and forecast work. A number of issues with the NARM RRP spreadsheet templates were identified and we have engaged with Ofgem on how best to resolve these ahead of the October NARM submission. We will confirm the final NARM delivered outputs and forecasts in the specific RRP NARM submission.

Annual Network Capability Assessment Report (ANCAR)

201. The Annual Network Capability Report (ANCAR) is an evolving document that is a new obligation in our Licence. Its aim is to include for all NTS Exit and Entry Zones, so far as is reasonably practical:
- the flow forecasts

- the physical capabilities
- the capability that can be delivered using commercial tools
- an explanation of any changes resulting from changes in our assets
- a view of the situation 10 years' time.

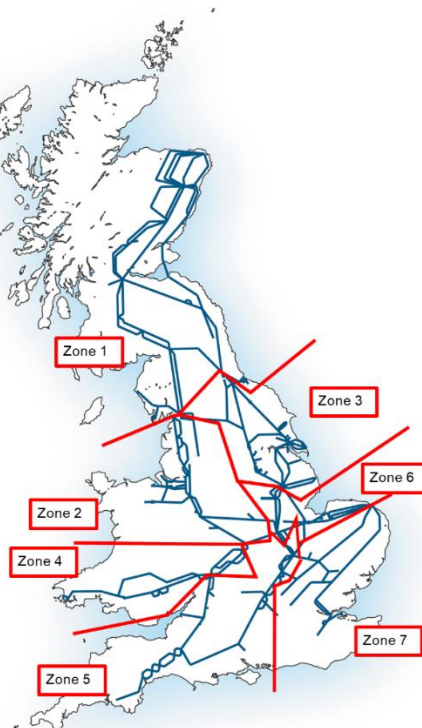


Figure 8: The Network Capability Zones

202. The first edition of the ANCAR⁴ was published on 29 June 2021, and the main findings were:

- The entry and exit capabilities of all the zones, bar South Wales and the Southeast, are sufficient to meet all the supply and demand flows anticipated under all FES scenarios, over the next 10 years.
- South Wales' entry capability shows the strongest indication of all the zones that an increased capability may be required in future years, due to a greater reliance on the imports of liquefied natural gas (LNG).

⁴ <https://www.nationalgrid.com/uk/gas-transmission/document/135991/download>

- The South East's flows indicate the network has sufficient capability to meet most of the requirements put upon it 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 investment programme in the current 10-year Business Plan, as contained within our RIIO-T2 proposals, remains the appropriate and economic approach to meeting forecast customer needs, although further consideration of the South Wales capability is necessary.
 - 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.
203. 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 based on the Future Energy Scenarios (FES).
204. We continue to work on a number of initiatives to improve subsequent ANCAR publications. Informed by our external engagement, we are focusing on projects that include asset utilisation and resilience, active linepack management and inter-zonal transfers.
205. Both prior to and after the publication of the report, a number of engagement activities were held to establish the requirements of stakeholders and how they would like to see the documents evolving.
206. The next publication will show:
- Updated FES figures – no significant changes
 - No significant changes in the expected flows or capability of the NTS since the 2021 ANCAR
 - Highlight the innovative project work we are carrying out to understand the impact of hydrogen use on the NTS
 - Progress reports on our improvement initiatives.

Exit Capacity

207. The annual exit capacity process is run according to the Exit Capacity Planning Guidance (ECPG) introduced as part of RIIO-T2. The aim of this new guidance/process is to ensure that Flat and Flex capacity bookings as well as Assured Offtake Pressure (AOP) requests are booked as efficiently as possible given the removal of the incentive arrangements on the GDNs. The ECPG process also aims to make the process more transparent and increase our engagement

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

208. This process was first run from April 2021 – January 2022. Capacity bookings were largely in line with what we would expect to see (based on previous years), suggesting that bookings are being made efficiently. AOP bookings saw more changes than previously experienced in RIIO-T1, given the increased engagement with the GDN's it was possible to negotiate AOPs in a way which avoided any unnecessary investment and therefore was to the financial benefit of customers and ultimately consumers.
209. We provided the outcome of the process in the 2021 Exit Capacity Allocation Report to OFGEM, as well as a redacted version made publicly available, in October 2021⁵ with the accompanying Exit Capacity Assessment Methodology Statement, in January 2022, in line with the licence condition under ECPG. The GDN's also published equivalent documents in line with their obligations under ECPG. For the exit capacity process July 2022 – January 2023, we have included additional elements of ECPG to provide a concise and reasoned opinion as to which of the proposed offtake booking patterns is the least costly option for the NTS, and an indication of the magnitude (in capex and opex terms) of the difference in cost between the options.

Asset Health – Non-lead assets

210. The majority 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 consist of:
- Security fences and gates
 - Major remediation of Civils at Bacton
 - Pipe supports
 - Access roads and paths
 - Lighting
211. The Non-Lead Assets requiring intervention are being considered alongside similar NARM assets requiring intervention. In this manner, bundling efficiency and timely intervention is best achieved.

⁵ <https://www.nationalgrid.com/gas-transmission/capacity/exit-capacity-planning>

212. The Non-Lead Assets associated with pipe supports, fences, access roads and paths form part of deliverables managed within the National AGI Renovation Campaign (NARC).
- 37 pipe support interventions have been undertaken against a RIIO-T2 intervention requirement of 1296.4.
 - Four fence interventions have been undertaken against a RIIO-T2 intervention requirement of 8.7.
 - Eight road and pathway interventions have been undertaken against a RIIO-T2 intervention requirement of 11.2.
213. The Non-Lead Assets associated with electrical lighting form part of the wider electrical campaign. During 2021/22, 69 sites have been surveyed and interventions have been reviewed upon basis of need. The lighting PCDs are currently in consideration for tendering along with a wider portfolio of electrical assets. Following receipt of tendering information, the lighting interventions will be developed into an efficient delivery programme committed into build phase.

VII. Deliver an environmentally sustainable network

214. 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.
215. In 2021/22 we have made good progress against our deliverables in this consumer priority area. Our engine inhibiting trial, as well as initiatives such as early unit isolation and control panel improvements, have reduced compressor emissions by circa 500 tonnes in 2021/22, with further roll-out of these schemes scheduled for Summer 2022. In new areas for RIIO-T2 such as the Environmental Action Plan and associated environmental incentives, we have outperformed against our baseline targets, reducing emissions in key areas such as transport and office waste. 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
216. There are a number of projects that contribute to this overarching consumer priority but that are covered under the XII. 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

217. The Environmental Action Plan (EAP) is a new requirement within the RIIO-T2 Price Control Period. It contains 30 commitments split over five key areas, with seven of the outcomes linked to environmental Output Delivery Incentives (ODI) in RRP table 8.3.
218. The five areas of focus are:
- 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.
 - Climate Change and Our Climate Commitment - Our key commitment in this space is to develop a science-based target by 2023. Science based targets are industry best practice and are carbon reduction targets. While we are developing the target, we are setting out a package of commitments that begin to help us to reduce our carbon footprint.
 - Responsible Asset Use - We will remove eighty redundant assets, asset groups or sites, supporting a sustainable lower carbon future through responsible demolition including asset repurposing.

- Caring for the Environment - We'll 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.
- 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.

219. The financial performance of the seven Output Delivery Incentives for Environmental outcomes are featured in RRP table 8.3.

220. Headline performance for each of five areas has been captured in the table below.

Area	Context	RAG	Update
Air Quality – 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.	Green	NOx emissions from compressors have fallen from last year by 1.4%, due to reduced running from warmer weather and using BAT units (newer, cleaner units)
Climate Change – Our Climate Commitment	Our key commitment in this space is to develop a science-based target by 2023. Science based targets are industry best practice and are carbon reduction targets. While we are developing the target, we are setting out a package of commitments that begin to help us to reduce our carbon footprint.	Yellow	The Science-based Targets Institute has withdrawn access to its frameworks for companies whose portfolios contain more than 50% fossil fuels. However, GT&M are creating glidepaths to emulate science-based targets; Ofgem to be consulted. The Methane Emissions Reduction Campaign has led to a methane emission focused reopener with Ofgem. NGGT will seek up to £30m of investment targeting up to 1000 tonnes of methane emission reduction and improvements in fugitive methane emission detection and quantification.
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.	Yellow	Asset Strategy are continuing with plans to decommission redundant assets.
Caring for the Environment	We'll 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.	Green	Full award expected for Output Delivery Incentive for Environmental Net gain in year one. Aylesbury Compressor station initiatives delivered 2.2% improvement to ensure full award in year one. Plans being developed for years 2 and 3 to achieve 10% target by the end of RIIO-T2
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.	Yellow	Head of Environmental, Social and Governance role filled, with vision and aspiration to be defined by key stakeholders within the business. Year 2 will set out plans for initiatives, engagement, training and learning outcomes

Table 4: Headline overview of EAP progress

221. There is a further requirement for us to provide an Annual Environmental Report (AER) on the specific outcomes and deliverables associated with the Environmental Action Plan (EAP) within six months of year end. We intend to include a wider narrative around EAP performance at this time.

GHG (venting)

222. The aim of the GHG incentive scheme is to incentivise us 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 and ourselves.
223. The GHG venting allowance is set each year by Ofgem, the allowance for 2021/22 was 2,897 tonnes. For each tonne of natural gas vented over the allowance we are subject to a price and a subsequent cost payment and for each tonne of natural gas vented under the allowance we are subject to a price and a subsequent revenue payment. These are based on our NTS GT Licence, as detailed in Special Conditions 5.6, Part D.
224. For 2021/22 this price was £1,916 per tonne of natural gas vented, this is an increase of £420 or 28% from 2020/21. The carbon reference venting price has increased by 28% to reflect the UK's ambitious climate goals, where the previous values were based on an 80% emissions reduction target whereas the new values are consistent with both Net Zero and Paris 1.5 degrees C which seek to reduce the carbon impact.
225. Compressors are used to increase pressure in parts of the National Transmission System (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).
226. The need to operate an individual compressor on any given day is dependent upon several variables, including the sources of demand and supply, the prevailing network conditions, and the need to accommodate maintenance and construction plans.
227. The total amount of natural gas vented from compressors in 2021/22 was 2,061 tonnes, which is 71% of the target allowance. This is a 9% improvement compared to the total amount of natural gas vented from compressors in 2020/21. The average venting through compressors in the last 10-year period including 2021/22 is 2,962 tonnes, with maximum venting of 3,928 tonnes (2017/18) and a minimum 2,061 tonnes this year.
228. We recognise the need to act responsibly and reduce GHG emissions from our own operations and demonstrate our commitment through a Net Zero target for our own direct greenhouse gas emissions by 2050. Therefore, we had an increased

focus in 2021/22 to not only continue to leverage the performance improvements identified in previous years, but we also undertook a summer compressor engine inhibiting and washing trial to allow non-critical compressor units not required over the summer period to be temporarily isolated from the network. The process involved the engine internals being sprayed with an environmentally friendly preservative spray to prevent the deterioration of engine condition through good engine healthcare management.

229. The engine inhibiting trial forms part of our continued focus on emissions and asset health approach. This trial saved circa 200 tonnes, in 2021/22, of venting that would have otherwise occurred due to the compressor units being isolated from the network. With compressor engines inhibited they did not then require 28-day test runs, hence saving non-operational venting. This trial was successful and therefore will be further rolled out in summer 2022, subject to flow patterns and operational requirements.
230. Other initiatives to support the continued focus across our business to reduce compressor venting emissions and asset health improvements include, but are not limited to; early analysis with GNCC to identify future flow requirements to make early compressor depressurisation decisions saving unit static seal losses, compressor maintenance procedural improvements to reduce venting occurrences while maintaining test requirement integrity, control panel improvements reducing emergency shutdowns. In addition, several units were isolated from the system early for summer maintenance further reducing test requirements. These initiatives and the early unit isolation reduced compressor emissions by a further circa 300 tonnes, we will continue to implement these initiatives in 2022, subject to flow patterns and operational requirements.
231. The GHG emissions calculation methodology for calculating the mass of Natural Gas vented will be verified by an Independent Examiner and will be submitted to the Authority by 31 July 2022.
232. November 2021 saw the advent of new commitments and regulations for methane emission abatement on the world stage. Prior to COP26, the US, EU and UK brought forward a pledge to reduce methane emissions by 30% on 2020 baselines by the end of 2030. This was followed by strong commitments in the US through the announcement of legislation to further control and report emissions, which emulate the regulations currently being considered in the EU. As COP26 ended in Glasgow, over 100 countries signed up to the pledge, attempting to stem the significant warming potential posed by methane emissions in the short-term.
233. We are currently progressing discussions with Ofgem to trigger the Net Zero Pre-construction and Small Net Zero Projects Re-opener (NZASP) uncertainty mechanism. This would expand our methane emission monitoring and quantification capability over and above the already funded Monitoring of Real-time Fugitive Emissions system (MoRFE), which came from the successful delivery of the Greenhouse Gas Investigative Mechanism (GHGIM) special licence condition in RIIO-T1.

234. Since the Final Determination MoRFE award, we have agreed with Ofgem to re-purpose this funding for periodic monitoring equipment. We have also continued the CH4RGE programme, exploring other operational methane emission reduction options via the Strategic Innovation Fund (SIF). This has had a specific focus on supporting our contribution to the UK's net zero challenge, by determining and demonstrating capture and recompression technologies that can be deployed on the existing gas network, to reduce vented compressor emissions. We have completed an initial 'Discovery' phase and now intends bringing further development and trial implementation within is NZASP uncertainty mechanism proposal.

NTS Shrinkage

235. 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.
236. Total NTS shrinkage costs for 2021/22 were £190m (in 2018/19 prices), including £139m for gas, £29m for electricity and £14m for emissions. All of these components were significantly higher than 2020/21 and previous years in RIIO-T1, driven by the large rises in global market prices for energy.
237. 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 3,506 GWh in 2021/22. This represents a decrease in overall volume of 910 GWh from 2020/21. This was driven by a decrease of 920 GWh in the volume of UAG, with smaller changes in OUG (down 69 GWh) and CV Shrinkage (up 80 GWh). UAG volume was 31% lower year-on-year. (This is pre-reconciliation UAG, which includes some energy that is reconciled to particular users after close-out.)
238. The volume of gas used for compressor use (OUG) was a 69 GWh lower than in 2020/21, while electric consumption for electric compressor units saw a small increase of 16 GWh. Compressor use is primarily driven by the supply/demand patterns presented by the market, which vary year-to-year, and different compressor units at different sites have different efficiencies in relation to compressor fuel use.
239. CV shrinkage volume was around a third higher than in 2020/21, with this component remaining a relatively small part (around 9%) of overall gas shrinkage. This was driven by CV capping in the winter months in the Northern and North-East LDZs, 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. No practical mitigation was identified to prevent this happening.

240. For gas shrinkage for 2021/22, 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 to mitigate against increasing prices. Over the year, forward purchases (for seasons, quarters, and months) totalled 97 million therms, 85% of the net total volume of gas trades. In April, we completed compliance for the new UK Emissions Trading Scheme (ETS) for gas compressor emissions in 2021.

Environmental Incentive

241. Through the development of our RIIO-T2 business plan, we listened to customer and stakeholder feedback and used this to develop an Environmental Action Plan (EAP), which set out how we intend to take forward specific actions relating to the environment. The EAP included stretching targets that went above our Licence obligations and it was recognised that there was value for consumers and wider society in incentivising some of these EAP targets. The following section discusses the Environmental Scorecard output delivery incentive term (*ESIt*), which outlines whether we have reached our yearly targets within the incentive. This provides us with the potential to receive a reward or penalty in relation to our performance.

242. The protection and enhancement of the environment is factored into all of our major investment proposals across our investment decision packs. This includes specific investments where deliverables are driven by environmental challenges, such as including the cost of carbon into decision making processes through our cost benefit analysis.

243. The following narrative defines our environmental incentives reporting progress, however, it can be noted that due to this being the first year that the Environmental Incentive has been reported on, there are no previous submission figures available for comparison and instead, baseline figures are used.

244. The table below summarises our 2021/22 performance against our EAP targets.

Environmental Incentive	Baseline levels	Benefit threshold	Penalty threshold	2021/22 level	2021/22 % difference to baseline	RAG
Operational transport emissions (tCO ₂ e) (% change)	1748 (2021 forecast)	-12% (1,538.24 tCO ₂ e)	8% (1,887.84 tCO ₂ e)	1751.25	0.2%	
Business mileage (tCO ₂ e) (% change)	1608 (2019/20)	-3% (1,559.76 tCO ₂ e)	-1% (1,591.92 tCO ₂ e)	605.89	-62.3%	
Percentage of operational and office waste recycled (value)	-----	52%	44%	87.4%	-----	

Office waste generated in tonnes (2019/20) (% change)	54.60	-3% (52.96 t)	-1% (54.05 t)	28	-49.0%	
Office water use in m3 (2019/20) (% change)	7,380	-3% (7,158.6 m3)	-1% (7,306.2 m3)	1,699	-76.98%	
Environmental value of non-operational land (£m) (% change)	32.92 (2020/21)	1.4%	0.6%	£0.7m increment	2.2%	

Table 5 – Environmental Incentive performance against baseline targets

245. We have a key climate commitment to reduce carbon emissions by 2026, with various strategies outlined to achieve this. Vehicle emissions is a key component of our climate commitment, with only electric vehicles (EVs) now being available for company car usage. Our operational transport emissions target is set at 1,538.24 tCO₂e to achieve the benefit threshold. With 1751 tCO₂e emitted for 2021/22 target levels were not met this year, but this value is below the penalty threshold.
246. Target business mileage emissions are set at 1,559.76 tCO₂e to achieve the benefit threshold. Results for 2021/22 were 605.89 tCO₂e, meaning our benefit threshold was exceeded. An increased use of hybrid working is accounting for a reduction in our vehicle use, with a greater use of virtual events having a positive impact on our commitment to reduce our business mileage in addition to the mileage from our customers and stakeholders.
247. Our *ESIt* targets state that we want to see an increase in the percentage of operational and office waste that is recycled. The combined office and operational waste for 2021/22 was 87.4%. This exceeded our benefit threshold target of 52% outlined in the *ESIt*. Furthermore, the total office waste generated in tonnes was 28t for the 2021/22 which exceeded the benefit threshold target of producing 52.96t or below. Whilst not outlined in the *ESIt*, it is worth noting that in line with our 100% waste diversion from landfill target, only 0.714t out of a total 28t of office waste reached landfill due to a transfer station fire. Due to the event being beyond our control, it is expected that office waste will reach this target in subsequent years. This performance benefit is currently being attributed to the COVID-19 pandemic that resulted in work from home guidance, and hence, a reduced office usage.
248. Within the *ESIt* our office water use targets further outline that we are aiming for water use to be at 7,158.6 m³ or below in order to reach the benefit threshold. Water use for the 2021/22 considerably exceeded this with a total of 1,698 m³ used. Likewise, to the waste targets this performance benefit is currently being attributed to the COVID-19 pandemic that resulted in work from home guidance, and hence, a reduced office usage.

249. Finally, we are working towards increasing our environmental value on non-operational land, through increasing biodiversity and natural capital. At the Aylesbury Woodham Partnership Agreement, 9.5 hectares of land have been 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. This achieved a 2.2% increase in natural capital valuation for 2021/22, 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% for the 2021/22.

Redundant Assets

250. As the requirements on the NTS change, there are assets on the network that are no longer required by National Grid 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 detrimental impacts to the environment.
251. 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.
252. We have now commenced a five-year Design and Build programme, leveraging efficient bundling and working with specialist contractors, to ensure optimum delivery, waste management and safety performance are delivered.
253. During 2021/22 we have pursued early opportunities to deliver efficiently, combining works with customer related projects and opportunities to recover value from major assets.
254. The below table shows progress made to date in the first year of our programme, we have progressed a number of the Price Control Deliverable (PCD) outputs through our investment process.

PCD Output Status	Volume of Outputs
Planned	41
Planned (Pending customer application)	1 (4/5 customer disconnections remaining)
Sanctioned - Conceptual Design Stage	25
Sanctioned - Build Stage	15 (inc 1/5 customer disconnections)
Not progressing	3
Total	85

Table 6 – Breakdown of delivery for Redundant Assets

Completed Works to Date

255. In the first year of the RIIO-T2 period, there have been five redundant asset outputs that have progressed through design to build stage and have been physically completed:

- Enron Billingham AGI (Fully delivered, alternative spec) – An alternative specification has been delivered as the opportunity arose through conversations with the landowner whilst on site to hand over the fence and hardstanding, rather than demolishing as the landowner wanted to retain them. This opportunity identified during the project has promoted the reuse of assets, whilst still being able to remove them from NGGT ownership so any future risk and maintenance liability will be removed. The handover of assets has not yet been completed as it has added additional activities for National Grid to legally transfer the ownership of the assets to the landowner.
- Feeder 6 Billingham ICI to Enron Billingham (Fully delivered)
- Carnforth Compressor Station – Unit A (Fully delivered) – An opportunity arose to make an agreement with a third party where they would carry out some decommissioning activities for us in exchange for taking ownership of some assets for reuse. This work was accelerated to take advantage of this opportunity.
- Customer Connection at five sites (First site disconnection: Gowkhall) – Fully Delivered – note this is one of five customer disconnections that relate to a single output.
- Sellafield Powerstation – Flow control valve and control cabinet. (Fully delivered).



Figure 9: Demolition works on site at Carnforth (Unit A)



Figure 10: Demolition works on site at Enron Billingham AGI

256. These outputs have been successfully completed on site and are now in the project closure phase, targeting final asset register update and financial reconciliation during 2022/23.

Works not progressing

At present we believe there are three outputs that we are not expecting to progress, these are:

- Feeder 17 (Theddlethorpe-Hatton)
- Feeder 8 (Theddlethorpe-Hatton)
- Hatton – Decommissioning two PIG traps and associated assets.

257. These outputs have all been impacted by a new customer request to connect to the network at Theddlethorpe, this means that one of the feeders is no longer redundant as it is required to be retained to flow the customers gas onto the network. At Hatton the PIG traps will also need to be retained to ensure the retained feeder can be in-line inspected. The second feeder also needs to be retained due to the low volume of gas being input by the customer. The customer will not be inputting sufficient gas to propel a PIG to inspect the line (which is required to ensure its integrity), therefore, both feeders will need to operate in a loop configuration which will enable gas from elsewhere on the network to be used to propel the PIG.

Works Currently at Build Stage

258. In 2021/22 we undertook Conceptual Design and procured long lead materials for Decommissioning activities to take place in 2022 and have now awarded Design and Build contracts for the following eight sites, to be delivered in 2022:

- Moffat Compressor Station
- Theddlethorpe Terminal
- Churchover Compressor Station Units A and Unit B (2 PCD outputs)
- Austrey AGI, Shustoke AGI and Feeder 14 (Austrey-Shustoke) (3 PCD outputs)
- Yarm Tees duplicate river crossing
- Lennel Tweed duplicate river crossing
- Asselby to Drax duplicate river crossing
- Feeder 7 Towton - Asselby

Works at Optioneering and Conceptual Design Stage

259. We have commenced works on twenty-five outputs at conceptual (4.2) stage.

Bundling, efficiency and contract improvements

260. A number of PCD outputs have been bundled with other project works ongoing to encourage efficient delivery and avoid duplication of resource, additional site establishment and to encourage efficient contract strategy, these are:

- St Fergus Terminal and Bacton Terminal – work is to be delivered by the respective local delivery teams to avoid duplication of site establishment and to remove the risk of having more than one team on site at once.
- Asset Health – two redundant River Crossings have been awarded for Design and Build to be delivered by the Asset Health team in 2022. The Asset Health team have experience of undertaking this type of activity and are completing other Asset Health works in the same location.

261. One area we have sought improvement is how we carry out our design phase of the works. We have taken on a Design Engineer with a view to in-housing the design works to retain better control of the process and to deliver the phase more efficiently.

262. As we have only historically delivered a small amount of decommissioning work, contractors were generally called off existing frameworks to deliver the works. Due to the significant increase in demolition type activities work is ongoing to set up specialised commercial arrangements with contractors who are suitably sized and skilled to complete these works for us. This has been under development this year and is expected to be complete during 2022/23.

Sustainability and Innovation

263. As part of the work that has been delivered this year, various assets have been recovered and reused by the Innovation team as part of the FutureGrid project. Assets recovered include a complete Exit Point (Enron Billingham) and a Flow Control Valve (Sellafeld). Instead of recycling or scrapping these assets, they will now be reused and have been incorporated into the Hydrogen test facility National Grid is building at RAF Spadeadam. This project will support our understanding of how Hydrogen interacts with our existing assets on the network. Reusing assets helps us to improve the sustainability of the Redundant Assets work, it also will support the research taking place which will support us towards repurposing the NTS to transition to transporting hydrogen in the future which could offer a future Hydrogen network to consumers at a lower cost than building new.

VIII. Innovation

264. Gas Transmission's innovation strategy consists of three RIIO-T2 Innovation themes: 'Fit for the Future', 'Ready for Decarbonisation' and 'Decarbonised Energy System', that support the business in preparing for net zero.

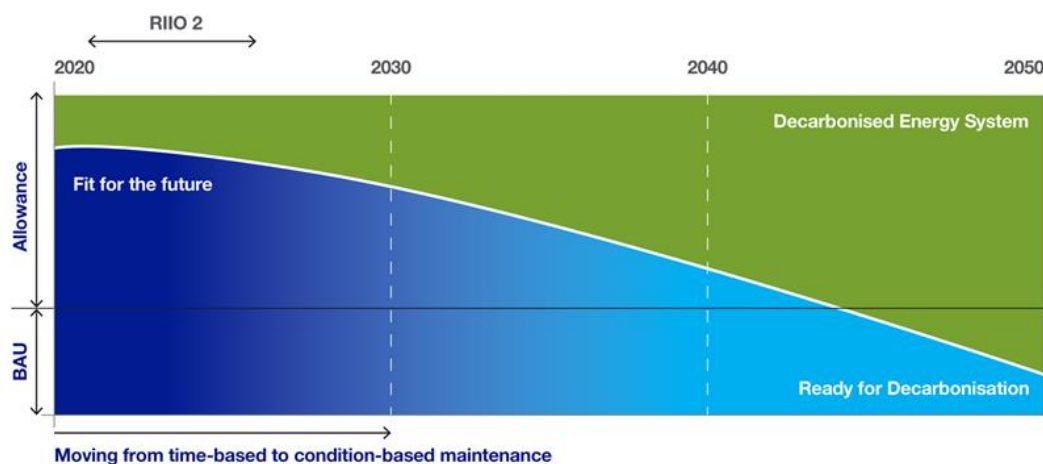
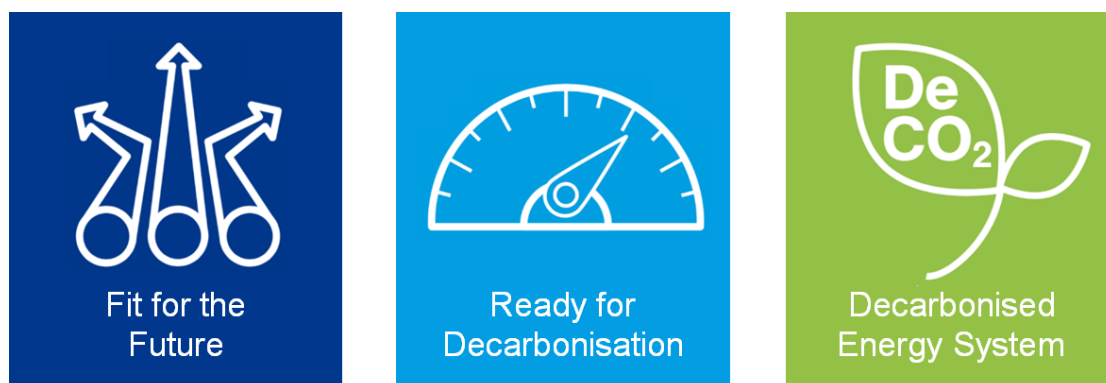


Figure 11: Gas Transmission RIIO-T2 strategic schematic

265. Fit for the Future focuses on extending the pipeline lifetime and enabling its use for the net zero future. Ready for Decarbonisation looks at those key assets and technologies that will be needed for the integration of net zero gases into the National Transmission System (NTS) and Decarbonised Energy System develops the systems and processes that are needed to run a net zero gas network.
266. These themes provide a roadmap of projects through to 2050. To further support this strategy, five Innovation Technology Portfolios have been established, each with its own technology roadmap and specific project pipeline. They each focus on net zero, specifically on hydrogen, examining the suitability of hydrogen as a cleaner alternative to natural gas and identify what changes may be needed across Gas Transmission to accommodate this.
267. The five Innovation Technology Portfolios are:

Asset Development for Risk Mitigation - Asset development for risk mitigation focuses on developing an understanding of our current asset landscape and its capability with future net zero gases. This includes developing solutions for compression, storage and capture of hydrogen.

Digital Systems and Simulation - Digital systems and simulation links with automation and measurement to develop Internet of Things (IOT) solutions that provide real insights for the core gas transmission teams and looks at the future options for digital twin solutions and the use of machine learning (ML) and artificial intelligence (AI).

Automation and Measurement - Automation and measurement focuses on all sensing systems within the gas network, as well as assessment methodologies such as the use of pipeline inspection gauges and robotic assessments.

Materials and Processing - Materials and processing focuses on solutions to help improve our materials resistance for current and future scenarios, whilst developing novel robust techniques to repair NTS assets more efficiently and help extend their lifetime.

Business Strategy and Development - Business Strategy and development focuses on the operation of the NTS and builds an understanding of how this may evolve with the market changes through the energy transition.

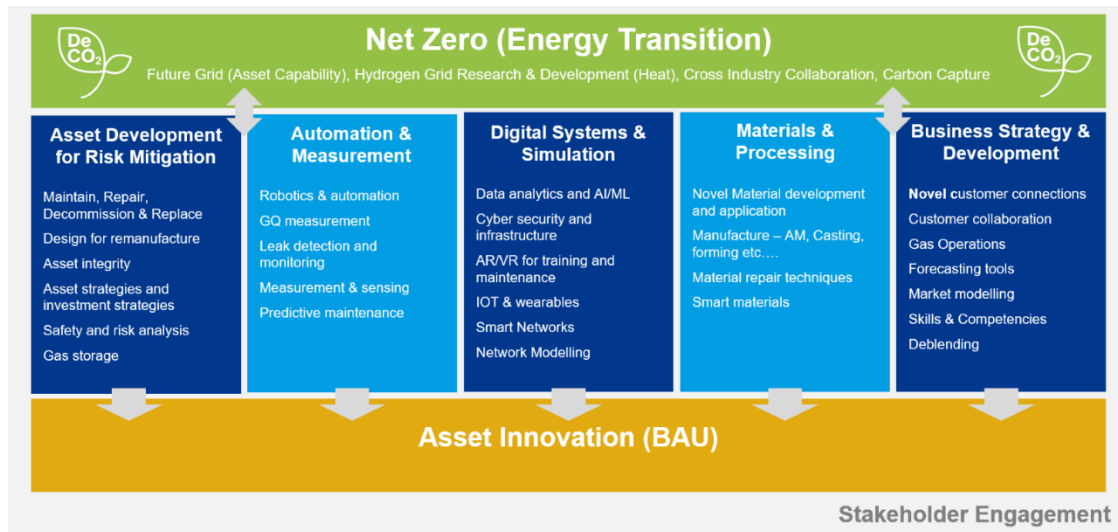


Figure 12: Gas Transmission Innovation Technology Portfolios

268. The portfolios tie into an overarching plan to transition us towards hydrogen and net zero. This is in support of Project Union and the development of the UK's hydrogen backbone. The below diagram highlights some of the innovation activities either underway or proposed for delivery.

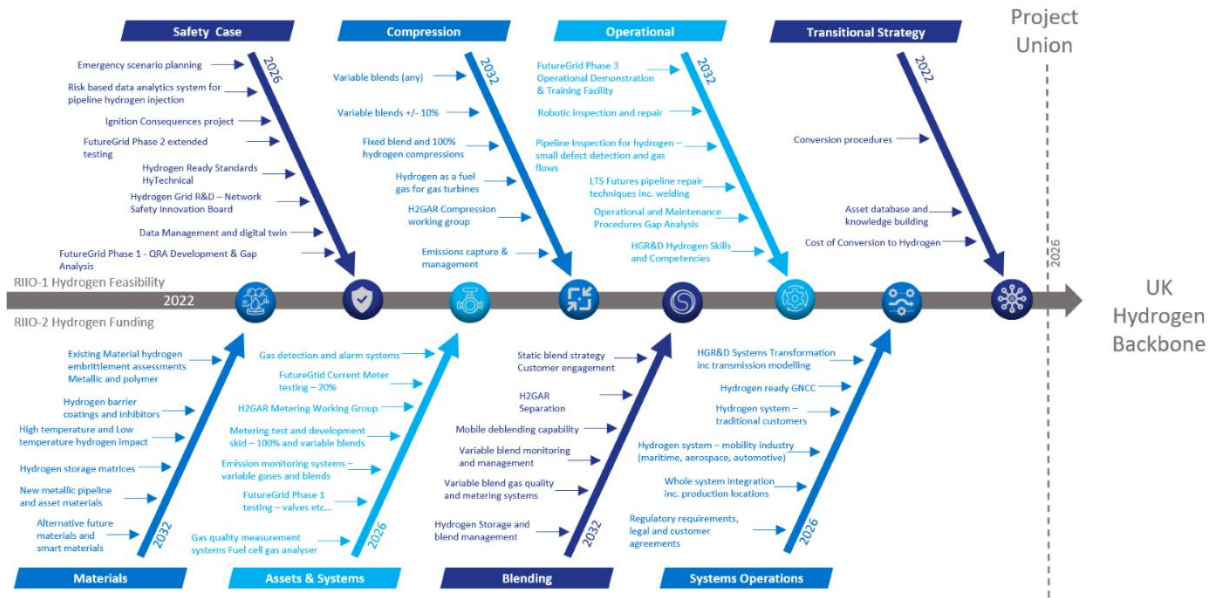


Figure 13: Innovation activities to support UK hydrogen backbone

269. In more specific detail, listed in the below diagram were the in-flight projects as of March 2022.

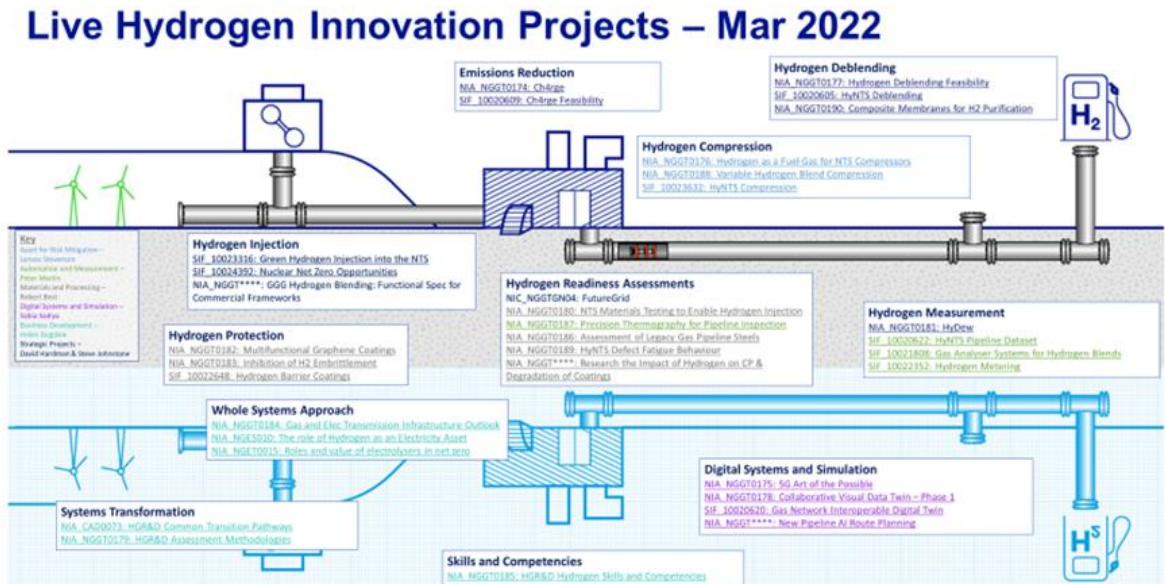


Figure 14: Graphical snapshot of innovation activities underway in March 2022.

Network Innovation Allowance (NIA)

270. In 2021/22 the innovation team undertook 17 new NIA projects and spent £2.17m. An additional eight projects were sanctioned but have not commenced yet due to the timing of the sanctioning and contract establishment. One project was carried forward from RIIO-T1 into RIIO-T2; this being GRAID, a project

designed to incorporate acoustic resonance technology onto our robotic platform to improve its inspection efficiency, which was closed in March 2022.

271. Compared to the performance from the previous financial year, the figures are down from 32 NIA projects with a spend of £4.9m. This has been due to a number of contributing factors. This has been the first year of a new regulatory period with adaptation to amended governance and project focus. Several sanctioned projects were subject to lengthy contractual negotiations and delays due to the governance changes and contractual requirements, which slowed the pace of realising the financial spend to sanction value. Additionally, SIF projects, new for RIIO-T2, drew resource away from NIA project development in the reporting period. When accounting for both NIA and SIF projects started in 2021/22, the figure is 27, broadly comparable to the previous NIA total of 2020/21.
272. The innovation team has been resourced to enable project portfolios to be managed by technology experts across the five portfolios (seen at Figure 12). These leads are responsible for progressing the NIA/SIF projects in their theme, engaging with relevant stakeholders and developing new ideas into projects. Alongside this, a business-as-usual innovation team has been formulated to support the deployment of the NIA and SIF projects into the business.
273. Of the 17 projects, six were completed within the financial year, as well as the GRAID project. These were:
- HyDew - The project was a desktop study looking at the theoretical impact that different hydrogen blends could have on the hydrocarbon dew point and water dew point within conventional gas mixtures. The study helped to inform the reviewed and updated the hydrocarbon dewpoint calculations need to adapt for hydrogen blend scenarios. The results obtained from the study show that the addition of up to 20% hydrogen and natural gas does not significantly affect the hydrocarbon dew point or the water dew point.
 - 5G – Art of the Possible - The project explored opportunities that the 5G network could offer with regard to the provision of high bandwidth wireless communications. Four main use cases were identified: communications resilience, asset management, workforce management digitalisation and supervisory control (SCADA). This preliminary work has opened more avenues of investigation which should lead to 5G trials.
 - Developing a Hydrogen Study for Cumbria - The project created a vision and pathway for creating a hydrogen system in Cumbria and assessed key drivers for this. The project outlined a number of advantages Cumbria has relative to other areas. Also, the study highlighted that Cumbria has the potential to become a vital hydrogen producer and suppliers for the whole of the UK, as well as a permanent CO₂ storage location.
 - HGR&D ST – Assessment Methodologies - The project developed and provided recommendations for a methodology of appraising a set of end states, pathways and scenarios that will be utilised within the System Transformation

programme. Six clear assessment areas have been set out as a result of this work and for each of these areas an assessment methodology was developed. The project represented Phase One, and Phase Two will look to fill the gaps this assessment identified.

- HGR&D ST – Common Transition Pathways - The project developed credible end states, pathways and scenarios for the System Transformation programme.
- CH4RGE – Methane Reduction from Gas Equipment – Phase 2 - The project progressed the technological development of a solution to capture and reuse vented emissions. The success of this project led to the generation of a successful SIF Discovery project and a follow on UIOLI project in RIIO-T2 Year 2 as the development of this technology looks to progress into Business-As-Usual.

274. The projects in delivery provides a good base for the following years in RIIO-T2 with a pipeline that can be accelerated utilising the contractual templates developed and guided by the early project findings. We continue to focus on collaboration and exploring new opportunities and in spite of COVID-19 restrictions, we have continued a close working relationship with the Gas Networks via numerous forums, primarily virtual in nature.

275. There has been a continued focus on both external and internal stakeholder engagement this reporting cycle. In total, there have been in-excess of 140 engagements in the financial year. This has covered supplier meetings, conferences, workshops, meetings with government bodies and webinars. Some highlights are outlined below:

- Shaping the Future – Innovation webinar - Held in November 2021, this platform enabled the team to communicate the latest innovation project developments as well as provide a setting to explore future opportunities. The event was attended by 75 people, representing 19 separate stakeholder groups. The webinar received a Net Promoter Score of 33.
- Energy Network Innovation Conference - Due to COVID-19 restrictions the event held in October 2021 was virtual. This still provided a great platform in which to have meaningful engagement with key stakeholders. We are now supporting the development of this critical conference into the Energy Innovation Summit (EIS).
- Gas Transmission SME forum - This quarterly event is designed to inform key internal stakeholders of the latest innovation activities. Additionally, this forum is a platform open dialogue with the SMEs on current pain points and a collective transfer of information from the various working groups the SMEs are members of.

Strategic Innovation Fund

276. New for RIIO-T2, the Strategic Innovation Fund (SIF) provided us the opportunity to apply for additional funding support for key large-scale transformational research and development activities. This fund is competitive across the energy networks and pleasingly we were successful in 10 of 11 Discovery bids.
277. The unsuccessful bid was EcoNET Telemetry, a proposal to create a pathway to modernise the future of telemetry solutions. The funding body ultimately decided the proposal was closer aligned to BAU rather than innovation.
278. The 10 successful bids were for what the fund terms 'Discovery Phase' projects, these are feasibility projects lasting two months from March 2022 to April 2022 and straddled two financial years.
279. The 10 successfully funded SIF projects were valued at £1.111m total funding; when allocated among the collaborative project partners this represented £0.173m funding direct to Gas Transmission and Metering. These discovery phase projects will provide the foundation for future Alpha and Beta phase funded projects for which we will be bidding for in financial year 2022/23.
280. The successful SIF Discovery projects are outlined below:
- HyNTS Compression - This project investigates the key challenges associated with compression of hydrogen using existing national transmission system (NTS) assets. This work will take learning from desktop studies and lab testing to determine the most cost-effective compression option for the gas networks and demonstrate the capability at the FutureGrid site.
 - HyNTS Deblending - This project aims to provide an offline demonstration of gas separation or 'deblending' technology on a gas network scale. The project aims to develop a skid mounted, mobile solution to demonstrate hydrogen fuelling from the NTS for the future transport network.
 - CH4RGE Emissions Capture - The project will determine whether the use of capture and recompression technologies can be deployed on the existing fleet of rotating machinery equipment, eliminating emissions from compressor leaks for both methane and hydrogen fuel gas options.
 - Green Hydrogen Injection into the NTS - This project focuses on the technical challenges of injecting and blending small volumes of 'green' hydrogen into the NTS, focussed on the localised impact of hydrogen.
 - Hydrogen barrier coatings for Gas Network assets - This project looks into the potential for deployment of hydrogen barrier coatings via electrodeposition onto the internal surface of a pipelines and other assets.

- Fuel Cell Gas Analyser and Data Analytics - This project aims to demonstrate a fuel cell gas analyser for blends of hydrogen and natural gas up to 100% hydrogen in the NTS.
- Gas Network interoperable Digital Twin - This project develops an interoperable digital system and twin of the transportation and distribution gas networks, building on work done by BSI and linking into the wider energy networks.
- HyNTS Pipeline Data Set. This project will address several challenges within the Inline Inspection industry as the pipelines are transitioned to hydrogen. Different inspection tools, techniques and criteria.
- Hydrogen Metering. This project will investigate how gas metering will change as the network is transitioned to hydrogen. There will be scope for demonstration of new technology, potentially at FutureGrid.
- Nuclear Net Zero Opportunities. This project will investigate how nuclear hydrogen, both at a large and small scale, can provide consistent hydrogen injection into the UK gas networks.

IX. Net Zero

281. 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.
282. 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 that we would 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.
283. Project Union is Gas Transmission's flagship project which will begin the first transition to hydrogen by creating a 100% hydrogen 'backbone' for the UK by repurposing existing transmission pipelines through a phased approach. A circa 2,000km hydrogen backbone would be created, representing around 25% of the UK's current natural gas transmission pipelines by the early 2030's.

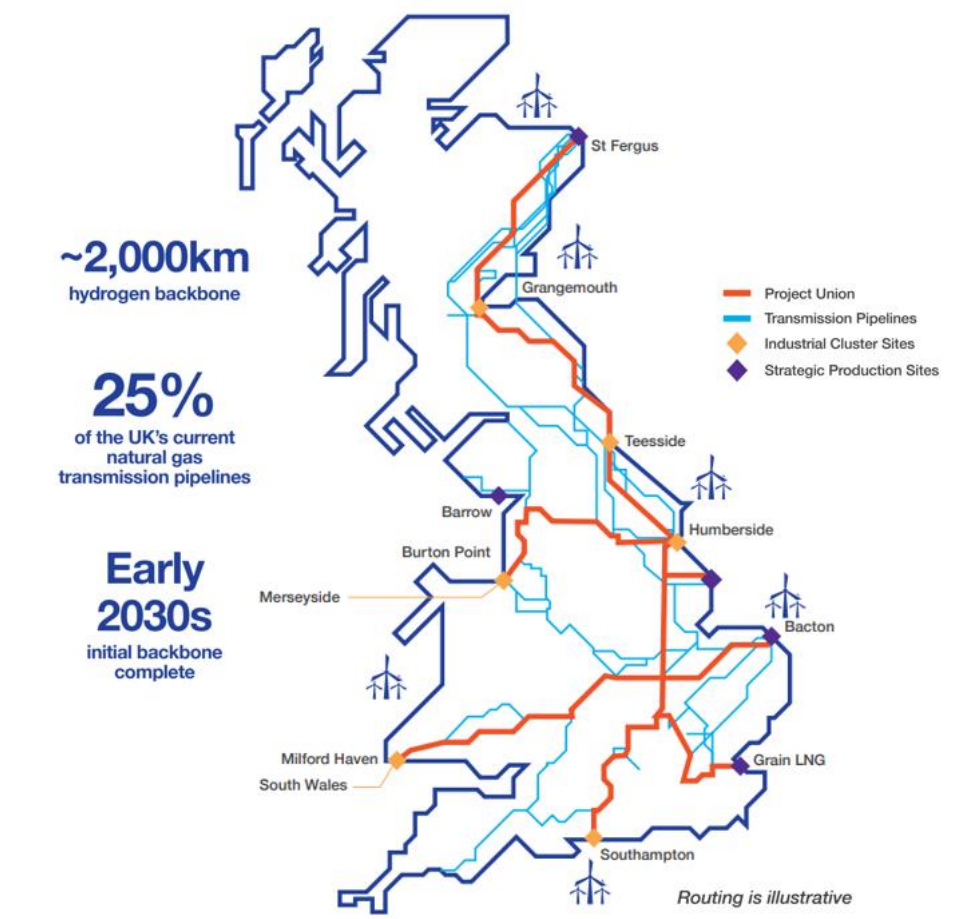


Figure 15: Project Union Illustrative Map

284. Several regional projects have been initiated in collaboration with other gas networks to ensure alignment and coordination of plans. In parallel, stakeholder engagement across the supply chain is ongoing to support the development of regional strategies, feeding into Project Union's transition plan. Each considered pipeline conversion will progress from early feasibility phases into project development and construction.

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

285. In 2021/22, we are focusing on strategy activities that will support Gas Transmission to achieve net zero by 2050. The NZARD UIOLI funding, new to RIIO-T2, enables and facilitates early development work on strategic projects which are critical to progress further through net zero re-opener mechanisms.

286. In 2021/22, the Hydrogen Programme team undertook eight new UIOLI projects and spent £0.805m with six projects being carried forward into 2022/23.

287. The Hydrogen Programme team has been resourced to enable project portfolios to be managed by regional leads. The regional leads are responsible for collaborating with other gas networks and industry across the UK and Ireland, shaping the roadmap for hydrogen blending and a full transition to a hydrogen network across each region to ensure co-ordination and collaboration on transition plans. This also enables best practice and innovation to be shared between regions.

288. NZARD UIOLI project descriptions:

- Project Union Strategy - Project Union will connect the key hydrogen production and use centres via mostly repurposed NTS pipelines, with an expected small amount of new infrastructure being built as necessary. Connecting the centres via pipeline will offer resilience to customers, as hydrogen production will not rely solely on local production. The early development work within this project sets up further Net Zero reopener funding for construction. This project completed within the reporting period and spawned further UIOLI projects.
- Project Union Transition Strategy - This project builds on the Strategy project to prepare the business to deliver the Project Union feasibility phase, which includes pre-FEEDs for the first pipelines by developing the required evidence and developing the business case to successfully trigger funding from either the Department for Business, Energy and Industrial Strategy (BEIS) or OFGEM.
- East Coast Hydrogen - This project is a collaboration with Cadent and Northern Gas Networks (NGN). The project was a feasibility study to demonstrate the roll-out of hydrogen from the industrial clusters to industry, power and heat customers across the East Coast region. This project closed within the reporting period and the outputs have led to a pre-FEED project.

- European Hydrogen Backbone - Phase Two - 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 builds on phase one work by deep diving into hydrogen supply and import corridors, storage, and geographical reach.
- Pan-European Integrated Hydrogen Infrastructure - This project looks 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.
- Capital Hydrogen - This project will look into London's future hydrogen supply, demand and storage requirements will be studied. It will establish a 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 the set-up of an over-arching programme for London's hydrogen conversion.
- The European Gas Research Group (GERG) H2 Velocities - The goal of this project is to determine and document what the impact is of using an existing natural gas transmission network for transporting hydrogen with the same energy capacity as for natural gas. Specifically, issues related to the required increase in flow or gas velocity will be identified to compensate for hydrogen's lower energy value per cubic meter.
- Network Modelling for BEIS Hydrogen Grid R and D - This project facilitates modelling provision to the System Transformation workstream which is a key component of BEIS'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.

289. Despite COVID-19, there has been a continued focus on both external and internal stakeholder engagement with an emphasis on our versatility in engagement methods with our key groups. Throughout this reporting cycle, there have been over 140 engagements across webinars, conferences, podcasts and events. Some of our key external stakeholder engagement sessions are highlighted below:



Figure 16: Stakeholder Engagement Sessions

- Shaping the Future – Transitioning to a Hydrogen Backbone webinar. Held in December 2021, the team communicated the key challenges we need to address to transition the transmission network to hydrogen combined with an overview of the projects that look to answer them.
- Shaping the Future – Supporting Regional Hydrogen Transitions webinar. Held in December 2021, this session focused on what's needed to transition different regions across GB to hydrogen transmission.
- Project Union Stakeholder Engagement. We have engaged with approximately 80 stakeholders across the whole hydrogen supply chain to share our plans for Project Union. Throughout this engagement, key themes and benefits that matter to our stakeholders have been identified.
- Gas Operational Forum. We presented an update in February to the Gas Operational Forum on our current progress on Project Union and East Coast Hydrogen.
- East Coast Hydrogen – Launch Event. We launched our East Coast Hydrogen feasibility report at the House of Commons in December 2021 and it was attended by over 100 stakeholders across the hydrogen supply chain and the UK Energy Minister Greg Hands.



Figure 17: East Coast Hydrogen Launch

Net Zero Reopener

290. The Net Zero Reopener enables us to initiate the Authority to amend the value of our Totex Allowance if a Net Zero Development is expected to occur. In 2021/22, no projects started or were delivered under this funding mechanism but we are continuing to develop our portfolio and programme of work which have the potential to trigger a Net Zero Reopener in 2022/23.

Net Zero Pre-construction and Small Projects Reopener

291. The NZASP enables us to take forward early design, development, pre-construction work and projects which will advance the business towards accomplishment of our Net Zero Carbon Targets.
292. We are currently developing a NZASP submission to address methane emissions from operating the NTS. The submission seeks funding to trial engineering solutions to reduce methane emissions from compressor venting and seal losses as well as an expansion of our mobile recompression capability to capture vented emissions from pipeline maintenance and pigging operations. The submission also seeks funding to implement a network wide leak detection and repair (LDAR) programme on all above ground assets combining periodic and continuous monitoring techniques.
293. Throughout 2021/22, we have been utilising UIOLI funding for the Transition Strategy Phase of Project Union. We have been developing an application for a Feasibility Phase of Project Union to be funded through the NZASP. This application is anticipated to be submitted in 2022, subject to a decision being made on the provision of interim funding for hydrogen network infrastructure being carried out through RIIO-T2 and future price controls. The proposed scope for the Feasibility Phase has been developed through a combination of bottom-up and top-

down approaches, supported by high-level network modelling and options assessment methodology development and specific analytical approaches that support economic appraisal of options and the management of uncertainty in investment decision making.

X. Totex (TO and SO)⁶

294. The table below summarises spend and allowances (baseline and uncertainty mechanisms) for 2021/22 and for the five Year RIIO-T2 period.
295. 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	FY22 Totex Spend (£m, 18/19 prices)	FY22 Allowance (£m, 18/19 prices)	Cost vs Allowance (£m, 18/19 prices)	5 Year Totex Forecast (£m, 18/19 prices)	5 Year Allowance (£m, 18/19 prices)	Cost vs Allowance (£m, 18/19 prices)
TO Load Related Capex	7.5	4.4	3.1	83.9	79.0	4.9
TO Non-Load Related Capex	121.6	118.4	3.2	780.9	722.0	58.9
TO Non-Operational Capex	31.4	27.9	3.5	119.1	123.3	(4.2)
TO Other Capex	35.9	33.8	2.1	215.2	204.0	11.1
TO Opex	96.6	119.9	(23.3)	558.7	592.3	(33.6)
TO Totex	293.0	304.4	(11.4)	1757.7	1,720.7	37.1
SO Capex	20.0	26.8	(6.8)	149.1	140.2	8.9
SO Opex	51.4	63.8	(12.4)	291.5	317.8	(26.3)
SO Totex	71.4	90.6	(19.1)	440.6	458.0	(17.5)
Total	364.4	395.0	(30.6)	2198.3	2,178.7	19.6

Table 7 - Summary of 2021/22 and five-year forecast spend and allowances

296. In 2021/22 our Totex spend was £364.4m compared to allowances of £395.0m. The underspend against allowances is predominantly associated with TO opex, SO capex and SO opex, offset in part by higher than forecast expenditure against

⁶ All numbers in this section are in 2018/19 price base unless otherwise stated

load related capex, non-load related capex, TO non-operational capex and TO other capex.

297. Over the five year RIIO-T2 period, Totex is forecast to be broadly in line with allowances at £2.2bn.
298. Totex forecast and allowances include some spend for uncertainty mechanisms. Spend and allowances for Western Gas Network project are included in the table above as the needs case has been approved. The 2021/22 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. Further information can be found in RRP table 8.10.
299. A further breakdown of the key variances is detailed below.

TO Totex Overview

300. TO Capital Expenditure for 2021/22 was £196.4m against total allowances of £184.6m. Capital Expenditure for the five year period is forecast to be £1,199.1m against allowances of £1,128.4m:
301. Load Related Capital Expenditure was £7.5m against allowances of £4.4m in 2021/22. Of this, £2.4m relates to Western Gas Network Upgrade against £2.4m of allowances expected under the relevant Uncertainty Mechanism. There was £4.2m was incurred on unfunded projects, principally Felindre VSD project, which accounts for the majority of the forecast overspend versus allowances across RIIO-T2.
302. Non-Load Related Capital Expenditure was £121.6m, £3.2m higher than allowances. This includes £16.4m of expenditure at St Fergus, the subject of a future Uncertainty Mechanism submission for which no allowances have yet been reflected in 2021/22 or in the RIIO-T2 forecast. This results in expenditure of £13.2m below allowances on other Non-Load Related Expenditure. Generally, the lingering effect of COVID-19, higher surveying requirements and recruitment of new personnel have delayed investment in 2021/22, notably in Asset Health schemes. Asset Health spend was below forecast in 2021/22, primarily across Compressors and Pipelines. Bacton Site Redevelopment Feed spend was £5.7m below forecast, driven by the extended review of future strategy, with remaining variances across Stopples, Recompression and GRAID primarily phasing across the RIIO-T2 period. Hatton Emissions spend was £9.2m higher than forecast, which reflects timing of expenditure within the RIIO-T2 period. RIIO-T2 spend remains principally in line with allowances, except for the King's Lynn Subsidence UM where £0.8m of allowances are forecast to be returned and expenditure on RIIO-T1 Non-Load Related Capital Expenditure, principally on Peterborough and Huntingdon compressor works.

303. Non-Operational capex spend was £31.4m in 2021/22, £3.5m above allowances. This includes the purchase of four sites at a cost of £7.4m. In 2021/22, £4.9m of unfunded costs have been incurred, primarily relating to the implementation of a new Enterprise Resource Planning (“ERP”) system. IT programmes spend was lower than allowances in 2021/22, which reflects additional planning processes being necessary to determine the best and most efficient solution. Expenditure across the RIIO-T2 period is expected to be broadly in line with allowances.
304. TO Other Capex expenditure was £35.9m, £2.1m above allowances. The underspend against allowances across Physical Security Resilience, Cyber Resilience OT and Non-Operational Capex (inc. IT) reflects additional planning processes being necessary to determine the best and most efficient solution, notably in IT programmes. RIIO-T2 forecast spend of £215.2m is £11.1m higher than allowances, primarily reflecting spend carried over from RIIO-T1. In respect of Cyber Resilience OT, spend less than forecast for Years 1-3 UIOLI is expected and as such £32.6m of allowances are expected to be returned.
305. TO opex costs were £96.6m against allowances of £119.9m. Direct opex was £4.1m lower than allowances, with lower maintenance costs driven by reduced use of agency staff and procurement efficiencies, offset by higher fault costs caused by higher than expected levels of Linewalking and costs associated with prolonged severe weather, notably winter storms across Northern England and Scotland. TO Business Support costs and Closely Associated Indirect costs were £4.9m and £5.8m lower than allowances respectively with new ways of working and ensuring all teams are correctly resourced. TO opex is expected to be £26.3m lower than allowances across the RIIO-T2 period, reflecting the ongoing impact of the factors noted above.

SO Totex Overview

306. SO capital expenditure in 2021/22 capex in the SO was £20.0m, £6.8m lower than allowances. This was primarily driven by IT capex and Cyber Resilience, partly due to additional planning processes being necessary to optimise chosen solutions and drive efficient spend. The RIIO-T2 forecast expenditure is expected to be £8.9m higher than allowance, reflecting RIIO-T1 spend carried over. There has been £1.4m of unfunded costs have been incurred in 2021/22, primarily relating to the implementation of a new ERP system.
307. SO opex costs were £51.4m in 2021/22, £12.4m lower than allowances. This was primarily due to new ways of working and ensuring teams are correctly resourced rather than being reliant on contractors, which positively impacted both direct opex and business support costs. Closely Associated Indirect costs are broadly in line with allowances. SO opex is expected to be £26.3m lower than allowances across the RIIO-T2 period, reflecting the ongoing impact of the factors noted above.

Consumer Bill Impact

308. In 2021/22, the portion of the consumer bill attributable to National Grid Gas was approximately £7.30. This is a decrease compared to 2020/21 where the National Grid Gas portion of the domestic consumer gas bill was £7.72.
309. We have applied Ofgem's methodology for calculating the components of a domestic consumer's bill. Approximately 50% of gas transmission charges are recovered via entry charges and classified by Ofgem as costs entering the wholesale market prices. The exit costs, which include the 'direct' domestic sector consumption, are allocated to Gas Transmission network costs.
310. Our calculation of the customer bill impact is aligned to the above approach (allocating entry charges to the wholesale sector).

XI. Load Related Capital Expenditure (TO)

Introduction

- 311. This section covers our Load Related Capital Expenditure. In 2021/22 our expenditure was £2.5m compared to an allowance of £4.9m.
- 312. This variance was primarily driven by lower Load – UIOLI spend (£1.7m), Western Gas Network Upgrade (£0.6m) and Network Capability (£0.2m), with lower-than-expected Customer Funded Offtakes (£2.2m) balanced by lower Customer Contributions (£2.2m).
- 313. Currently, our forecast spend for RIIO-T2 remains in line with allowances.
- 314. In terms of RIIO-T1 unfunded Load Related Capital Expenditure, we have incurred costs in 2021/22 for Entry T1 Carryover works (£4.2m), principally driven by the Felindre VSD project.

Entry RIIO-T1 carry over (Felindre)

- 315. Felindre Compressor Station was built as part of the South Wales Expansion Project (SWEPE), 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.
- 316. 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.
- 317. 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, issues were identified and have been resolved. This included repairs to the motor and ancillary equipment needing repair or replacement.
- 318. During summer 2021 various safety compliance issues were identified; the majority of these were resolved ahead of winter 2021/22 commissioning runs.
- 319. We now plan to have the VSD available for use by autumn 2022, on a restricted operation basis. The restrictions will be in place until replacement of the control system is completed. We have adopted a self-delivery approach to complete the commissioning. Our Construction and Operations teams are working together to address the technical issues and to complete the test runs, using specialist contractors where applicable

Incremental Capacity - Western Gas Network Project

320. 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 request cannot be met by the existing network in any scenario and is therefore to be treated as Funded Incremental Obligated Entry Capacity. As reported last year, the project works will be carried out under permitted development rights.
321. Throughout 2021 we have continued our community and stakeholder engagement, including briefing the Welsh Government and engaging with local residents. We also commenced landowner engagement and submitted Permitted Development and Planning Act applications. Negotiation of Heads of Terms with landowners is ongoing and we expect to have voluntary agreements in place by early 2023. In parallel with voluntary land rights negotiations, we have been preparing to make a Compulsory Purchase Order (CPO) in accordance with our Land Rights Strategy; we expect to make the CPO in July 2022.
322. With the outputs of the technical studies we further developed our preferred option and submitted our Need Case in June 2021 as part of the RIIO-T2 Funded Incremental Obligated Capacity process; approval was published in December 2021. We continue to refine the scope, as well as seeking opportunities for efficient delivery.
323. The preferred option scope, which has the lowest capital cost with the greatest consumer benefit, is:
- Pressure uprating of the existing Feeder 28 Felindre to Three Cocks and Felindre to Cilfrew pipelines and associated installations
 - Compressor modifications at Wormington and Felindre to facilitate the increased flow and pressure (expected to include re-wheels and addition of load sharing control functionality at Felindre)
 - 9 km of new pipeline between Wormington and Honeybourne
 - 2 km of new pipeline between Churchover Compressor Tee and Churchover Multijunction (MJ)
 - Related works at several existing sites to facilitate the increased flow, pressure uprating and connection of new pipelines (Alltwern, Cilfrew, Felindre MJ, Llanwrda, Three Cocks, Tirley, Wormington MJ, Honeybourne, Churchover Compressor Tee, Churchover MJ)
324. Due to the impact of the Ukraine-Russia conflict on global prices and availability of materials, we are anticipating cost increases beyond our previous estimate. In the last few months materials quotes for the project have increased by around 30%. 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.

325. We are developing our procurement strategy and expect to award contracts for long lead items after September 2022. Purchasing materials ourselves and free-issuing to the Main Works Contractor shortens the timeline for the project, so we can meet the capacity release date of January 2026. It also allows us flexibility to purchase materials at an opportune time, given the current volatility in prices.
326. Work overall is proceeding to plan and we are on track for the Project Direction submission in spring/early summer 2023.

Network capability – changing customer needs

327. 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.
328. The works on both sites will be carried out as part of the wider yearly metering projects. These projects involve the replacement and upgrades of various metering assets on the network. Front end engineering and design activities are complete at ICI Billingham with physical works scheduled to start in 2022/23. Front end engineering and design activities at Weston Point are ongoing with physical works planned to start in 2023/24.

Network capability – Tirley Access

329. The Tactical Access project at Tirley AGI is required to enable filter maintenance to be undertaken without causing constraints on the network. 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.
330. The Western Gas Network Project includes works at Tirley AGI and therefore we have decided to deliver the Tirley Tactical Access Project in parallel, both to manage design interactions and to benefit from delivery efficiencies. We are on track for full project delivery within the RIIO-T2 period.

Offtakes

331. Delivering connections is a Licence obligation and important to continue to facilitate a competitive market supporting natural gas both entering and exiting the network. The end-to-end process can often take several years to complete considering the scale of customer projects, with projects moving through various stages including pre-application, application/offer, design, build and commissioning/go-live.

The NTS Connection Application to Offer (A2O) Process

332. In total, there were 11 NTS connection applications received within the A2O process during 2021/22.

333. Of the 11 applications made, six were for exit connections, three were for entry connections and two were for entry and exit connections at the same site .
334. Of the 11 competent applications received, five Final Connection Offer's (FCOs) were not due within this period and were carried over to 2022/23. Five offers were accepted and have progressed to either conceptual design studies, detailed design or construction. The remaining offer has not been progressed by the customer .

Connection Applications		Offers made in 2021/22	
Received in 2021/22	11	Applications not progressed	1
		Offers accepted	5
		FCO Extensions	0
		FCO Lapsed	0
		FCOs not made Application carried over to 2022/23	5

Table 8: Summary of the NTS Connection Applications and Offers

335. COVID-19 and the uncertainty in the market impacted the number of applications received during the first part of the reporting period although from January 2022 onwards we have seen a ramp up in activity for new projects.

Projects Carried forward from RIIO-T1

336. There are currently six connection projects carried over from the RIIO-T1 period in the detailed design and build phase. These projects will continue to progress with one expected to commission in the next period.

Disconnections

337. In 2021/22 we received one new application for a disconnection and have received enquiries about several others which will carry over to the next period. Customers are considering how they use their assets going forward, investigating both the continued use of natural gas and converting to green alternatives. We expect this transition to drive a number of modifications or disconnections to existing connections in the future.

Future Connection Requirements

338. We have continued to listen to our customers and stakeholders to understand their future connection requirements. An example from this year is UNC modification 0771S 'Removal of the absolute requirement to include a remotely operable valve (ROV) installation for new NTS entry connections'. Building on the lessons learnt

from recent projects and customer feedback we raised this modification to provide flexibility to new entry connection projects. Once implemented, all new entry connections will be risk assessed with a view to not including an ROV in the design where it is safe and operable to do so. Further data can be reported in the next period but the aspiration is a reduction in entry connection costs by 15-25% where this applies.

- 339. Another of our priorities has been to progress the IT deliverables in our business plan aligned to customer feedback. Work has begun to create an integrated external connections portal with internal workflow management capability. The project is being delivered using an agile approach so new functionality will be gradually released. We aim to improve the interface between the customer and our internal processes, ultimately delivering automation and efficiency to reduce overall connection costs.
- 340. We continue to engage both with networks and existing/new customers on several fronts to encourage more green gas connections onto our network in support of the pathway to Net Zero. We are progressing the feasibility stage of Project Union and have recently supported a blending innovation project with the other gas networks considering how hydrogen customers could connect to the network in the future.
- 341. This year we have received our first formal applications from customers wishing to use natural gas to produce hydrogen. We have also received our first biomethane connection application since the Murrow pilot project, supporting the wider transition to net zero over the coming years.

XII. Non Load Related Capital Expenditure (TO)

Introduction

342. This section covers our Non-Load Related Capex. In 2021/22 our expenditure was £83.2m compared to allowances of £111.1m.
343. The first year of RIIO-T2 has experienced slower than expected progress across many of our Non-Load Related Capex deliverables. The lingering effect of the COVID-19 global pandemic, together with a sharp increase in both surveying requirements and recruitment of new personnel for the new regulatory period have all slowed our expected rate of progress in 2021/22.
344. The key variances to forecast include:
- Asset Health – Our overall RIIO-T2 workbook is relatively unaffected, but slight delays in completing planned survey works have shifted some 2021/22 works into the later years of RIIO-T2. Our Asset Health spend was £19.2m below forecast in the first year of RIIO-T2. This is broken down as follows:
 - £21.2m lower on Compressors.
 - £5.3m lower on Pipelines, most of this relating to 'In Line Inspection Defect Digs'.
 - £1.1m lower on Civils.
 - £1.0m lower on Electrical.
345. Partly offset by the following:
- £5.5m higher on Valves, principally driven by spend relating to St Fergus Actuators (£7.5m), which have no baseline funding for, with funding expected through our Asset Health Uncertainty Mechanism (UM) re-opener.
 - £3.8m higher on Plant and Equipment (St Fergus UID's which fall under the Asset Health UM reopener).
 - £0.1m higher on Cabs.
 - Bacton Site Redevelopment Feed – our spend was £5.7m below forecast, principally driven by extended review time associated with the overall Bacton future operating strategy.
 - Stopples – our spend was £4.2m below forecast. Stopples costs will manifest themselves on pipeline interventions within the Pipelines Asset Health theme, only used where the relevant pipeline intervention cannot achieve without usual

outage shutdown and where we need to maintain supply, for instance to a customer.

- Recompression – our spend was £3.4m below forecast because of phasing. The work has now been sanctioned for delivery with expectation of delivery in both the coming financial year and next.
- GRAID – our spend was £2.9m below forecast due to phasing. The project teams are in process of being stood up with delivery scheduled within the RIIO-T2 timescales.

346. The above underspends were partly offset by higher than forecast within year spend on Hatton Emissions (£9.2m). The project timeline has been progressing towards the emissions compliance deadline of 31st December 2023, with site clearance and associated site establishment activities completed.

347. It should be noted that other than our St Fergus Compressor Emissions spend (£16.4m), no other spend has been applied to-date against our non-load UM's at this time, with all spend currently allocated against baseline allowances.

348. In terms of RIIO-T1 carry over Non-Load Related Capex, we have incurred £38.4m of costs in 2021/22. These costs cover the ongoing Peterborough and Huntingdon Compressor works (£31.1m), with further costs incurred on both asset health RIIO-T1 carry overspend (£5.6m) and Feeder 9 RIIO-T1 carry overspend (£1.7m).

RIIO-T1 carry over - Feeder 9

349. In 2021/22, we continued to progress closure of the Feeder 9 pipeline project associated with the Humber estuary river crossing. This investment was driven by our continuing concerns over the integrity of Feeder 9 due to rapid and unpredictable estuary movements that were reducing the depth of cover over the former pipeline. As the sole transportation route across the River Humber, Feeder 9 is one of the most critical pipelines on the NTS. It plays a pivotal role in the provision of entry gas from the Easington area to demand centres in the South and East, and to the UK gas market as a whole.

350. With the construction works completed, the project team have continued the demobilisation and project closure phase. Works have included:

- Restoration of land and access routes in accordance with Planning conditions.
- Handover of enhanced passing places to Highways Agency.
- Completion of all drainage installation, reinstatement and hedgerow planting completed to facilitate land hand-back in October 2021.
- Completion of enhanced environmental reinstatement measures (reptile hibernacula, owl boxes, swales and species rich environment, seeking to provide reptile friendly habitat) at Paull in line with planning condition.

- Completion of Cathodic Protection (CP) Operational Handover on 23 December 2021.
 - Compilation of data-books and records.
 - Condition monitoring during early life of the asset.
351. The commissioning of the bespoke CP system was phased to supply full CP to the pipeline in the 2020/21 reporting period. Due to the minimal amount of coating damage encountered during pipeline installation, the current demand was too low for the CP system to control. A design change was progressed to provide a new transformer rectifier (TR) that can control to this extremely low level of current. Final commissioning of the revised system was completed on 9 July 2021 in accordance with the plan. Final adjustment of the CP system and initial performance monitoring formed part of the project handover to the Operational team, with full operational acceptance completed on 23 December 2021.
352. With the former Feeder 9 pipeline no longer in operational service, the ongoing negotiations with Associated British Ports (ABP) have resulted in outline principles that the surveying of the pipeline, and the associated lease agreement, would commence a new inspection regime utilising a risk-based methodology aligned to appropriate industry practice for a disused pipeline. Initial results from these inspection findings will be used to determine evidence-driven future inspection frequencies.
353. Final decommissioning of the former Feeder 9 Humber Crossing is subject to a separate project with ongoing review to determine the most environmentally sustainable solution, whilst recognising the need to complete this in a cost-effective and efficient manner.

Compressor Emissions

354. For National Grid 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.
355. 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.
356. The figure below illustrates the compressor unit types across the NTS and their compliance with environmental legislation.

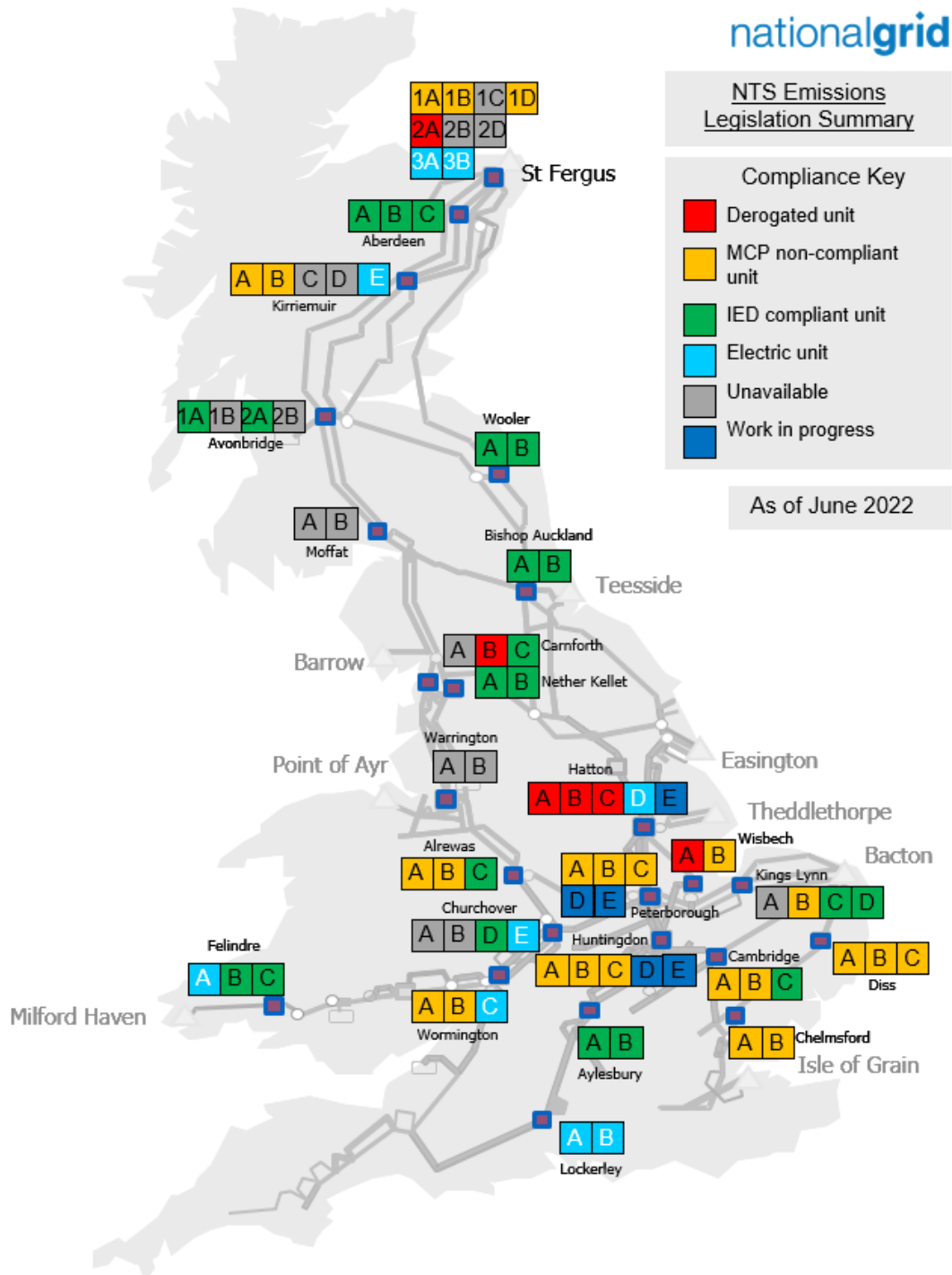


Figure 18: Compressor unit type and compliance with environmental legislation

Compressor Emissions – Peterborough and Huntingdon RIIO-T1 carry over

357. 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 19.



Figure 19: Importance of Peterborough and Huntingdon to the Midlands Axis - Enabling high LNG flow from Milford Haven to Bacton for exporting to or importing from Europe

358. 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. Assessment of flows shows that once national demand is above 250 mscm/d, parallel operation at Peterborough is critical. For example, without a resilient compression solution at Peterborough we would not be able to comply with the 1-in-20 design standard in the South of the country. The need for parallel operation is one of the drivers for additional compression to provide the necessary capability.
359. Under RIIO-T1 allowances, two new gas turbine compressor units were progressed to be installed at both sites as part of the Emissions Reduction Project 3 (ERP3) initiative, which falls under Integrated Pollution Prevention and Control (IPPC) legislation. These two new Dry Low Emissions (DLE) compressor units will take over responsibility for primary compression duty, leaving the existing Avon units to resilience status.
360. The selected Main Works Contractor (MWC) for these works, initially mobilised to Huntingdon in 2017 and Peterborough in 2018. However, in June 2020 National Grid and the MWC agreed to terminate the existing Contract by way of Settlement agreement due to substantial dissatisfaction with the delivery of the works. In February 2021 a new MWC was appointed.
361. At Huntingdon during 2021/22, the key activities which were carried out include the completion and testing of buried pipework, mechanical completion of the two new compressor units, the completion of the site ducting system, the commencement of the cabling and the completion of the new control building structure and building services.



Figure 20: Image of Huntingdon showing installation works associated with two new gas driven compressors (top left) with existing Avon units (right)



Figure 21: Image of from Huntingdon showing installation of new Control Station (top right); existing Avons can be seen (left)

362. At Peterborough during 2021/22, the key activities which were carried out include completion of the new control building, commissioning of the new station control and protection system for the existing three units, installation of the structural steelwork for new units D and E, installation of the ducts and commencement of the cable pulling for the units D and E and the installation of the auxiliary systems for the new units.



Figure 22: Image of the ongoing construction works at Peterborough. New units D and E are shown (left) with existing Avon units A, B and C (right)

363. At Peterborough, upon completion of the IPPC works, there will be three remaining Siemens Avon gas compressors (Units A, B and C) which are non-compliant with Medium Combustion Plant Directive (MCPD) emissions legislation. Please see the section below regarding Peterborough MCPD project for more information on MCPD investment progress.
364. The Peterborough and Huntingdon ERP3 projects have experienced significant cost increases in 2021/22 due to inflation pressures linked to the Ukraine-Russia conflict, energy price increases and reduced availability of suppliers resulting in increased equipment, material and labour costs which were not factored into the original funding request from Ofgem. There is a forecasted increase on materials which are still to be contracted including, architectural steel (Peterborough), landscaping packages and workshop fit-out (Huntingdon).

Compressor Emissions – Hatton

365. Hatton is pivotal in the transmission of high east flows to the wider network; main relevant entry points are Teesside and Easington 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. See geographical representation in Figure 23 below.



Figure 23: Geographical Importance of Hatton Compressor Site

366. 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. These RB211s are not IED-LCP compliant. We are now committed to the installation of a new compliant gas-powered compressor (Unit E), of equivalent capability to the 35MW Electric VSD, which is planned to be operational by the end of 2023.
367. On 1 January 2016, in order to comply with the requirements of the LCP Directive, Units B and C were each placed on 17,500 Limited Life Derogation (LLD) and are due to be decommissioned by December 2023. Unit A was placed on 500 hours 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.
368. Following Ofgem's November 2019 needs case decision to invest at Hatton to maintain resilience at the site, we agreed with Ofgem to install one new gas turbine driven compressor unit, across RIIO-T1 and RIIO-T2 price control periods.
369. This represented the most cost-effective option in the CBA and is consistent with the BAT assessment performed.
370. At Hatton during 2021/22, the following works have been completed; approval of planning permission for installation of new unit, removal of vegetation and earth mound to clear new unit location, installation of stone roads, footpaths, hardstanding and utilities for construction village and laydown areas, isolation of compressor station from the NTS, cut, cap and removal of redundant pipe between

the AGI and compressor station to clear the way for installation of new foundations for the new compressor. Additionally, construction of the new compressor progressed at Siemens' (Supplier) off site facilities.



Figure 24 and 25: Hatton construction works - Cut, cap and removal of redundant 36" pipe between AGI and Compressor station

371. The project is now in Stage 4.4 (execution phase) of the Gas Network Development Process (GNDP). Detailed design and engineering are currently ongoing with our Engineer Procurement Construction Management (EPCm) contractor and Compressor OEM. Long lead materials have been ordered for outage works in 2022 and works packages have been awarded for Enabling Works, and Underground Piping Diversions. A further competitive procurement event is currently underway for the provision of a works package contractor to undertake a bundled scope of Civils, Pipework and Steel.
372. Similar to Peterborough and Huntingdon, Hatton LCPD project has experienced significant cost increases in 2021/22 due to inflation pressures linked to the Ukraine-Russia conflict, energy price increases and reduced availability of suppliers resulting in increased equipment, material and labour costs which were not factored into the original funding request from Ofgem. In the case of steel procurement, the Hatton construction team has experienced cost increases in the region of 30-40% on steel piping between November 2021 and June 2022. Equipment costs are also increasing beyond expectations, a standby diesel generator quoted within the original FEED estimate was found to have increased in price by ca. 200% when the team sought a final quotation during execution. These quotations are increasingly volatile and in some cases are valid only for a number of hours. Our mitigation is planned in the form of procurement outside of framework suppliers to stimulate competition and the utilisation of EPCm contingency funding for items which have increased beyond FEED estimates.

Compressor Emissions – St Fergus

373. 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. Since the invasion of Ukraine, and its 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 Anacala, Shell and North Sea Midstream Partners (NSMP)/Gassco). Uniquely on the NTS, National Grid 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. St Fergus comprises three plants; Plant 1 has four Avon units, Plant 2 has one Avon and two RB211s and 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 using the auxiliaries of either Plant 1 or Plant 2, and therefore cannot be used as an independent plant. All gas driven compressors are impacted by the IED legislation.

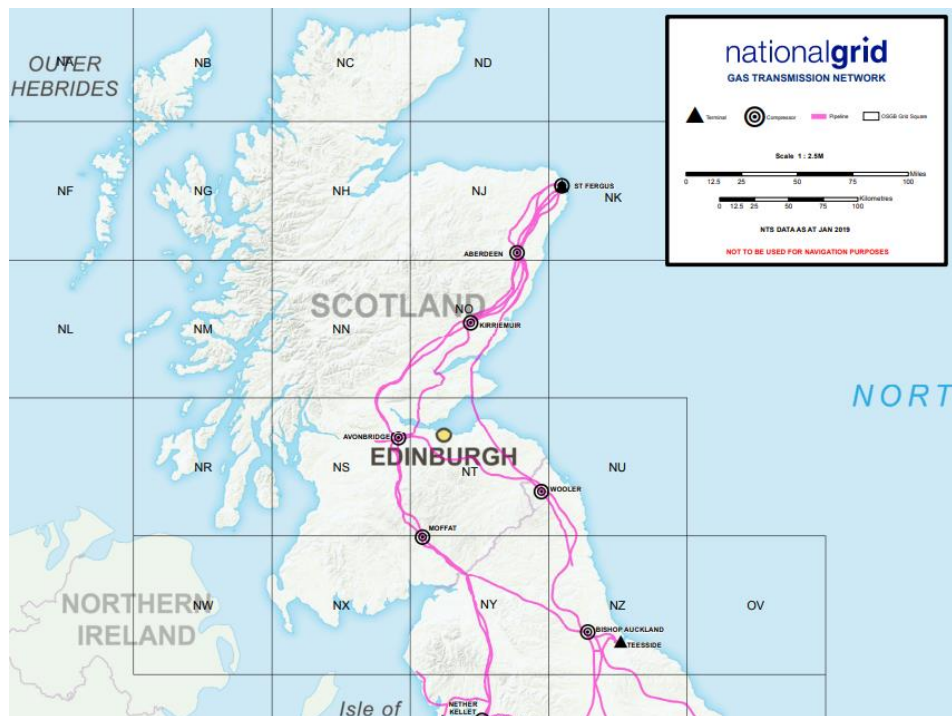


Figure 26: Location of St Fergus Terminal

374. Our plans to achieve compliance with the requirements of the IED legislation have evolved following Ofgem's decision not to approve our St Fergus RIIO-T1 reopener application submission in November 2019. The previously phased IPPC, LCPD and then MCPD compliance approach has now become a combined LCPD/MCPD compliance approach to form the St Fergus Future Operation Strategy (FOS) which will ensure the site can operate from 2030 out to 2050.

375. As previously stated, in terms of LCPD, we gained approval from the Scottish Environment Protection Agency (SEPA) to enter the RB211 units (2A and 2D) into the LLD from 1 January 2016.
376. With MCPD affecting the operation of the Avon units we are investigating options on how best to utilise them, until the end of 2029 as alternative compression solutions will be required from 1 January 2030.
377. Based on Ofgem's Final Determination in December 2020, St Fergus Compressor Emissions compliance is being funded via a UM with the same funding strategy being used at Wormington, King's Lynn and Peterborough MCPD. A two-step reopener process is being followed with approval of the preferred option via the submission of a Final Option Selection Report (FOSR) scheduled for submission January 2023 and a reopener to gain funding for remainder of the programme of works scheduled for submission June 2025. The FOSR submission was originally planned to take place in December 2022 but was postponed until January 2023 to align the submission with the Asset Health reopener submission.
378. To deliver a FOSR which is robust, evidence based and delivers value for money for the end consumer, the same development approach as Wormington, King's Lynn and Peterborough MCPD is being taken at St Fergus. The 22 initially identified options were reduced to a long list of 18 options, which are now progressing through the options selection process with five options currently under consideration for the shortlist.
379. The final CBA is planned to take place in September 2022 with final submission of the FOSR in January 2023.
380. Investment at St Fergus is wider than emissions related investment so we have developed an investment programme that adopts a two-phase strategy to ensure clarity for future investment at the terminal, with some of the investment to be submitted as part of our Asset Health in reopener in January 2023.

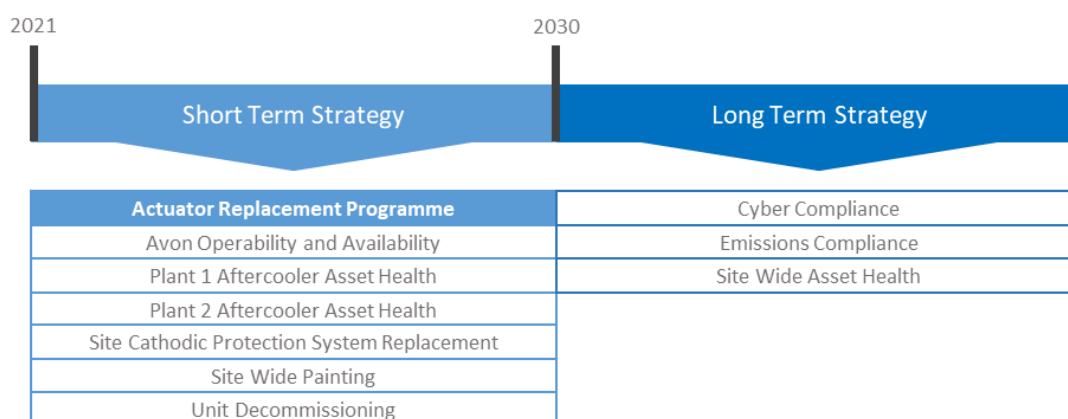


Figure 27: Investment Strategies for St Fergus Terminal

381. The long-term strategy element delivers an enduring terminal solution, including gas compression, required for operation beyond 2030.

382. The intention of the short-term strategy element is to ensure the continuity of the terminal operation requirements, including minimum compression across Plants 1 and 2, for operation to 2030. This current strategy is intended to maintain the integrity of the site and reduce the current risk to site staff by demolishing Units 2C and 2D, replacing the Cathodic Protection System and initiating a site-wide painting programme. Continued operation of the wider terminal will also require the delivery of the actuator replacement programme.
383. Maintaining compression from four operational Avons will be achieved by carrying out cab infrastructure and cyber work to reinstate Unit 2B. 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.
384. Finally, the short-term strategy will look to retain flexibility of options for the long-term strategy solution by retaining the Avons until the results of the FOS Preliminary FEED are available (estimated summer 2022). Investment on Unit 1C will be avoided where possible..
385. Funding for the short-term strategy elements shall be requested through the Asset Health UM in a single submission in January 2023.
386. The short-term strategy will be reviewed following the results of the FEED and CBA undertaken for the St Fergus Compressor Emissions Compliance FOSR to ensure that the short-term recommendations are still justified considering updated long-term plans. Funding shall be requested for these investments through the Compressor Emissions UM.

Compressor Emissions – Wormington

387. The use of compression at Wormington is strongly linked to the supply and demand levels in South Wales. It is critical in supporting NTS gas entering through the Milford Haven LNG terminal and utilisation is forecast to remain high over a wide range of network conditions. Due to its bi-directional flow capabilities, Wormington is also required to support the extremities in South Wales when demands are high and Milford Haven inputs are low and to support domestic and power station demand in the South-West, notably around Seabank. Additionally, Wormington plays a supporting role to Lockerley compressor station which is responsible for ensuring adequate gas flow to Cornwall and Devon. Therefore, we have determined an ongoing need at the site for at least 80mscm/d and this has been confirmed through our network capability analysis. Geographical location in relation to the NTS is indicated in Figure 28 below.



Figure 28: Importance of Wormington within Midlands Axis – Enables flow from the LNG terminals at Milford Haven to Bacton for export to Europe

388. Wormington compressor station comprises two Siemens Avon compressors (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.
389. While there is already demand for high compression at Wormington going forward, that demand is likely to increase further in the coming years. A Planning and Advanced Reservation of Capacity Agreement (PARCA) to increase entry capacity at Milford Haven has needs case approval and is currently being investigated in detail. Current assessments do not identify any requirement for additional compressor units at Wormington but still serves to reinforce the criticality of Wormington station to future gas flow resilience.



Figure 29: Wormington Units A and B taken during site visit 13 May 2022

390. As part of our 2019 RIIO-T2 business plan submission, we recommended replacing two Avon 1533 compressor machinery trains with two new MCPD compliant gas-driven compressors.
391. Based on Ofgem's Final Determination in December 2020, Wormington MCPD compliance is being funded via an UM. Baseline allowances have been agreed 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 re-openers are scheduled for August 2022 (agreement of the preferred option in the FOSR) and November 2024 (reopener submission to agree costs for remainder of programme of works). Wormington FOSR was originally planned to take place in May 2022 but was postponed until August 2022 to allow for completion of the Avon 1533 DLE performance trial, which is forecast to be completed in September 2022.
392. In order to deliver a FOSR, which is robust, evidence based and delivers value for money for the end consumer, we have engaged in the following activities to help inform our investment decision; network capability modelling, BAT (Best Available Technology) external study, FEED study development through the selected FEED consultant, validation of the FEED consultant's estimates as well as supporting a number of external studies to best understand technical feasibility of selected innovative abatement technologies including Control System Restricted Performance (CSR), Selected Catalytic Reduction (SCR) and Dry Low Emissions (DLE) modifications of existing units. All of these FEED inputs are combined and

evaluated against future network requirements using the CBA tool which aids the overall decision-making process.

393. Final CBA is planned to take place in June 2022 to compare the 10 options under consideration at this stage with final submission of the FOSR in August 2022.

Compressor Emissions – King’s Lynn

394. King’s Lynn compressor station performs a critical role on the National Transmission System (NTS) and is used to resolve supply-demand imbalances in the South-East. Geographically, King’s Lynn is located in a very dynamic location for gas flows on the NTS. Due to the proximity of the bi-directional interconnectors at Bacton (Interconnector and BBL) King’s Lynn is critically important in enabling movement of gas into and out of this area as dictated by market demand. A geographical representation of this key function is shown in Figure 30 below.



Figure 30: King’s Lynn’s role in the Midlands Axis – Enables flow from LNG terminals at Milford Haven to Bacton for export to and import from Europe

395. King’s Lynn comprises four existing compressor units of which the two Siemens Avons (Units A and B) are impacted by MCPD. Unit A was disconnected from the network in 2017 after becoming life expired and not cost efficient to continue investing in for current requirements. This means that current site capability is lower than its designed capability.
396. As part of our RIIO-T2 business plan we proposed proceeding with FEED studies to build two new, gas-driven compressor units (~15MW each), with an UM within the RIIO-T2 period to agree the final solution.
397. 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 used at Wormington and St Fergus, 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 has been agreed with agreement of the preferred option via FOSR scheduled for January 2023 and agreement on costs

for remainder of programme of works scheduled for April 2025. The FOSR submission was originally planned to take place in October 2022 but was postponed until January 2023 to align it with the Peterborough FOSR submission and to enable to apply any learning from the Wormington FOSR submission planned for August 2022.

398. To deliver a FOSR, which is robust, evidence based and delivers value for money for the end consumer, the same development approach as Wormington MCP is being taken. The 16 options currently under consideration will be assessed via the Preliminary CBA to identify the short-listed options. Final CBA is planned to take place in August 2022, with final submission of the FOSR in January 2023.

Compressor Emissions – Peterborough and Huntingdon

399. As stated in the narrative above concerning Peterborough ERP3 project development, Peterborough compressor station comprises three existing compressor units of which the three Siemens Avon's (Units A, B and C) are not compliant with MCPD. As part of the ERP3 project, two new Dry Low Emissions (DLE) compressor units (Solar Titan 130s: units D and E) will be installed as the lead units.
400. As part of the RIIO-T2 business plan, we proposed proceeding to FEED with a recommendation of one new 15MW gas-driven compressor, to provide resiliency back-up to the lead units (Unit D and E) and decommissioning of Units A, B and C once the new unit was commissioned.
401. Based on Ofgem's Final Determination in December 2020, Peterborough MCPD is being funded via an UM rather than Baseline. Again, the same funding strategy is used as at Wormington, King's Lynn and St Fergus. A two-step reopener process is also planned with agreement of the preferred option via FOSR scheduled for January 2023 and agreement on costs for remainder of programme of works scheduled for June 2025.
402. To deliver a FOSR, which is robust, evidence based and delivers value for money for the end consumer, the same development approach as Wormington and King's Lynn MCP is being taken. Final CBA is planned to take place in October 2022 to compare the four options currently under consideration, with final submission of the FOSR in January 2023.

Compressor Emissions – Methane detection and quantification

403. We were awarded within the RIIO-T2 final determination funding for 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 which concluded on 31 Mar 2021.

404. Since Final Determination award, and following 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.
405. We have been reviewing the marketplace for continuous fugitive emission detection systems since final determination award which is a fast-moving area of development. We agreed with Ofgem while we work together 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 that the funding awarded for MoRFE rollout could be repurposed for periodic detection equipment rather than implement the MoRFE detection system.
406. We have not yet spent any of the reallocated allowance for periodic detection equipment, but this is a priority for the first half of the 2022/23 reporting period while we continue to develop our re-opener submission due at the end of 2022.

Asset Health

407. In 2021/22, we have continued to deliver our programme of asset health works. This expenditure underpins our work 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.
408. Network risk, as calculated by our NARM methodology has become an important tool in selecting assets for intervention. The methodology was developed in parallel with our RIIO-T2 business plan submission and therefore our planned interventions did not fully reflect our new and improved understanding of risk on our network. During 2021/22, we have reviewed the asset interventions within our programme to ensure that we are addressing the highest priority assets and delivering maximum benefit to our customers and stakeholders, as measured by Long Term Risk Benefit (LTRB) within our NARM methodology.
409. Our NARM methodology provides an important view of network risk but this modelled view needs to be balanced with other compelling considerations such as statutory compliance and observed asset condition and integrity issues which are not consistent with the modelled view.
410. The need to survey and develop projects in advance of delivery means that much of the work in build phase, was identified and developed in the final year of RIIO-T1. In parallel to this, we have been surveying and developing projects that will go into build phase in future years of RIIO-T2. It should also be noted that claiming of outputs such as LTRB can lag behind work delivery as project closure activities are often undertaken in the following year.
411. Where work has been developed for tender, the approach taken has been to consider packaging of works and associated bundling opportunities in order to

accelerate work delivery and seek to deliver better value from the marketplace. The work selected for intervention is awarded to the appropriate provider from our frameworks; a series of contract framework arrangements having also been a preparatory piece of work further developed over the 2021/22 reporting period.

412. Prior to any tendering, a further consideration has been undertaken to determine whether work can be delivered more efficiently within the existing organisation. Our Area Operations teams manage smaller discrete asset interventions alongside their maintenance work. This is not only a low-cost delivery method but also improves utilisation of operations technicians by providing fill in work around the maintenance programme. We also have our highly skilled Pipelines Maintenance Centre (PMC) teams who support across the mechanical and civils aspects of our asset health programme.
413. Our asset health allowance is broken down into seven categories and the key work delivered in 2021/22 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.

Plant and Equipment, Valves and Civils

414. The asset health categories of Plant and Equipment, Valves and Civils are predominantly delivered through our National AGI Renovation Campaign (NARC) and therefore are grouped together in this section.
415. Valves are an essential part of the NTS, controlling the flow of gas and providing isolation to allow safe intervention for operational or integrity reasons. Together with associated plant, equipment and structural integrity assets, a proactive programme of intervention is required to avoid unmanageable levels of risk, associated adverse impacts on the safety, operation and availability of the NTS and any potential legislative non-compliance.
416. Plant and Equipment includes above and below ground pipework and associated assets. Civil assets include site access, drainage, ducting, pipe supports, pits and pit covers, plinths and security fences on National Gas Transmission AGIs. Valves includes actuators, flanges and associated equipment on local, remote or process operated valves.
417. There is also some Plant and Equipment work that comes under other investment sanctions such as Asset Health works at St Fergus and Bacton as well as works delivered by Operations. Plant and Equipment spend is also associated with planned Cathodic Protection works at AGIs, which have completed feasibility and conceptual design studies and will be ready for detail design and build starting in 2023.
418. Our RIIO-T2 business plan includes a proactive intervention programme for these assets. The sites and assets included in the scope of this project have been surveyed and the interventions selected and prioritised based on risk. This investment is part of our RIIO-T2 programme to manage network risk on our AGI

assets and is an essential part of delivering the RIIO-T2 NARM output as set out in our business plan.

419. NARC has continued from previous years, accelerating asset health works across the NTS by allowing us to bundle packages of work for survey and delivery, which helps us to increase delivery volumes and drive efficiency for our customers and stakeholders.
420. Campaign Decision Panels (CDPs) remain an integral part of NARC decision making and project progression. These panels have the responsibility to agree the scope and approve construction works outside of usual governance cycles, therefore further increasing efficiency and pace of delivery.
421. The NARC21 Investment delivered a volume of 159 interventions in the 2021/22 delivery year – 64 by PMC and 95 by MWC. This investment was funded via baseline asset health via the Plant and Equipment, Valves and Civils themes.

Theme	Sub-Theme	Volume interventions
AGIs	Above ground pipework	15
	Pipework protection	12
Valves	Actuators	8
	Flange	1
	Valve refurbishments and replacement	44
	Valve removal	1
Structural Integrity	Drainage	11
	Ducting	3
	Pipe supports	35
	Plinths	8
	Security fences and gates	10
	Site access	11
TOTAL		159

Table 9 – NARC21 investments by theme

Delivery Strategy

422. Asset surveys have been completed and preferred scopes selected.
423. Works are either delivered by PMC or go to tender to MWC depending on the size and scopes of work. This is managed by multiple Project Managers.

- 424. For the NARC investments, work has been allocated where possible within our business to reduce overheads with consideration to the complexity of works and other efficiencies that can be made. The chosen delivery approach is to bundle interventions on AGI sites across Valves, Plant and Equipment and Structural Integrity asset health themes. This approach minimises project costs and maximises utilisation of network outages. By creating discrete bundles of work, in conjunction with the decommissioning works, we can therefore deliver efficiencies through bundling and allocation. There are tailored tenders for each delivery strategy (Internal delivery vs MWC).
- 425. Sites selected for delivery in 2021/22 have targeted sites with high numbers of known defects and plant status. The RIIO-T2 strategy is to align where possible the NARC outage works with the in-line inspections (ILI) Dig programme to enable bundling, optimising the outages, reducing overall recompression required and minimising disruption to our customers.
- 426. In 2021/22 works commenced at 22 sites. All have been fully delivered with the exception of Stane, Lanark and Crawford John. The figure below shows locations of NARC21 works during 2021/22.

RIIO-2 year 1 portfolio (NARC21)

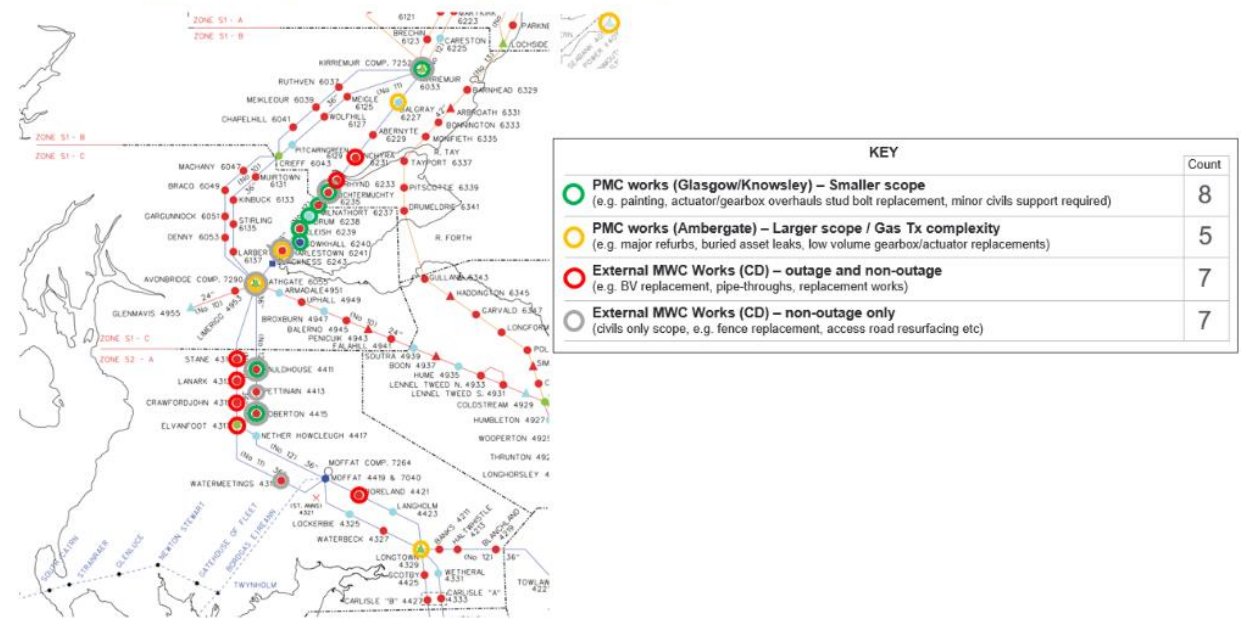


Figure 31: NARC21 portfolio of works

- 427. The below is an example of works successfully delivered at Milnathort Block Valve site by PMC during the 2021/22 delivery year. This is typical of the types of work that are being identified and resolved as part of the NARC campaign. This includes a full site paint including wind/water lines, corrosion inspections (P/11 and P/20 inspections), minor remedial works and minor civil works (note, after photo prior to final sandbox installation).



Figure 32 and 33: Before and after photos of Milnathort Block Valve site



Figure 34 and 35: Before and after photos of Milnathort Block Valve site

Future NARC Development

428. The NARC22 asset health portfolio will cover works across the RIIO-T2 themes of Valves, Plant and Equipment and Structural Integrity and our RIIO-T2 business plan continues to include a proactive intervention programme for these assets. The sites and assets included in the scope of this project have been surveyed and the interventions selected and prioritised based on risk.
429. Similar to NARC21, and following surveys and development throughout 2021/22, 63 site projects have been delivered by either internal or via external MWC depending on the size and scopes of work.
430. The sites in NARC22 similarly have been selected based around the current ILI programme, defects and monetized risk benefit to the network.
431. Consideration also commenced in the reporting period to develop survey and intervention strategies for future NARC developments, out to NARC25, to provide greater clarity on longer term, condition need based intervention plan.

Compressors

432. The compressor machinery used on our gas turbine driven compressor units is made up of three parts: gas generator, power turbine and centrifugal compressor. Investment in machinery overhauls is typically driven by utilisation (running hours).
433. Compressor units running on the National Transmission System (NTS) since the submission of our RII0-T2 business plan has been less than anticipated. This has necessitated less overhauls and consequently less investment than previously forecast. Should the compressor unit utilisation subsequently meet the running hours, that will trigger overhaul requirements, which will be carried out in a timely manner. The investments on each of these assets carried out in 2021/22 are detailed below.

Gas Generator

434. There are five different types of gas generators making up the national fleet currently in operation across the NTS. In addition, we hold spare gas generators to provide resilience to some operational units. 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 pressurised exhaust gas that drives the power turbine which then drives the compressor.
435. 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.
436. Relatively low utilization of the Baker Hughes LM2500+DLE fleet has kept the installed engines with low running hours. Only one spare engine was overhauled in 2021 which has been installed in Avonbridge unit 1A. The two spare engines have minor defects and are currently being repaired by suppliers ready for operation in winter 2022/23.
437. The Solar Titan DLE fleet also have low running hours despite greatly increased utilisation over the last few years due to the location of the units making them critical to supporting gas flows from the Milford Haven LNG terminals. Only one Solar Titan is likely to require overhaul (Churchover) in 2023 if compression continues to be high at Milford Haven.
438. In the SGT400 DLE fleet, the gas generators and associated assets at Avonbridge 1B and 2B are in a state of Mothball. The Nether Kellet units are approaching overhaul, one of which is currently being overhauled in 2022. The spare SGT400 DLE requires overhaul which will be done in 2022. The three similar units at King's Lynn and Cambridge have minor defects that will be repaired in summer 2022.
439. The SGT A-35 (Rolls-Royce RB211) fleet has seven units remaining across four sites (St Fergus, Carnforth, Hatton and Wisbech). Two SGT A-35s were overhauled in 2021 and installed at Hatton A and Carnforth B to provide resilience to the central area of the network.

440. 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 and two further engines in 2021. Repairs were needed on the combustion sections of the Avon's from St Fergus and Aylesbury. The engines at King's Lynn B and Wisbech B will be overhauled in 2022 and the engine at Wormington A will be overhauled in 2023.

Power Turbine

441. There are eight different types of power turbine making up the national fleet in operation across the NTS. In addition, we hold spare power turbines to provide resilience to the operational units. Power turbines convert the stream of hot pressurized exhaust gases produced by the gas generator into the torque that is required to turn the compressor. Power turbine maintenance and overhaul requirements, as with the other machine train components, are heavily influenced by both run hours and installed time.
442. During 2021/22, work started to overhaul two EAS1 PT's at Kirriemuir A and King's Lynn B, and an ERB1 PT at Wisbech B.
443. The PGT25+ power turbine at Avonbridge 1A was replaced with an upgraded power turbine that has double the time between overhaul compared with the previous power turbine.

Centrifugal Gas Compressors

444. Compressors are the machinery that drives the natural gas through the NTS. Each compressor is driven by a dedicated high voltage (HV) electric motor or gas generator and power turbine. All the NTS compressors are centrifugal compressors, mostly single stage but some two or three stage where higher pressure ratios are required.
445. During 2021/22 work continued on two major overhauls that started in RIIO-T1 at Bishop Auckland unit A and Kirriemuir unit A which is now back in service. Work is ongoing to reinstate the Nether Kellet unit A and Nether Kellet B compressors that failed in 2019 and 2020.
446. There was a dry gas seal age related failure on the compressor at Aberdeen unit A which is scheduled to be replaced in summer 2022, and the dry gas seal was proactively replaced on St Fergus unit 3B due to a trend of increasing Nitrogen consumption which would have resulted in an unplanned outage if left untreated.
447. The Nitrogen generator on Carnforth unit C was replaced due to a problem with the existing generator, which resulted in impure Nitrogen being supplied to the barrier seal.

Electric Variable Speed Drive Compressors

448. The electric compressor systems consist of a HV supply, typically 132 kV, 66 kV, 33 kV or 11 kV fed via a Converter Transformer to a Frequency Converter (Variable Speed Drive or VSD) at 5-6kV which then supplies power at a variable frequency

and hence variable speed to an HV motor. In addition, a Harmonic Filter is usually required to 'clean up' the power supply and meet distribution network operator (DNO) connection agreement terms and conditions.

449. There are two different types of HV motor making up the national fleet in operation across the NTS. The systems either comprise of a Siemens synchronous motor connected by a solid shaft to a centrifugal compressor (see the section above) or utilise a MANMOPICO motor in pipeline compressor, these consist of an integrated pipeline mounted induction motor connected to twin compressor units at either end of the motor.
450. The high voltage motor at Wormington was rewound and overhauled in 2021/22 to replace failed resistive temperature detectors (RTDs) on the motor stator which are required for DSEAR (Ex) compliance. Churchover has also experienced RTD failures and therefore will also require a rewind in RIIO-T2 for the same reason.
451. Lockerley has experienced an earth fault on the HV motor and is currently undergoing repairs. There have been a number of RTD failures on both Lockerley units, but as these are not required for DSEAR compliance (due to the nature of the machine construction) a rewind is not required from a safety aspect.

Cab Infrastructure

452. The Cab Infrastructure theme aims to resolve three compliance issues that are specific to gas turbine compressor cabs and the closure of asset health related plant status items. This strategy has developed packages of appropriate investments as per below.

HSE Publication PM84

453. The HSE guidance note referred to as PM84, and the more recent BS ISO 21789 standard, refers to the risks in gas turbine enclosures. Whilst most compressor cabs were built before standards or similar equivalent guidance documents were published, the scoped elements below were identified as risk reduction measures. Typically, these relate to refurbishment of Cab Exhaust System, Air Intake System, Cab Ventilation System and Cab Structure (including Gas Detection).

Fire Suppression Systems

454. Fire suppression is the final element of the fire and gas system and is in place to protect the asset in the event of a fire. Due to the age, condition and design of some of our systems, they are no longer fit for purpose and need investment to enhance the integrity of the system.

Emission Sample Lines

455. Emission sample line upgrades are driven by Environmental Agency Legislation requirements, for homogenous emissions sampling of gas turbines that are compliant with the IED. This is to ensure compliance and removal of all non-compliances.

456. The following works have been completed in 2021/22 on our Cab Infrastructure:

- HSE Publication PM84 Works: Carnforth Unit C
- Combustion air intake filters have been replaced. Machinery and personnel doors on the combustion housings have been replaced due to corrosion issues and water ingress. Acoustic Louvre Boxes have been replaced with like for like equivalent from stainless steel to provide added protection and prevent corrosion. Guard rails on access platform and grab rails above ladders have been installed for access above ventilation fans. Exhaust Compensator was replaced to prevent cracking.

Fire Suppression Works: Carnforth Unit C

457. Uncertified flexible hoses have been replaced at Carnforth for compliance reasons. Pumps have also been replaced due to failures and now being obsolete with no spares available.

HSE Publication PM84 Works: Wooler (Units A and B)

458. Combustion Air Intake filter house has been re-painted to remove surface corrosion. The anti-ice dampers, door seals, vent fan junction box and gas detectors have all been replaced.

Fire Suppression Works: Wooler (Units A and B)

459. Uncertified flexible hoses, tubing, solenoids and spray heads replaced at Wooler for compliance reasons.

HSE Publication PM84 Works: Kirriemur (Unit A)

460. Lube Oil louvres and Silencer ducts replaced. The HVAC air intake housing louvres, acoustic splitters and filters have been replaced and weatherhoods installed. Exhaust Compensator and gasket have been replaced.

Stopples

461. Stopples are an intervention technique used to permit intrusive operations, allowing the plant to remain live with the exception inboard the safe side of the stopple. No stopple operations were undertaken during the reporting period.

Pipelines

462. The pipelines 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 any part of the network would entail extreme expense and a significant disruption to the UK economy.

463. A brief description of some of the main work types that feature in this campaign is as follows:

- PSSR In Line Inspections (ILI): involve inserting a Pipeline Inspection Gauge (PIG) into the pipeline with various tools that measure pipe wall thickness, geometry, depth of ground cover and other conditional and geographic attributes. The data collected via these inspections is then used to inform the ILI Digs/Interventions Programme. Separately, mandatory PSSR inspections are carried out to ensure the integrity of our PIG Trap facilities and other pressure containing vessels on our sites.
- ILI Digs: are interventions on the pipelines, generally involving excavations, where the ILI inspections have identified features of interest e.g., corrosion or dents. These features are then categorised and prioritised. Remediations are carried out where necessary, using repair methods such as re-coating or the use of epoxy filled repair sleeves.
- Closed Interval Potential Surveys (CIPS) and Interventions: These surveys assess the health of our Cathodic Protection (CP) system, which is the secondary defence of the pipeline against corrosion, after the pipeline coating. CIPS ensure that the integrity of the pipelines is validated and maintained to enable their continued use in compliance with our obligations under the Pipeline Safety Regulations (PSR) 1996 and as part of our Safety Case. CP defects that are identified during these surveys are then assessed and the required interventions are identified and carried out.
- Pipeline Impact Protection: including Reduced Depth of Cover (RDoC), River Crossings and Nitrogen Sleeves, can become necessary on locations where the pipeline is closer to the surface than expected. Typically, this is in ditches where they have been cleaned out too deeply, but it can also be in areas where the land has eroded over many years. Remediations may include a combination of compensations to landowners, installation of ditch boards and slabs, and building a protective fence along the affected area. River Crossings remediations deal with exposed pipelines within a river system or on the riverbanks. Typically, this is caused by the river moving or by a bank collapse. The pipeline is then protected by cover reinstatement on the riverbank, or by installation of frond mats or gabion cages.

464. Within the Pipelines theme of works, National Grid has delivered the following outputs in 2021/22:

- ILI Runs: National Grid performed 22 In-Line Inspections within the 2021 calendar year, covering a total length of 1032 km. This is 116% of the distance completed in 2020/21. The selection of the pipelines requiring inspection is driven by a risk-based approach, considering pipeline condition, criticality and performance of its corrosion prevention system. The results from the 2021 inspections are currently under review to determine the nature and severity of any defects requiring excavation and repair. All the required PSSR inspections

on PIG Traps, Heat Exchangers and Filters were completed during Year 1 as well, some of which also instigated necessary minor refurbishment works on these assets.



Figure 36: In line Inspections (using various PIGs) underway

- Pipeline Impact Protection: Within the impact protection work category, we have 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. Impact protection has also been installed during 2021/22 at 16 locations. These works will be part of the outputs claimed in 2022/23 after the validation and project closure activities are concluded. We are currently in the process of optioneering, scoping and optimising delivery for the rest of RIIO-T2. Specifically, for Nitrogen Sleeves, we have identified and interrogated over 100 defects through our decision support panels and are developing a standard design for sleeve grouting (using the patented Carr Civils grouting compound) which can be used in Year 2 and onwards. Similarly, we are developing the remediation requirements on 22 identified River Crossings defects.
- ILI Digs: Based on the ILI runs performed in 2019, and the historical defect run rate detailed in the RIIO-T2 Pipelines Engineering Justification Paper (EJP), National Grid predicted a total of 38 defects requiring excavation within the 2021 calendar year. SME review of the 2019 ILI results determined that 17 defects required excavation, of which we carried out 12 and deferred 5 to 2022 (due to wider outage constraints on the NTS). We have rectified fewer ILI features than our predicted modelling forecast, which explains our underspend against planned costs within the ILI Digs work category. For 2022/23, we have identified 54 digs (excluding the five deferred ones) which is more than what our modelling predicted (48.6 digs). We appreciate the limitations of our modelling year on year; however, we expect it to be more closely aligned over a longer range of time. Although these digs were physically completed during Year 1, we are currently completing the design management and quality assurance closures and validation of this work and the risk reduction outputs will be claimed in the Year 2 submission.



Figure 37: Examples of some of the 2021/22 pipeline corrosion defects and rectifications

Among these works, some higher complexity defects were successfully rectified, including very deep (5 m+) pipelines and defects where ground drainage systems had to be installed to counter severe water-ingress.

- CIPS: 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. We have an ambitious plan to carry out circa 3,000 km (60% of the total RIIO-T2 workload target) of CIPS in Year 2. With the aim of increasing our contractor-resources to enable us to deliver this accelerated workload, we retendered for the combined programme of CIPS and defects management work, and the new procurement arrangements will be in place from July 2022. These surveys will provide us with holistic data to derive the scope of CIPS Digs and to efficiently plan delivery of CP interventions targeted for RIIO-T2 and to better forecast volumes for RIIO-T3.



Figure 38: Groundwork to remove seven meters of ground cover and redundant railway banking

- CIPS Digs: 13 CIPS Digs were also carried out to investigate previously identified CP and coating defects; where this results in a confirmed defect resolution, these works will be claimed in 2022/23, otherwise additional iterative interventions will be carried out to pursue correct resolution. We bundled up some of the ILI and CIPS interventions at the planning stage to ensure cost efficiency. Moreover, 20 defects were rectified within our 'unpiggable pipelines' as part of the On-Line Inspections (OLI4) pipeline defect remediation work; these have been claimed in Year 1.

Electrical

465. Prior to the reporting period, high level scopes had been generated for electrical asset health works; these consisting of 14 scope types arranged primarily by electrical asset type. The agreed approach was to undertake a series of site electrical condition surveys and compile a broad work package based upon a compelling needs case to intervene.
466. This is the first major electrical project on a national basis that we have undertaken. We are keen to introduce contract stability such that we can leverage value from the market-place with these larger packages of electrical work.
467. In 2021/22, we reviewed and agreed a list of sites that we required to undertake condition surveys upon. This consisted of 69 sites, made up of a mixture of 55 Above Ground Installations (AGI) and 14 Compressor sites. The approach taken was intended to give a good cross section of information across varying site types in varying locations and differing ages.
468. Teams visited sites and undertook condition surveys, compiling necessary electrical condition support information in preparation for presentation at Campaign Decision Panel (CDP) meetings.

469. One CDP meeting was held per operational area (East/West/Scotland). Cross-departmental representatives were present to agree which condition interventions had compelling need. Minor issues were left to Operational colleagues to manage, with larger scale issues collated into the list forming part of upcoming tender event.
470. The outcome of the CDP meeting was then compiled into a tender pack with the relevant site and contracts information.
471. The tender event is due to launch early in the next reporting period, where upon, site tender visits will be undertaken; tenders will be received; technical and commercial clarifications will be undertaken prior to award of work. Current forecast for award of contract is for the third quarter of the next reporting period.

Bacton Site terminal redevelopment

472. 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).
473. In May 2021 we awarded the contract for the FEED Feasibility Study. The study generated a long list of options which were analysed for technical feasibility, cost, environmental and sustainability factors and carbon neutrality. This gave us a shortlist of four options to analyse in October 2021.
474. The feasibility study 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. The study identified our previously recommended option of brownfield redevelopment as unviable. This was due to a combination of factors, such as untenable safety risks associated with proximity of live gas assets to occupied buildings. The four shortlisted options had the same scope up to 2035, to maintain and repair existing assets. From 2035 onwards the options were:
- Disconnect UKCS incomers.
 - Disconnect the incomers, carry out rationalisation to decommission and remove redundant assets.
 - Disconnect the incomers and re-build the site, with sub-options to build within the existing fence-line or to extend the site (partial greenfield).
475. Through October and November, alongside internal reviews and CBA of the options, we engaged with individual stakeholders and held a webinar to share the FEED study output and seek their views.
476. The key messages across our range of stakeholder engagements were:
- The criticality of security of supply and ensuring the site continues to be reliable and flexible.

- Effective management of the asset health risk, given that the options all retain existing assets in service out to the mid-2030s. The risk will increase as we see operational assets well beyond their 40 year design life, some potentially being in operation for up to 70 years.
 - Hydrogen and the transition to Net Zero was a consideration that was repeatedly mentioned. There was a desire to see development of the site for future energy
 - Concerns associated with our FES-based planning assumptions.
 - Of the options presented, the strongest preference was for new build with marginally more preferring new build within site over partial greenfield.
477. 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.
478. 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. Since December we have identified the requirements and developed scopes for detailed remnant life studies and for surveys that are more intrusive than those we have previously undertaken. This work should provide meaningful information upon which to base our future decisions in terms of asset health risk, with the added benefit of identifying suitability for a hydrogen future. Tender returns for carrying out the work are due at the end of May 2022. Once the tenders have been assessed we will be able to update our programme and confirm the revised FOSR submission date.
479. From the discussions around planning assumptions and use of FES, we concluded that we should seek further detail about future supplies at Bacton. We have been working with the relevant stakeholders to explore whether this information can be broadened.
480. There was an indication that the preference of new build on-site over partial greenfield may have been influenced by knowledge of a previous unsuccessful planning application. However, subsequent discussions with the local council have indicated that a site extension would be considered, particularly with commensurate measures (e.g. environmental and community benefits). We are therefore further developing the partial greenfield site extension option. We see this option as our contingency in case the asset condition surveys identify anything of significant concern.
481. Throughout all the above activities we have completed a number of stakeholder engagements, including newsletters and one-to-ones with several stakeholders. We have run online webinars and workshops with the stakeholder community: in June 2021 we held a Technical Design Webinar; in October 2021 an Options Workshop and in January 2022 a Stakeholder Playback Webinar. This

engagement continues with quarterly key stakeholder one-to-ones planned, newsletters and the opportunity for stakeholder site visits. We will plan future webinars and workshops for key stages of the project when the revised programme has been confirmed.



Figure 39: Bacton stakeholder engagement material

482. 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.
483. We are anticipating that costs for Bacton could increase beyond our original estimates. Significant cost increases have recently been experienced on other National Grid projects, due to inflation pressures linked to the Ukraine-Russia conflict, energy price increases and reduced availability of suppliers resulting in increased equipment, material and labour costs. In some cases, materials prices have risen by around 30%.

King's Lynn Subsidence

484. The King's Lynn bi-directional area allows the compressor station to support the Bacton terminals entry and exit flows through the interconnectors to Europe and facilitates the connection to the NTS, moving gas away from the South East when combined entry flows from the Bacton and Isle of Grain terminals exceeds local demand. Analysis of all Future Energy Scenarios suggest a long-term requirement for the bi-directional area which is critical for meeting customer's entry and export requirements allowing the UK to import and export gas with continental Europe and meet the UK's gas demand.
485. In 2011, we identified the subsidence issue at King's Lynn with various work having been carried out since then to quantify and mitigate the risk. Remedial work

included excavation and removal of the concrete from the 50mm Nominal Bore (NB) pipework allowing it to relevel, and installation of shallow land drainpipe. The quantification work included surveys, bore holes, laser scans, ground penetration radar and stress analysis. Given the strategic significance of the site, its criticality to UK gas flows and the available data at the time, we considered that there was a need for urgent remediation in the form of a major project to rebuild the bi-directional area to mitigate risks from the eventuality of the complete failure of the bi-directional area pipework.

486. In 2019, we submitted a request for funding to rebuild the bi-directional pipework arrangement at King's Lynn compressor site as part of our RIIO-T2 Business Plan. Ofgem's final determination was to fund the development of a reopener submission for this project by way of a PCD in the amount of £1.16m, to be submitted by the 31 March 2022.
487. In 2021, we appointed Premtech to undertake FEED Engineering Justification study to facilitate our delivery of the PCD and address the specific questions posed by Ofgem in the Reopener Guidance. To undertake further stress analysis work, the 900mm NB pipework was excavated at strategic locations and monitoring rods were affixed to the buried pipework to facilitate greater accuracy with the surveys than had been achieved by the laser scans. A search through the physical archives of construction records was undertaken and a prior assumption that the original 1970's valves were not on piled foundations (which had originated from secondary digital sources) was incorrect. These key refinements were fed into an updated stress analysis study involving Finite Element Analysis (FEA) and fatigue analysis taking into account past and future operation out to 2050.
488. This refined modelling showed that all but one of the identified over stresses (on a 900mm NB equal tee) was resolved. The increased confidence in the findings together with the continuous operation and future safe operating life analysis has led us to conclude that the perceived extent of the subsidence and associated integrity risks have therefore been reduced to manageable levels by this study.
489. The monitoring rods, which have been affixed to the 900mm NB pipework, will remain in situ to facilitate ongoing monitoring. The most recent survey in December 2021 found negligible movement (≤ 2 mm). We submitted the reopener submission to Ofgem proposing the PCD had been partially delivered with alternative specification because the work to deliver the reopener submission was curtailed when it became apparent that the subsidence needs case driver for the project was no longer valid on 31 March 2022.



Figure 40: Summer 2021: King's Lynn bi-directional area (top of monitoring rod locations in foreground)

490. The work on the subsidence issue has delivered the ancillary benefit (albeit under the Network Innovation Allowance (NIA) funding mechanism) of furthering the technological readiness of geopolymer injection for ground stabilisation via a successful trial where subsided pipework was stabilised and, in some cases, relevelled at the King's Lynn site.
491. The project to rebuild the bi-directional area would have addressed outstanding asset health issues concerning valve seal rates; cathodic protection survey findings of potential coating failures; corrosion and refurbishment of actuators. We are conscious the resolution of these issues is interdependent with considerations of the King's Lynn emissions FOSR/reopener event and/or the Asset Health re-opener and future RIIO-T3 plan. We will continue discussions with Ofgem about the best way to take forward a coherent investment strategy for King's Lynn site under the RIIO-T2 framework of regulatory instruments and ensure we deliver our network capability and reliability levels required from the gas transmission network
492. In our reopener submission, we have proposed that the unused portion of baseline allowance will be returned to consumers, this will be subject to Ofgem review and decision.

Gas Robotic Agile Inspection Device (GRAID)

493. 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. 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. This innovation project concluded successfully in March 2022 and the robotic platform was returned to storage until required.

494. In parallel to the innovation activities an application was submitted during the RIIO-T2 Business Planning for funding to build robot access points within our AGI and to operate the GRAID robot. Historically AGIs were not designed with connection points on them, and so varying levels of construction projects are needed to facilitate robotic inspection. This was split into large, medium and small-scale project size, with large being significant excavation and pipework installation and small being a removal of an above ground flange or dome end for example.
495. In 2021/22 a GRAID deployment Strategy Paper was developed which aimed to create a prioritised portfolio of works to be delivered over the RIIO-T2 price control. The paper summarises GRAID and details the prioritisation exercise leading to an ordered list of 48 locations. Sites were ordered on their benefit case which included metrics on Monetised Consequence of Failure, Defect Score, CP Defect Score and Site Age. OLI4 sections were also included alongside the sites which are sections of pipeline that cannot be inspected by the standard inline inspection tools and which GRAID could help inspect.
496. The next stage is to carry out detailed design activities on the top 20 sites, additional sites were prioritised in case one of the top 20 is not possible and so the next location will be taken forward. A review of other construction projects was also carried out to identify any potential bundling opportunities, particularly with the NARC projects which are doing work on our sites already. Once the design stages have concluded, the work to install the robot connection points can begin and once the site is returned to operational conditions the robot can be inserted to carry out an inspection of the pipework.
497. In summary there was no business spend in 2021/22 on GRAID. The innovation project was concluded, and work has been carried out in prioritising the locations where robot entry points could be installed on the NTS.



Figure 41: GRAID robotic platform and tether reel following the innovation project

XIII. Non Operational Capital Expenditure (TO and SO)

TO non operational capex

498. In 2021/22, our Non-Operational Capex (TO) is £22.5m, which was £1.0m above 2021/22 allowances of £21.5m.
499. Our spend was higher than Year 1 allowances in Non Operational Capex (excluding IT) by £4.2m, but off set by lower than Year 1 allowance spending in IT Capex (£3.3m).
500. Non-Operational Capex (excluding IT) before one-off adjustments was £3.2m below allowances, driven by lower spend vs. Year 1 allowances on both Property (£2.0m) and Vehicles (£1.3m). However, a one-off property charge (£7.4m) that covered the purchase of four gas sites ahead of the National Grid Gas sale transaction turned this £3.2m underspend to a £4.2m overspend in year.
501. Our spend on IT (TO) programmes has started slightly slower, resulting in the underspend against Year 1 allowances (£3.3m) 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 has had a knock-on impact on the timing of several programmes.
502. However, this spend category, together with vehicles and property excluding one-off costs are fully expected to recover to allowance levels across the remaining RIIO-T2 period.
503. It should also be noted that no spend has been applied to-date against our Non-Load UM's, with all spend allocated at this time against baseline allowances.
504. All Non-Operational Capex (TO) spend forecasts remains broadly in line with RIIO-T2 allowances.
505. For T1 Non-Operational Capital Expenditure, we have incurred £4.9m of unfunded costs in 2021/22. These costs are primarily through TO Non-Operational Capex and relate to the implementation of a new ERP system (SAP4 Hana), which is often referred to as MyFinance (£4.9m).

SO non operational Capex

506. This section covers our SO Capex Investment. In 2021/22, total SO Capex was £16.2m, which was £7.5m lower than our Year 1 allowances. This variance was principally driven by lower spend in IT Capex, with this programme commencing at a slower rate than was previously forecast. This is similar story to that described above in the TO non-operational capex section, where additional planning steps have been considered by the business in an attempt to optimise the chosen solutions and to indirectly drive efficient spend.

507. Currently our RIIO-T2 SO Capital Expenditure forecast remains in line with allowances.
508. There were also £1.4m of unfunded costs incurred in 2021/22 for RIIO-T1 Capital Expenditure (SO) projects, all relating to SO Non-Operational Capex RIIO-T1 work for MyFinance.

Small tools, equipment, plant and machinery (STEMP)

509. In 2021/22, total STEPM Capex was £4.1m, which was £0.5m lower than our allowances of £4.6m. This variance was driven by lower spend in both Strategic Spares and in Small Equipment Plant and Machinery, with both programmes commencing at a slightly lower rate than expected.
510. Currently our RIIO-T2 SO Capital Expenditure forecast remains in line with allowances.

IT and Telecoms

511. As part of our RIIO-T2 investment plan we deliver against our digitalisation strategy. Our plans focus on unlocking new value for stakeholders and consumers through our digital investments and our IT projects have been mobilised to focus on this as well as delivering on our ongoing asset health and efficiency commitments with our core IT systems.
512. Our Data and Insights Platform investment will provide the foundations we need across both TO and SO to enable the various internal teams and external users to unlock the value of the data we hold in a secure and reliable manner.
513. We are building a new platform that will bring together data from across the Gas Transmission estate together into a single, highly capable platform which will allow us to improve sharing and analysis of data, reducing the time to insight and unlocking operational efficiencies and benefits to customers. The project has been mobilised with delivery focused on providing the base platform capability upon which we can unlock further analytics and modelling capability.

IT Operations Enablement

514. We have continued to investment in our field force work management systems since go live in 2021 and expect to deliver the first phase of enhancements in Summer 2022. This will ensure we continue to deliver work efficiently, capture required data to support asset health plans and ensure the continuous safety of our people and the transmission network.

Data Driven Asset Management

515. We have mobilised our Digitalised Asset Management project to deliver a replacement of our Enterprise Asset Management (EAM) solutions to ensure a reliable and supportable service and including enhancements to support key

business processes. We have also invested in key projects to maintain and enhance our Geospatial Information Systems.

Market and Customer Insights

516. We have mobilised our Gemini sustain programme to ensure that our Gemini system, which is core to how the gas market operates, continues to remain fit for purpose. Further significant investment in Gemini and other IT systems is driven by a requirement to ensure our IT systems which support commercial and market processes facilitate gas regulatory change. Investment this year has been driven by several UNC modifications including UNC728 to support the new NTS Optional Charging discount and UNC759 to enhance Within Day Entry and Exit Capacity Allocations.
517. We have also begun investment focused on ongoing enhancements and development of the Customer Connections portal solution and rationalisation and automation of GTO managed processes into our Customer Relationship Management tool, and further enhancements and automation of workflows in Gas System Operation (GSO). This investment will ensure our IT platforms continue to support our interactions with customers and improve the overall customer experience.

Optimised System Operations

518. We have mobilised investment to refresh our Gas Control Suite (GCS) of applications in line with our asset health policy to ensure these systems remain reliable and secure. We have also initiated investment via our Safety and Compliance programme to ensure that our operational processes continue to address ongoing operational and safety compliance requirements, driven by the evolving configuration and behaviour of the NTS, operational learning and industry best-practice.

Shared Investments

519. Our Shared investment portfolio has focused, as planned, on the twin outcomes of reducing the technical debt across our hardware estate and moving towards cloud-based products and platforms with the aim of achieving an “evergreen” software estate.
520. We have been reducing technical debt through our investments in Local Area Network (LAN) infrastructure, Wide Area Network (WAN) infrastructure and End User Compute. One example of investment in these areas is the replacement of end-of-life routers and switches across our sites.
521. Achieving an evergreen software estate will mean large project delivered upgrades to systems become rare. Instead, we will integrate and extract value from the updates that most cloud-based products regularly receive.

522. Across our software estate a key focus for 2021/22 has been delivering the second phase of Project One with this release occurring during this reporting year. This programme has been initiated to drive improved efficiencies in relation to data management and reporting and involves investing in a new cloud-based SAP system which will transform finance processes.
523. Other investments in our currently shared software systems have been slowed or paused to ensure that the delivered solutions provide best value and service to our future standalone gas business.

Non operational property

524. Non-operational property is made up by the core estate excluding any operational sites such as substations, compressor stations etc. The core estate includes offices like Warwick, Wokingham, Reading and Homer Road (Solihull). Strand, the corporate head office is also part of the core estate but excluded for T2 purposes.
525. In 2021/22, investment in non-operational property projects was impacted by the COVID-19 pandemic due to which we are facing supply chain issues and delays associated with the national lockdown restrictions. The overall RIIO-T2 total spend in 2021/22 in 2018/19 prices was £0.88m. This includes projects funded directly and indirectly including the EV chargers project.
526. The RIIO-T2 indirect property allowance for GT and GSO for 2021/22 is £3.1m in 2018/19 prices. The funding utilised was £0.1m for projects within Warwick, Ambergate PMC and Birmingham Erdington.
527. The remaining £0.8m spent in 2021/22 is directly funded.
528. EV chargers project is directly delivered by Gas therefore not part of the indirect RIIO-T2 funding available to property core estate.
529. As part of the preparation for the sale of the National Grid Gas business, a review of the property portfolio took place. This resulted in the realignment of four sites, at a cost of £7.4m.

Vehicle Fleet

530. We recognise the need to act responsibly and reduce our operational transport emissions to help support the UK's commitment to reduce carbon emissions by 2026. Our ambition is to reduce our operational transport emissions by 30% using various methods including installation of telematics, reduction of current fleet and Electric Vehicles.
531. In 2021/22 we have commenced further work to better understand the best vehicle types and areas suitable for AFVs, whether this be Electric Vehicles (EV) or Fuel Cell Electric Vehicles (FCEV) when they come to market. As part of this analysis, we will consider infrastructure, cost and operational efficiencies.

532. We develop our vehicle replacement programme a year in advance, with orders for the 2021/22 year being placed in 2020/21. Unfortunately, the vehicle manufacturing industry has been impacted by significant delays due to the global shortage of semiconductor microchips, as well as the impact of the Ukraine-Russia war on vehicle supply chains. This has meant that we have not received, or been invoiced for, any replacement vehicles in 2021/22.
533. We will continue to work with our manufacturing suppliers to understand revised timelines, and to determine how best to proceed with the remainder of our vehicle replacement programme.

XIV. TO Other Costs

534. In 2021/22, our Other Costs (TO) capex is £30.1m, which was £3.8m below adjusted 2021/22 allowances of £33.9m.
535. The above variance is also adversely impacted by a RRP model data alignment error with Cyber opex costs (£4.2m) currently pulling into Other Costs Capex. Excluding this issue, our spend was £8.0m lower than allowances, driven by underspends in Physical Security Resilience (£9.1m) and Cyber Resilience IT (£0.4m), which were partly mitigated by higher spend vs. allowances in Cyber Resilience OT (£1.4m). The latter reflects where allowances have been adjusted down to reflect a partial return of unused allowances.
536. 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, with 2021/22 spend primarily focused on proof of concept and scalability. Our latest view on our ability to complete all planned works through approved outages, as well as indicative unit costs from completed and contracted works indicate that our forecast for Year 1-3 UIOLI spend can be reduced, and a reduction of £27.7m⁷ to reflect this forecast has been included in the Cyber OT PCD reporting section, with the Control System workstream representing most of the shortfall.
537. 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.
538. Other than Cyber Resilience OT, where we are presently forecasting an underspend against Year 1-3 UIOLI allowances, the remainder of the Other Costs (TO) capex forecast remains broadly in line with RIIO-T2 allowances.
539. For RIIO-T1 Other Costs Capital Expenditure, we have incurred £5.8m of unfunded costs in 2021/22. These costs are primarily related to PSUP RIIO-T1 (£4.7m), with the balance supporting Cyber Resilience (£1.1m).

Other Costs (SO)

540. In 2021/22, our Other Costs (SO) capex is £3.8m, which was £1.9m above adjusted 2021/22 allowances of £1.9m. The above variance is adversely impacted by a RRP model data alignment error with Cyber opex costs (£2.1m) currently pulling into Other Costs capex.

⁷ Total Cyber OT UIOLI reduction of £32.2m. £27.7m reduction to capex based on PCFM allocation percentage of 85%

541. There is also a slight overspend versus allowances on our Cyber Resilience IT programme (£0.1m). This reflects where allowances have been adjusted down to reflect a partial return of unused allowances, for similar reasons as noted above in the TO section.
542. Our RIIO-T2 forecast for this programme remains broadly in line with allowances.
543. There were no unfunded costs incurred in 2021/22 for Other Costs (SO).

Cyber resilience information technology (IT)

544. The overall GT business cyber strategy is to eliminate, and where not achievable, reduce our cyber risks through pragmatic and timely means.
545. This is the first year of RRP 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.
546. Full details of the Cyber IT expenditure for 2021/22 is contained within the January 2022 and July 2022 PCD status reports as submitted on a confidential basis.

Cyber resilience information technology (OT)

547. The overall GT business 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.
548. This is the first year of RRP performance reporting for the new category of Cyber OT, noting we have provided mid-year PCD performance data to the Competent Authority, alongside regular NIS advisory sessions. These six monthly reports provide performance detail on scope, cost, time and quality.
549. We have delivered on the vast majority of our Year 1 regulatory commitments, as detailed in our PCD submission with some PCD's in front of the baseline schedule.

Physical Security Capex

550. Our network is subject to a multitude of security threats, which are continually evolving and often increasing in sophistication and persistence. These threats include terrorism, criminality, espionage, activists/extremists, vulnerabilities within systems and vulnerability from insider action.
551. The Physical Security Upgrade Programme (PSUP) is a government mandated initiative to enhance physical site security with all works closely evaluated by the BEIS.

552. In 2014, National Grid worked with BEIS and the Centre for Protection of National Infrastructure (CPNI) to identify a number of gas transmission sites as PSUP based on BEIS' pre-defined criteria.
553. Of these gas transmission sites, those identified by BEIS prior to the site review in 2014 were designated Phase I of our programme of works. Solutions at all these sites were completed as of 31 March 2018, with all sites now being monitored by the Alarm Receiving Centre (ARC) now called the Security Control Centre (SCC). The remaining sites included by BEIS constituted Phase II of our programme of works.

Phase II

554. Phase II of the programme constitutes 20 sites. Of these 20 Phase II sites all have had solutions constructed and commissioned and are now connected to the National Grid SCC. The last three sites were commissioned in 2021/22. Ten of these sites have costs forecast for Financial Year 2022/23 relating project closure.
555. The delivery of these sites was impacted due to COVID-19 where a delay of six to eight weeks was seen due to temporary site shutdowns. Following recommencement of the projects, social distancing measures were enforced for health and safety reasons which had an impact on project delivery that was unrecoverable.

Site Extensions

556. There are occasions when our sites need to be extended, for example to accommodate additional assets. If this is required at a site at which physical security has already been upgraded through the PSUP, then the existing solution must then be modified and extended to ensure the revised perimeter meets the PSUP specification.
557. Allowances for two PSUP solution site extensions were requested in our May 2018 Reopener, however, Ofgem challenged the efficiency of our original proposal and did not adjust our RIIO-T1 allowances as our overall funding request fell under the RIIO-T1 materiality threshold.
558. The delivery of both site extension was impacted by COVID-19 through site shutdowns and from changes to the principal contractor. The selected delivery model utilises one PSUP contractor supported by internal SCC operatives.
559. One PSUP site extension project was completed on the 29 March 2021 and has been operationally accepted by the SCC. Costs relating to project closure and defect resolution are forecast in financial year 2022/23. At the second site, the PSUP solution is still within delivery and is expected to be completed within Financial Year 2022/23.
560. Our latest cost forecast is £4.573m. Overall project efficiencies have been achieved through our revised delivery approach, using one principal contractor supported by

the SCC. The project actuals and forecast for those projects are captured under the Peterborough and Huntingdon RIIO-T1 carry over line in RRP table 6.1.

Physical Security Capex – New Sites (Phase III)

Shared Sites/new build

561. As part of the review of sites in 2014/15, several shared sites were classified as requiring PSUP solutions. In this case shared sites are sites owned by Gas Distribution Networks (GDNs) but contain assets owned by National Grid.
562. The new build CAPEX works in RIIO-T2 consist of nine shared sites owned and operated by GDNs.
563. All of these sites contain National Grid owned assets of significant footprint that drive the requirement to upgrade to BEIS and CPNI standards.
564. In RIIO-T2 the approach and works to date has been centred on how to set up for a streamlined and successful delivery. The work in year one has included several focus areas:
- Delivery Strategy
 - Procurement Frameworks
 - Innovation and Efficiencies

Delivery Strategy

565. In RIIO-T2 on the new build sites, National Grid have elected to undertake the role of Principal Designer (PD) under the Construction Design Management Regulations (CDM) 2015.
566. Survey work has been split between National Grid and the designer. Where a survey was deemed to be low risk and relatively simple, we plan to undertake these directly to reduce costs but also ensure that we are in control of the survey information.
567. To aid the overall delivery and strive to obtain fixed price delivery contracts, our approach in RIIO-T2 for these works has been to take on more design responsibility within the realm of the teams' capabilities.

Procurement Frameworks

568. To provide an overall de-risked approach to delivery of the new build works, a full review of all the procurement options available was undertaken in the first year to ensure that the best vehicle has been selected.
569. The aspiration for these works was to ensure that the delivery effort input was proportional to the scale of the works being undertaken and as such we have been

working to engage a wider range of Integrated Security System (ISS) delivery partners to provide options of cover for all potential delivery scenarios.

- 570. A new ISS build framework has been set up which includes a mixture of Tier 1 and 2 suppliers that can offer a range of build services.
- 571. Design works will utilise existing National Grid Design Services frameworks to gain access to pre-qualified designers.
- 572. To de-risk the overall delivery and ensure that a staged approach was taken in RIIO-T2, a two-lot strategy has been developed to allow the new ways of working to be proven. This has also enabled lotting in geographically convenient packages to take place which may support efficient delivery.

Innovation and Efficiencies

- 573. To ensure the optimum solution is deployed in RIIO-T2 the project delivery team have reviewed the existing fence line in the design and survey stage and established that in some cases there may be potential to upgrade the security system, as opposed to full demolition.
- 574. It is envisaged that up to four of the sites due to be upgraded can be re-utilised and enhanced in this way by retrofitting a modification to the palisade fence line coupled with installation of security services around the existing site infrastructure.
- 575. As part of the delivery, we will need to acquire the existing fence lines that are to be re-utilised from the respective GDN owners and a process has been started to legally transfer the asset to National Grid..
- 576. Re-using the fence line may provide efficiencies by innovating in terms of the design solution itself and also greatly reduce the carbon footprint of the construction works with minimal demolition.

Overall Progress

- 577. The work in year one has taken slightly longer to start when compared to the original programme submitted at the Final Determination stage, however this has been a strategic decision to allow the optimum solution to be developed. Spend in 2021/22 was £1.3m versus £9.6m at the initial inception of the plan but this is reflective of taking time to ensure that the delivery has been set up to perform efficiently and all the tools to do so are in place.
- 578. Combining innovation via re-use of assets and enhancing them rather than demolishing them has allowed the team to build a strategy that focusses on lean delivery.
- 579. Works are progressing well and relationships with the GDN owner for Lot 1 sites is good and enabling the parties to work collaboratively.
- 580. Works to date and progress on new build sites includes:

- Lot 1 Design and Survey completion
- Lot 1 Establish and set up a new build framework
- Lot 2 Design and Survey scoping completed prior to design services call off
- Lot 2 Survey works started where sites have been accessed

Physical Security Capex – Asset Refresh

581. The Asset Refresh Programme is targeting upgrade of both Technology and Hardware assets at legacy ISS sites that were delivered under prior price control arrangements. Assets installed at existing sites will become obsolescent / redundant or unsupported in RIIO-T2. This programme of works is delivering upgrades to key items and equipment to ensure continued compliance with BEIS and CPNI standards as well as ensuring that the optimum solution is installed now that Technology systems may have improved.
582. In parallel to the main Asset Refresh Programme there are two sites that will also undergo some major project works as well as Technology and Hardware upgrades.
583. An initial development sanction was put in place in January 2022 to allow scoping and planning of the works to be undertaken as well as developing the full execution strategy including:
- Design delivery plan
 - Procurement strategy
 - Project overlap and opportunities for bundling

Design delivery plan

584. The initial sanction is in place to establish what level of modification is to be undertaken based on the scope / intervention type and to look for opportunities to roll these up into a single or multiple design packages.

Procurement strategy

585. The intention is to utilise a combination of the existing Gas Design services and new National Grid wide ISS frameworks to undertake both design, survey, and installation works.
586. A review of the lotting strategy is to be undertaken considering the geographical location of the sites and potential for bundling with contractors to strive for efficiencies.
587. Where possible, we will undertake direct procurement of equipment and free issue or novate this to the selected delivery partner.

588. Also, if it is deemed possible to do so, we will utilise some of its own staff from within the SCC to undertake commissioning works to again attempt to realise efficiencies.

Project overlap and opportunities for bundling

589. As there are other workstreams that will be on site at the same time as this delivery programme there is an intention to coordinate works to minimise disruption to site and if possible, bundle scope elements to drive a single deliver unit at site. This may reduce mobilisation costs where possible.

Physical Security Capex – Major asset health upgrades

590. The major asset health upgrades are also being executed as part of the asset refresh works, albeit via a separate investment sanction. The works are centred on upgrading elements of the security systems at Bacton and St Fergus terminals.
591. This investment will later be broken out to be executed by the existing major project teams that are already based at these key National grid terminals to ensure that a bundled approach is managed and to generate mobilisation efficiencies.
592. The projects are in the early scope development stage prior to going to the next stage sanction at which design can be commenced and long lead item procurement can take place
593. In 2021/22, spend is minimal in comparison to the original phasing plan set out at final determinations. Similar to the works being carried out on new build /shared sites, our strategy has been to take a considered approach on how best to execute the works in the most streamlined and efficient way.

Physical Security Opex

594. 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.
595. Enhanced Physical Site Security service and support services commence at the point of operational completion of the Enhanced Physical Site Security solution. At National Grid Gas Transmission Sites these services are provided by the National Grid Security Control Centre. The services that are provided include:
- 24/7 monitoring of Enhanced Physical Site Security sites including alarm and video signals through an Alarm Receiving Centre function;
 - Planned maintenance and 'fix on fail' repairs of Enhanced Physical Site Security equipment using ARC direct labour engineers backed by Enhanced Physical Site Security Service and Support Contracts with third parties;
 - A provision to deliver minor capital improvement projects; and

- Management of communication infrastructure between SCC and Enhanced Physical Site Security sites.

596. Our expenditure for 2021/22 was £5.5m (2021/22 prices) compared to an allowance of £33.7m. Our updated forecast for the five years of RIIO-T2 remains at £33.7m (2018/19 price base).

Customer Funded Diversions

597. We can be required to divert sections of our pipeline network due to Integrity issues with the pipeline or requests from third parties.

598. 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.

599. 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 ourselves are compensated.

600. During 2021/22 we completed a single diversion for National Highways. In addition, we advanced the development of a further 18 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.

National Highways – A428, Black Cat to Caxton Gibbet Improvements Diversion

601. National Highways are building a new dual carriageway between the A428 Black Cat roundabout and Caxton Gibbet roundabout. This new carriageway will reduce congestion in the area and improve connections between the M1 and M11. It will also better connect the communities of Bedford, St Neots and Cambridge.

602. The new road crosses our pipelines in five locations. At four of these locations, we’ve worked with the Highways Scheme designers to enable a pipeline protection approach to be considered. A diversion to reduce the level of the pipeline below the new road and increase the pipeline wall thickness was required at the fifth location.

603. The Diversion was on the Feeder 18 Little Barford Power Station Spur section of pipeline which cannot be shut down during power station operation. The works were aligned with an extended gas outage of the power station enabling efficient

use of our operational resource and a reduction in the overall cost to the Customer of circa. £0.5m.

604. The diversion itself was completed via directional drill to avoid disturbing the ground at surface level. This method was chosen in agreement with the Highways Team to enable necessary archaeological investigation to take place after the diversion works.



Figure 42: A428 diversion arial view– pipeline string ready for directional drill pull

605. The redundant section of pipeline following the diversion has been carefully removed and transported to Spadeadam for use by our Hydrogen test project.
606. The pipeline diversion was completed under budget and more than a year before Highways England apply for a Development Consent Order (DCO) – de-risking the overall carriageway project. Positive feedback has been received from the Customer.

“They had a very collaborative approach and transparency at all stages. I’m very happy working with National Grid. Delivery of the project was outstanding, and we are praising National Grid for their performance.”

Figure 43: Customer Feedback – Borys Moj at Skansa with a CSAT Score of 10

National Highways – A47 Improvements, North Tuddenham to Easton

607. We continue to work with National Highways and their contract partner on plans for a Diversion of Feeder 3 required for a new dual carriageway section of the A47. The Detailed Design for the diversion was completed during 2021 and a successful environmental screening report providing consent for the diversion to take place was submitted to BEIS.

608. Works were scheduled to take place during 2022, however, the highways scheme has been unable to come to an agreement with the landowner prior to the Highways Scheme DCO being approved. Works are now scheduled for 2023 by which time the land access required should be subject to Compulsory Purchase by the Highways Scheme.

National Highways A66 duelling scheme

609. We engaged with the National Highways A66 project team in March 2021. Two pipelines, Feeders 11 and 15 are affected where they cross the existing A66. Initial optioneering works to agree Diversion routes has been completed involving some changes to the Highways Scheme proposals to ensure a solution which is acceptable to both parties. Coordination with United Utilities has also been necessary due to the location of a large diameter sewer beneath one of the existing pipelines.
610. Ongoing development of the design and programme planning to ensure dependencies are documented and assigned clear owners has taken place through 2021/22.

National Highways – Lower Thames Crossing

611. Two significant pipeline diversions are required to enable the Lower Thames Crossing scheme in a congested area for highway and utilities infrastructure. Ground Investigation has been completed and is being used to finalise the Detailed Design which is to include a significant tunnelled section. During 2021/22, work has continued on completion of the Detailed Design, support of the Highways Scheme DCO and wider multi utility programme ensuring that the National Grid Diversions are deliverable within the wider Lower Thames Scheme and all dependencies are clear. The Diversions are expected to take place during 2024/25.

National Highways – A358

612. The A358 improvement scheme contacted National Grid in 2017. At this time, the requirement for Diversions of our pipelines was highlighted enabling the Highways Scheme to include high level budgets at the optioneering stage. The preferred road scheme has now been agreed and we've engaged with the Highways team to complete Conceptual Designs for one / two diversions (subject to further detail on the road scheme).

High Speed 2 (HS2)

613. We have been working with HS2 since 2012. The final diversions for HS2 Phase 1 were completed during summer 2020 and we continue to work with the HS2 team to complete land related activities prior to internal closure for this phase.
614. For HS2 Phase 2A, between Birmingham and Crewe, eight diversions are required. Three of these diversions are to be completed in 2022, two in 2023 and three in 2024, in line with the HS2 project requirements.

615. During 2021, ground investigation and detailed design works for Phase 2A have been carried out. Our proposals for the 2022 diversions passed through the HS2 Final Design Review and work has commenced on site. Preparatory work continues for the remaining Phase 2A diversions. We are anticipating increased materials costs for these later diversions; recent quotes for pipe on other projects have been around 30% higher than six months ago. Current volatility is due to the Ukraine-Russia conflict and has resulted in quote validity periods as low as 24 or even 4 hours.



Figure 44: Aerial view of site establishment and commencement of reception shaft works on HS2 crossing.

616. For HS2 Phase 2B, six diversions have been confirmed and initial feasibility studies for these commenced during 2021. Of the potential further ten diversions, two are known to have been cancelled and we await confirmation for the remainder. The Phase 2B diversions are expected to take place between 2025 and 2028.

Diversion Development - Other

617. The Detailed Design of a Diversion of feeder 29 for an East Riding of Yorkshire Council highway improvement scheme has been completed during 2021/22 with ongoing planning taking place prior to completion of works in summer 2023.
618. Three proposed Diversions for Cheshire East Councils A500 widening scheme, a private developer near Brentwood and the proposed West Winch Housing Access Road (WWHAR) are making steady progress with plans being put in place for works over future years.

619. We are committed to working with Customers and by ensuring they understand that by early engagement and development of Diversion options prior to overall schemes being fixed significant overall cost savings and simpler programming of works can be achieved.

XV. Network Operating costs (Direct Opex)

TO Direct Opex

620. In 2021/22, Total Direct Opex costs were £36.1m versus allowances of £36.4m, driving a £0.3m variance. The breakdown of costs was as follows:
- Planned maintenance represents £22.4m of the total cost, which was £3.8m below allowances
 - Unplanned Maintenance (faults) were £6.6m, £1.5m above allowances of £5.1m
 - Therefore, the net maintenance costs were £29.0m, £2.3m below allowances.
621. Reduced maintenance costs overall were driven by a broad mix of factors, including the following:
- Continued efficiencies through new ways of working following the COVID-19 pandemic, particularly travel and subsistence spend
 - Labour cost savings through a 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 and a focus on productivity (e.g. electronic permit to work system live at St Fergus and Bacton terminals) have also contributed to savings
622. 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.
623. The higher fault costs were primarily driven by higher-than-expected levels of unplanned Linewalking.
624. Additionally, prolonged severe weather in parts of the UK (predominantly Northern England and Scotland) impacted sites, with teams responding to challenges to keep the NTS flowing across the UK (see Figure 45 below).

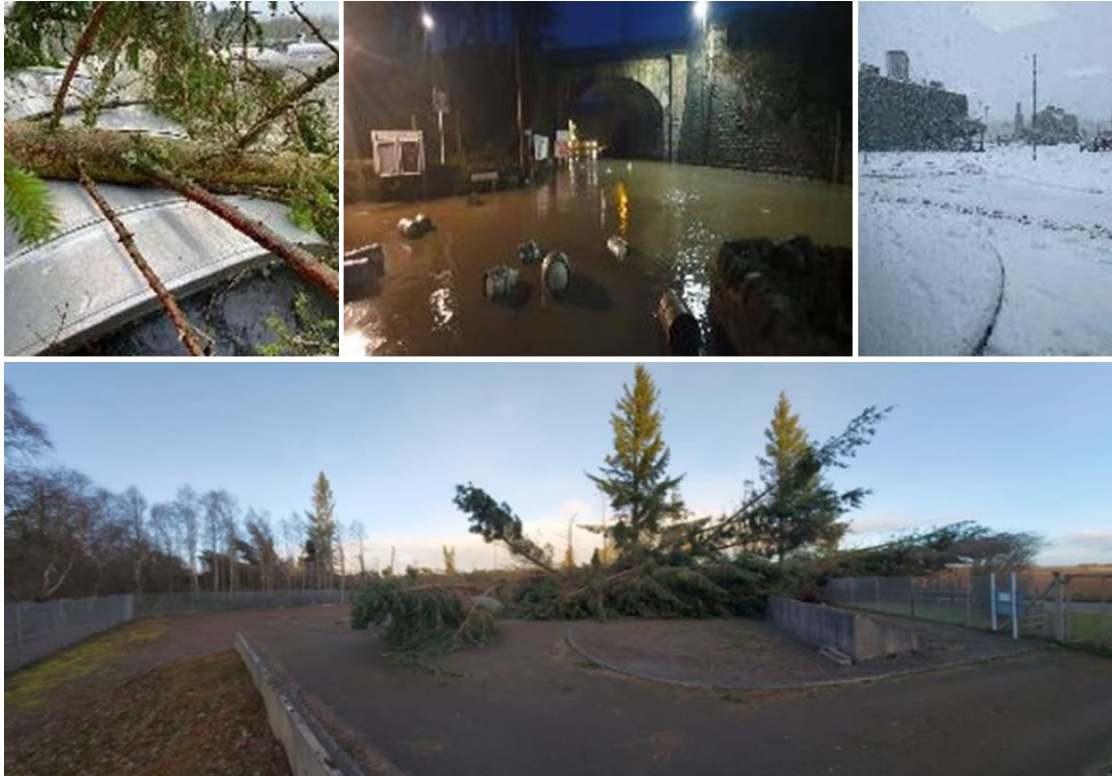


Figure 45: Impact of severe weather on the NTS

625. Operational Property related costs were £7.1m, £2.0m above allowances of £5.1m, driven in part by inflation related cost increases to own use utilities (namely own use electricity costs for the day to day running of the network).

SO Direct Opex

626. Total SO direct controllable opex costs for 2021/22 were £24.7m, which is £5.8m lower than the RIIO-T2 allowance of £30.5m. This has been driven by new ways of working and ensuring the GSO is correctly resourced across the teams, operating headcount mandates and relying on permanent staff rather than agency heads.

XVI. Indirect Opex

627. In 2021/22, total Indirect Opex Costs (across TO and SO for Business Support, Closely Associated and Quarry and Loss) were £80.9m, compared to a total allowance of £95m.

628. This underspend has been possible by ensuring support teams are correctly sized, including holding to headcount mandates and additional focus on bought in services to ensure they are cost effective.

TO Business Support Opex

629. TO Business Support costs were £29.1m for 2021/22 which is £4.9m lower than the allowances. This was driven by a focus on costs across the support functions, with new ways of working being implemented and making sure all teams are resourced appropriately to provide an efficient service.

SO Business Support Opex

630. SO Business Support costs were £17.3m for 2021/22 which is £5.2m lower than the allowances. This reduction was driven by a focus on costs across the support functions, with new ways of working being implemented and making sure all teams are resourced appropriately to provide an efficient service.

TO Closely Associated Indirect Opex

631. TO Closely Associated costs were £21.8m for 2021/22, which is £4.2m lower than allowances. This is partly related to the slower than expected progress across many of our non-load related capex deliverables. The lingering effect of the COVID-19 global pandemic, together with a sharp increase in both surveying requirements and recruitment of new personnel for the new regulatory period have all slowed our expected rate of progress in 2021/22.

SO Closely Associated Indirect Opex

632. SO Closely Associated costs were £9.2m, which is largely in line with allowances of £9.3m.

Quarry and Loss

633. Quarry and Loss costs were £1.9m for 2021/22 which is £0.5m higher than allowances of £1.4m

634. The payments in 2021/22 related to existing crop and drainage claims, there were no Quarry claims for 2021/22.

635. There were no major provision releases or increases in 2021/22.

Appendix I - Totex Table

Totex Summary

TO/	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/F net	Cost Load Related	Capex		£m	7.5	15.5	15.2	43.6	2.2
TO	TIM	Act/F net	Cost Non-load related	Capex	Compressor emissions	£m	16.8	33.5	61.5	16.4	0.1
TO	TIM	Act/F net	Cost Non-load related	Capex	Asset Health	£m	61.3	78.6	120.9	87.8	113.0
TO	TIM	Act/F net	Cost Non-load related	Capex	Other Non-load	£m	43.5	63.7	29.1	29.9	24.7
TO	TIM	Act/F net	Cost Non-operational capex	Capex		£m	31.4	29.2	21.3	18.5	18.7
TO	TIM	Act/F net	Cost Other	Capex		£m	35.9	68.7	93.8	10.4	6.3
TO	TIM	Act/F net	Cost Indirect	Opex		£m	55.4	89.9	89.5	68.0	66.9
TO	TIM	Act/F net	Cost Network operating costs	Opex		£m	41.2	35.1	37.2	39.4	36.1
Allowances											
TO	TIM	Allwr net	Cost Load Related	Capex		£m 18/19	2.0	2.9	2.4	2.0	1.7
TO	TIM	Allwr net	Cost Non-load related	Capex	Compressor emissions	£m 18/19	12.2	34.7	59.7	20.6	1.1
TO	TIM	Allwr net	Cost Non-load related	Capex	Asset Health	£m 18/19	80.6	105.7	104.2	65.2	77.8
TO	TIM	Allwr net	Cost Non-load related	Capex	Other Non-load	£m 18/19	19.2	28.6	24.7	21.3	20.4
TO	TIM	Allwr net	Cost Non-operational capex	Capex		£m 18/19	26.1	24.6	22.0	20.0	18.9
TO	TIM	Allwr net	Cost Other	Capex		£m 18/19	56.0	109.5	100.3	3.2	1.9
TO	TIM	Allwr net	Cost Indirect	Opex		£m 18/19	62.6	63.8	62.2	54.1	52.2
TO	TIM	Allwr net	Cost Network operating costs	Opex		£m 18/19	42.4	42.1	42.0	43.7	40.2
Performance vs Allowance											
TO	TIM	variarnet	Cost Load Related	Capex		£m 18/19	5.5	12.6	12.8	41.6	0.5
TO	TIM	variarnet	Cost Non-load related	Capex	Compressor emissions	£m 18/19	4.6	- 1.2	1.8	- 4.2	- 1.0
TO	TIM	variarnet	Cost Non-load related	Capex	Asset Health	£m 18/19	- 19.3	- 27.1	16.7	22.6	35.1
TO	TIM	variarnet	Cost Non-load related	Capex	Other Non-load	£m 18/19	24.3	35.1	4.4	8.6	4.4
TO	TIM	variarnet	Cost Non-operational capex	Capex	Non-operational capex	£m 18/19	5.3	4.7	- 0.7	- 1.5	- 0.2
TO	TIM	variarnet	Cost Other	Capex		£m 18/19	- 20.1	- 40.8	- 6.5	7.2	4.4
TO	TIM	variarnet	Cost Indirect	Opex		£m 18/19	- 7.3	26.1	27.3	13.9	14.6
TO	TIM	variarnet	Cost Network operating costs	Opex		£m 18/19	- 1.1	- 7.0	- 4.8	- 4.3	- 4.1
System Operator											
Actual / Forecast Totex											
SO	TIM	Act/F net	Cost Non-operational capex	Capex		£m 18/19	16.2	30.1	26.2	45.2	27.6
SO	TIM	Act/F net	Cost Other	Capex		£m 18/19	3.8	-	-	-	-
SO	TIM	Act/F net	Cost Indirect	Opex		£m 18/19	26.7	21.4	32.6	33.2	33.5
SO	TIM	Act/F net	Cost Network operating costs	Opex		£m 18/19	24.7	27.0	30.9	30.8	30.5
Allowances											
SO	TIM	Allwr net	Cost Non-operational capex	Capex		£m	23.7	25.1	34.2	26.7	15.7
SO	TIM	Allwr net	Cost Other	Capex		£m	7.6	2.5	2.2	-	-
SO	TIM	Allwr net	Cost Indirect	Opex		£m	30.8	30.3	29.7	30.6	30.3
SO	TIM	Allwr net	Cost Network operating costs	Opex		£m	29.3	29.6	29.4	29.2	28.6
Performance vs Allowance											
SO	TIM	variarnet	Cost Non-operational capex	Capex		£m	- 7.5	5.1	- 8.0	18.5	11.8
SO	TIM	variarnet	Cost Other	Capex		£m	- 3.8	- 2.5	- 2.2	-	-
SO	TIM	variarnet	Cost Indirect	Opex		£m	- 4.1	- 8.9	3.0	2.6	3.3
SO	TIM	variarnet	Cost Network Operating Costs	Opex		£m	- 4.5	- 2.6	1.5	1.6	1.9

Appendix I – Published Outputs

Incremental Capacity

636. 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.
637. The PARCA termination value for 2021/22 was £0m.

Customer and Stakeholder Satisfaction Scores

Customer and Stakeholder Satisfaction Survey Scores

					Actual	Actual	Fcast	Fcast	Fcast
					RIIO-T2				
					2022	2023	2024	2025	2026
Unit									
Survey Results									
Customer Satisfaction									
Incentives	Customer Satisfaction Survey Score	CSPt	Score		8.6	8.5	8.5	8.5	8.5
Stakeholder Satisfaction									
Incentives	Stakeholder Satisfaction Survey Score		Score		8.5				

Gas Constraints

Gas Constraints

	Revenue Streams	Licence Terms	Entry/Exit	Units	Actual	Projection			
					2021/22	2022/23	2023/24	2024/25	2025/26
Constraint management revenues	Sale of Non-obligated Entry Capacity (incl accelerated release)	RNOEC	Entry	£m	1.9	-	-	-	-
	(/RNOEC*0.14)		Entry	£m	0.3	-	-	-	-
	Sale of Non-obligated capacity forming accelerated release	RAREnCA	Entry	£m	-	-	-	-	-
	(/RAREnCA*0.14)		Entry	£m	-	-	-	-	-
	Locational sell actions	RLOC	Entry	£m	3.3	-	-	-	-
	Physical renomination incentive charges	RLOC	Entry	£m	-	-	-	-	-
	Total RLOC		Entry	£m	3.3	-	-	-	-
	Sale of Non-obligated Exit Capacity	RNOExC	Exit	£m	8.8	-	-	-	-
	(/RNOExC*0.14)		Exit	£m	1.2	-	-	-	-
	Any further revenues derived by the licensee that the Authority directs to include	RADD		£m	-	-	-	-	-
Total CM Revenues (with 14% scaling)			£m	4.9	-	-	-	-	

Constraint management costs	Licence Terms	Entry/Exit	Units	Actual	Projection			
				2021/22	2022/23	2023/24	2024/25	2025/26
Operational buying back of entry capacity	EnCMOpC	Entry	£m	-	-	-	-	-
Locational buy actions	EnCMOpC	Entry	£m	-	-	-	-	-
Turnup or tumdown contracts	EnCMOpC	Entry	£m	-	-	-	-	-
Total EnCMOpC		Entry	£m	-	-	-	-	-
Operational Buying back of exit capacity	ExCMOpC	Exit	£m	-	-	-	-	-
Offtake flow reductions	ExCMOpC	Exit	£m	-	-	-	-	-
Total ExCMOpC		Exit	£m	-	-	-	-	-
Total CMOpC			£m	-	-	-	-	-
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	-	-	-	-

Variation to the Constraint Management target

CMOpDT

-	-	-	-	-
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Constraint Management incentive revenue (CMIR)	0.39*(8.5-CMOpPM)-CMInvC	£m	5.2
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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...
	RNOExCt	Excludes...

Legal disclaimer

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