Gas Transmission

Our Performance: 2019/2020

nationalgrid

National Grid Gas Transmission

Our Performance for 2019/20

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I. Strategic Performance Overview (SPO) for 2019/20

1. This report describes the financial and operational performance of National Grid Gas Transmission (hereafter abbreviated to National Grid) against the stakeholder outputs we have committed to deliver.

Director update on Business Plan, risks and future strategy

Performance Overview

2. I am proud to report that we have delivered good output performance, which is consistent with last year in most areas. We continued to deliver our reliability and safety outputs, setting a good foundation on which to begin the next period of price control. We have demonstrated further improvement in our environmental incentives and our customer and stakeholder satisfaction scores.

3. Overall our Totex performance has improved by £33m compared to last year. Our forecast allowances were affected by the St Fergus and Hatton needs case decision. However, we have mitigated the impact of this; at St Fergus, changing approach to optimise works with proposals in our RIIO-T2 plan, and more widely, seeking scope changes and identifying further opportunities for efficiencies. We have achieved £14.1m in Opex cost efficiencies linked to our Performance Excellence (PEx) value programme and other cost saving initiatives.

4. This year we continued to deliver our asset health investment plans; balancing our position between managing network risk, delivering Network Output Measures (NOMs) and delivering against our allowances. Overall through the period, we will have invested £99m over our asset health allowances to ensure the safety and reliability of the network for customers and consumers. As we move into the final year of the period, our focus now moves to final completion and close out of projects, as well as undertaking the preparatory works including feasibility studies and survey work for the RIIO-T2 period.

5. In June 2019, we made a Needs Case submission to Ofgem for the Industrial Emissions Directive (IED) investments at St Fergus and Hatton. We received approval of the Hatton needs case in November 2019, and have continued to progress works. The cost assessment forms part of our RIIO-T2 business plan. For St Fergus, our plans to achieve compliance with the requirements of the IED legislation have evolved following Ofgem's decision not to approve the St Fergus needs case at this time, noting this would be needed in the future. The previously phased approach has now become combined with the investments proposed in the RIIO-T2 business plan submission.

6. In December 2019, we submitted our RIIO-T2 business plan to Ofgem. In developing our plan over the last few years, we have carried out our most extensive ever engagement exercise to understand our stakeholder's priorities and future

requirements. The plan reflects stakeholder priorities which include keeping bills affordable whilst maintaining a safe, resilient and reliable gas network during this period of transition to a sustainable energy future. We have worked to define and determine the network capability stakeholders need and we are proposing £553m per year of investment (39% higher than RIIO-T1) to maintain a safe, reliable and resilient transmission system. We have challenged ourselves to ensure our proposals deliver efficiently and create optionality as we develop the lowest cost pathway to net zero. We have tested the acceptability of our plan with consumers, finding that 88% of domestic and 82% of non-domestic consumers find the average impact of our RIIO-T2 plan acceptable.

Output Delivery

7. We have continued to deliver good performance for our customers against our five output categories. Table 5 summarises our performance against each individual output and provides a comparison to our 2018/19 performance.

8. In 2019/20, we were compliant with our **safety** related outputs. There were three employee and one contractor lost time injuries. We have focused on a number of initiatives to promote and encourage safety and wellbeing at National Grid. Two serious process safety events occurred and these have been fully investigated in line with Health and Safety Executive (HSE) legislation, with measures being implemented to minimise the likelihood of similar issues occurring in the future.

9. This year we have continued to provide high levels of **reliability and availability** ensuring the efficient delivery of 99.99% of our customers' gas requirements. We have continued to maintain strong communication with our stakeholders, presenting to industry forums on topics such as constraint management, using a simulation to increase understanding of how we manage capacity constraints and commercial tools, and providing an overview to explain the different tools at our disposal when managing an entry or exit capacity constraint.

10. In 2019/20, we have delivered £155.5m of investment to deliver a safe and reliable gas transmission network for our customers. We are forecasting to meet our target for the number of Replacement Priority 1 (RP1) assets reported through the current NOM regime and remain on target to deliver all NOMs in aggregate by the end of RIIO-T1, thus maintaining the health of the network for the benefit of current and future consumers.

11. In 2019/20 we made good progress with our key investment projects such as our River Humber Gas Pipeline Replacement Project, which will replace an underwater section of the Feeder 9 pipeline with a tunnelled solution. This pipeline section is one of the most critical to UK gas supplies on the National Transmission System (NTS) and these works are essential in continuing to provide a reliable and secure gas supply to our customers. The Tunnel Boring Machine (TBM), broke through into the pre-constructed reception shaft on 10 September 2019, marking the completion of 18 months of continuous tunnelling activities. Following the removal of the TBM from site in October 2019, the installation of the complex and bespoke Cathodic Protection system has been completed, and the tunnel water filtration and

filling operations have now commenced. The pipeline is planned to be commissioned in Autumn 2020.

12. Changing supply patterns have the potential to have a significant impact on our **environmental** outputs. In 2019/20, the network experienced a continuation of the diverse supply of gas into the NTS, close to the centres of demand. Liquefied National Gas (LNG) terminal flows increased once more, with the number of LNG cargoes received increasing from 109 in 2018/19 to 189 in 2019/20. This demonstrates the highly variable nature of gas flows on to the NTS, which are dependent on prevailing supply and demand conditions both in the UK and the global market.

13. As a result of these demand and supply patterns, usage of our compressor fleet reduced by 32%, allowing the network to be operated in a more economic manner. This resulted in a subsequent reduction of CO_2 emissions from compressors by 46% compared to 2018/19 levels. Our electric drive compressors have also taken a bigger proportion of overall operational running hours. This has had a positive impact on our Greenhouse Gas (GHG) emissions incentive with emissions at 86% of the target allowance and the lowest level in the RIIO-T1 period to date.

14. Our compressor emissions compliance work at Peterborough and Huntingdon are continuing, with the control room construction at Huntingdon underway whilst at Peterborough the two new units have been installed on concrete bases. Interconnecting pipework on both sites is now under construction. The programme of works has been impacted by COVID-19 working restrictions. There have also been important contractual developments, resulting in the mutually agreed exit from the contract with the Main Works Contractor, which we believe is in the best interest of both parties and the consumer. We are retendering the remaining works to minimise any risk to security of supply over the 2020/21 winter period and to ensure we still meet our environmental commitments.

15. We provide our annual emissions performance as part of our Carbon Disclosure Project (CDP) submission. This enables us to benchmark our performance against other organisations. In 2019 we achieved an ‘A’ rating for our CDP submission, putting us in the top 3% of global companies recognised for our actions to reduce emissions and mitigate climate change.

16. For **customer satisfaction,** we have continued to build upon our successful actions to significantly improve survey response rates, which has been reflected in our increased customer satisfaction rating from 7.79 last year to 7.80 in 2019/20. Our stakeholder satisfaction score also increased from 8.08 to 8.40. This improvement reflects the focus across our whole business to improve the way we provide the experience our customers need.

17. In terms of **customer connections**, we have met all requirements associated with connection and capacity requests submitted by our customers. During 2019/20, the first trial self-lay connection offer has been commissioned and is operational. We have also been progressing the connection of the first Bio-methane site to the

NTS at the Murrow offtake. This is the trial site from our Network Innovation Competition (NIC) Project CLoCC (Customer Low Cost Connections) which will be another first for NTS connections. We anticipate further low or zero carbon connections in the future as we look to meet the UK net zero ambitions.

18. **Innovation** in 2019/20 has expanded with a further focus on projects that can facilitate our target of 'Net Zero by 2050'. We undertook 31 Network Innovation Allowance (NIA) projects, many of which are now progressing under our hydrogen research banner 'HyNTS' and form part of a pathway of projects based around our NIC submission – FutureGrid. This project supports our roadmap net zero ensuing our network is ready to enable the transportation of hydrogen by 2026. We also continue to seek new and innovative ways to maintain and operate our network, to further enables us to deliver the greatest value for consumers.

Financial Performance

19. Across RIIO-T1 our Totex is planned to be £3,221m against an allowance of £2,956m. This results in a forecast spend above allowances of £265m, which is an improvement of £33m compared to 2018/19. Over the RIIO-T1 period we plan to invest circa £1.8bn of Capex across our overall business.

20. The change in performance is due to a decrease in forecast allowances of £42m, offset by a decrease in Totex of £74m. The allowances have decreased as a result of the outcome of the St Fergus Needs Case decision. To partially mitigate the impacts of these allowance changes, we have reviewed our spend across these specific and other wider activities, and have driven through scope and efficiency changes.

21. We are forecasting to spend above our allowances in the areas of Transmission Owner (TO) Non Load Related Capex, TO Non Operational Capex and TO Opex. Details on performance against allowances for each area and changes in performance compared to 2018/19 are detailed in the Performance Summary section.

Consumer Bill Benefit

22. In RIIO-T1, less than £10 (2019/20 prices) of the average domestic consumer gas bill of £572[1] will relate to the gas network services we provide. In 2019/20, the proportion of the bill attributable to National Grid services was approximately £7.60 which equates to 1.3% of the typical gas bill. This is an increase compared to 2018/19 where the National Grid portion of the domestic consumer gas bill was £7.26 and is largely driven by an increase in allowed revenue from 2018/19 to 2019/20 by circa. £58m.

[1] Figure taken from the Ofgem publication 'Bills, Prices and Profits'

Key Risks and Looking Ahead

23. As the global response to the coronavirus pandemic continues to evolve, we're working hard to make sure the gas keeps flowing. The pandemic has presented our business with a fresh set of challenges. All our planned work has been assessed against guidance provided by Ofgem and The Department for Business, Energy and Industrial Strategy (BEIS); considering the need to balance the safety of our employees with the requirement to keep the gas flowing and maintain the integrity of the NTS. Each of our projects is required to undertake and implement a project specific risk assessment for COVID-19 measures including, for example social distancing requirements. Many projects therefore required a pause to understand and agree measures prior to recommencing and each project, with its respective mitigations will continue to be assessed, in particular ahead of critical milestones such as mobilisation, breaking containment or taking outages. Whilst the full impact is not yet clear, this will affect our ability to complete all works in normal timescales and is expected to result in additional cost. There will also be an additional layer of uncertainty to forecasts. Since the end of the reporting period, we have been providing a weekly report to Ofgem to signal any changes to works or costs as they develop.

24. The RIIO-T2 price control review remains a very significant event. The outcome of which fundamentally impacts our ability to provide the essential services our customers and ultimately consumers expect, as well as our ability to fulfil the decarbonisation agenda. We submitted our RIIO-T2 business plan to Ofgem on the 9 December 2019 and have undertaken a substantial assessment process during the final quarter of 2019/20. The feedback in Draft Determinations is due in July 2020, with the final setting of our allowances and outputs for the period 2021-2026 in Final Proposals due in December 2020.

25. In addition to the RIIO-T2 submissions, we had taken steps to plan for and agree the RIIO-T1 regulatory issues requiring 'close-out' during this financial year. The impact of COVID-19 on Ofgem's work priorities means this activity will now be undertaken in 2021. The intent remains to keep close-out issues to pre-defined items as outlined within the RIIO-T1 Final Proposals.

26. The development of monetised risk to inform asset health plans has progressed further during this last year and remains a key building block of our RIIO-T2 asset investment plan. We completed our work on the rebasing of the RIIO-T1 NOMs target and in February 2020 Ofgem released a formal consultation on the rebasing and associated licence change. We now anticipate a decision on this consultation later on in 2020.

27. The decarbonisation of the energy system is one of the biggest challenges facing our world and in November 2019 we made an important commitment to reduce our own direct greenhouse gas emissions to achieve net zero by 2050. We are looking at a range of ways in which to reduce our direct emissions, from electrifying our vehicle fleet through to our 'Future Grid' project looking to address the challenges

of moving to a hydrogen economy. Decarbonisation and whole energy systems form a core part of our RIIO-T2 strategy.

28. The implications of Brexit remain a significant concern and we have continued to assess and prepare for the UK withdrawal from the European Union (EU). We have been collaborating closely and regularly with BEIS, Ofgem and wider stakeholders, including interconnectors and other gas network operators. This year, the changes required to industry codes and related agreements in readiness for a 'no-deal' scenario progressed through normal industry open governance up to the point of final decision and have either been withdrawn (if they related to 'no deal') or put 'on hold' pending the outcome of negotiations during the transitional period.

29. I trust you find this performance report informative and we would welcome any feedback on how we can improve our reporting.

Phil Sheppard (Director, National Grid Gas Transmission)

Performance Summary

Financial performance

30. Across RIIO-T1 our Totex is planned to be £3,221m against an allowance of £2,956m. This results in a forecast spend above allowances of £265m which is a decrease of £33m compared to 2018/19.

31. Overall, we are forecasting to spend above our allowances in RIIO-T1. The change in performance from 2018/19 is due to a combination of changes in Capex spend (TO Load and Non Load Related and SO Capex) and an adjustment to allowances to reflect the St Fergus and Hatton needs case decision.

32. With reference to the restated[2] table, compared to last year our forecast spend has decreased by £74m on a constant 2019/20 price base and the adjusted allowances have decreased by £42m.

Activity	Spend (8 Year forecast) (£m)	Allowance (inc. uncertainty mechanism) 8 year forecast (£m)	Cost vs Allowance (£m)
TO Load Related Capex	24	47	23
TO Non Load related Capex	1,367	1,178	(190)
TO Non Operational Capex	149	74	(75)
TO Opex	901	778	(123)
SO Capex	272	340	69
SO Opex	507	539	32
Total	**3,221**	**2,956**	**(265)**

Table 1: Eight-Year Forecasted Spend and Allowances Overview (restated table)

[2] In order to better understand the underlying position of spend versus allowances, Table 2.4 is restated to better align allowance with spend categories.

33. Based on the table above, the main areas of differences between cost and allowances relate to:

- TO Load Related Capex – we are forecasting to spend below our overall allowance. We are currently forecasting to underspend our allowances for Scotland 1-in-20, but overspend on the ongoing works at Felindre and Tirley pressure reduction installation (PRI). Our performance compared last year has changed by £22m as a result of forecast spend decreasing for Scotland 1-in-20 works.

- TO Non Load Related Capex – we are continuing to forecast spend above allowances for asset health and whilst we have spent underspent against allowances on the Aylesbury IED-Large Combustion Plant (LCP) works delivering an innovative catalyst solution, this is partly offset by additional spend on Integrated Pollutions Prevention and Control (IPPC) phase 1 and 2 works from the last price control period. The year-on-year change is predominantly due to the St Fergus and Hatton needs case decision, removing the St Fergus LCP spend and deferring the majority of the Hatton LCP spend into RIIO-T2. This decrease is offset by an increase in IPPC costs at Peterborough and Huntingdon and spend on the Network and Information Systems (NIS) directive works. For asset health spend our performance compared to last year is broadly unchanged.

- TO Non Operational Capex – we are forecasting to spend above allowances driven by the need to invest in data and systems to improve the management of the asset health of our network. This is driven by additional investment in MyFinance, enhancing enterprise resource planning and transforming finance processes and Cyber Security. Our forecast spend has remained broadly stable from 2018/19 at £149m.

- TO Opex – we are forecasting to spend above allowances on Business Support costs and Closely Associated Indirect costs. Costs in this area are linked to the higher levels of asset health spend impacting on Business Support costs. Compared to last year, we show a similar level of performance. There has been a small decrease in Closely Associated Indirect costs overall, offset against an increase in Business Support costs from last year.

- SO Capex – we are forecasting to spend below allowances as a result of lower forecasted spend on Xoserve and Telemetry separation. Our SO Capex costs are £11m lower than last year due to reduced spend on IS Security and Risk Management, Telemetry, Regulatory Driven Gemini System Enhancements and Regulatory Driven GSO System Enhancements. These decreases are slightly offset by higher spend on Data Centres and Gemini Replatforming.

- SO Opex – we are forecasting to spend below allowances due to a higher proportion of Xoserve allowances allocated to Direct Opex, following the outcome of the review of agency costs. Our SO Opex costs have remained stable from 2018/19 at £507m.

Return on Regulated Equity (RoRE)

34. The overall NGGT (TO) RoRE across RIIO-T1 is 6.66%, a decrease of 0.51%. This is due to a decrease in post-tax financing performance. The change in post-tax financing performance is primarily due the impact of closing the gap between actual and the notional gearing level. The RIIO-T1 operational RORE has decreased marginally from 6.07% to 6.04%, this is driven by the marginal decrease in Totex performance with Enduring Value adjustments applied. Further detail on Totex performance is detailed below.

	2019/20	2018/19
Operational RoRE	6.04	6.07
Financing and tax	0.61	1.09
Total RoRE	6.66	7.17

Table 2: RoRE comparison

Primary outputs

35. Our primary outputs (as driven by incentives) are detailed in Table 5.

Maximum Allowed Revenue TO

36. The Gas Transmission TO Maximum Allowed Revenue for 2019/20 is £706.0m.

Licence Term	2018/19 (18/19 price base £m)	2019/20 (19/20 price base £m)	Commentary for year-on-year variance (Commentary in 19/20 price base unless otherwise stated)
Base Revenue (BR)	688.6	695.0	• (£7.0m) decrease in opening base revenue (PU) allowances. • (£15.5m) decrease in MOD. Detailed MOD commentary included in **Final Proposals base revenue against adjusted base revenue** section. • +£5.8m relating to TRU in 2019/20 as a result of the movement between forecast and actual RPI in 2019/20 compared to the movement in 2018/19.

Licence Term	2018/19 (18/19 price base £m)	2019/20 (19/20 price base £m)	Commentary for year-on-year variance (Commentary in 19/20 price base unless otherwise stated)
Pass Through (PT)	4.7	-4.2	• Business rates, licence fees and policing costs are trued up against the ex-ante allowances with a two year lag. The value from 2018/19 to 2019/20 has decreased by £8.9m. • Independent systems costs are trued up within year. The true up value increased by £0.5m between 2018/19 and 2019/20.
Incentives (OIP)	6.2	3.7	The 2019/20 incentive includes the Customer and Stakeholder Satisfaction Incentive and Stakeholder Engagement Reward for 2017/18 performance. The incentive revenue has decreased since 2018/19 by £2.7m
Network Innovation Allowance (NIA)	4.2	4.3	NIA costs have increased slightly on a year on year basis, due to an increase in the number of sanctioned innovation projects through 2019/20.
Network Innovation Competition Funding (NICF)	15.4	13.8	As per the Ofgem direction, the NICF revenue term has decreased by £2.1m (19/20 price base) compared to 2018/19. This year funding has been awarded to Cadent (£13.3m) and SGN (£0.5m).
PARCA (PTV)	-	-	The PTV term has been removed from the Revenue RRP and PARCA costs will be retrieved as part of the Base Revenue calculations in the PCFM.
Correction Term (-K)	-11	-6.4	The correction term in 2019/20 is based on the £6.2m over-collection of revenue in 2017/18 (as reported in the 2017/18 submission) and subsequently uplifted as per the licence algebra requirements to £6.4m
Maximum Allowed Revenue	**708.0**	**706.0**	

Table 3: Gas Transmission TO Maximum Allowed Revenue breakdown

Maximum Allowed Revenues SO

37. The Gas Transmission SO Maximum Allowed Revenue for 2019/20 out-turned at £243.4m.

Licence Term	2018/19 (18/19 price base £m)	2019/20 (19/20 price base £m)	Commentary for year-on-year variance
Base Revenue (SOBR)	94.6	140.9	• +£2.8m increase in opening base revenue allowances (SOPU). • +£39.3m increase in MOD. Detailed MOD commentary is included in **Final Proposals base revenue against adjusted base revenue** section. • +£1.1m relating to TRU in 2019/20 as a result of the movement between forecast and actual RPI in 2019/20 compared to the movement in 2018/19.
Constraint Management (CM)	13.3	14.1	• The 2019/20 revenue includes the cost adjustment of £37.6m plus incentive revenue of £16.4m for 2017/18 performance. • Above values are quoted after WACC and RPIF uplifts have been applied. • The cost adjustment and incentive revenues are subject to a two-year lag from the year of performance.
Transportation Support Services (TSS)	-1.0	-5.9	• The 2019/20 revenue does not include any ex-ante allowance. The cost adjustment is -£-10.6m plus incentive revenue of £4.7m for 2017/18 performance. • Above values are quoted after WACC and RPIF uplifts have been applied. • The cost adjustment and incentive revenues are subject to a two-year lag from the year of performance.
Incentives (SOOIRC)	108.1	106.6	Further detail on incentive costs and performance is included below.
Correction Term (-SOK)	-16.6	-12.3	The correction terms in 2019/20 is based on the £11.7m over-collection of revenue in 2017/18 (as reported in the 2017/18 submission) subsequently uplifted as per the licence algebra requirements to £12.3m.
Maximum Allowed Revenue	**198.4**	**243.4**	

Table 4: Gas Transmission SO Maximum Allowed Revenue breakdown

Innovation

38. Alongside new and innovative ways to maintain and operate our network, innovation in 2019/20 has focused on projects that can facilitate the target of 'Net Zero by 2050' and provide a safe, reliant and efficient decarbonised energy system for the future that delivers value for our customers.

39. In 2019/20, the team undertook 31 NIA projects at a cost of £4.8m. These ranged from the 'Spatial GB Clean Heat Modelling' project that will create a prototype modelling platform to better understand the demand for low-carbon energy, through to the 'Geopolymer Resin Injection' project, tackling the challenge of ground settlement and subsidence putting stress on the buried pipework and fittings below.

40. The roadmap to decarbonisation for Gas Transmission has accelerated from a small collection of projects looking at the feasibility of network transition, to a point of developed understanding and the formation of a pathway of projects based around our NIC submission – FutureGrid.

41. Following the successful completion of both our NIC projects; Project GRAID (Gas Robotic Agile Inspection Device) and Project CloCC in 2018/19, Ofgem recognised that both projects had met the Successful Delivery Reward Criteria (SDRC) set out at the start of the projects. This resulted in 100% reward, reflecting Ofgem's assessment that the projects were well managed, cost effective and timely.

42. Innovation forms a pivotal part of our strategy for the remainder or RIIO-T1 and into the RIIO-T2 period. In December 2019, we submitted our Innovation RIIO-T2 Strategy setting out our vision to "innovate to create your network of the future and facilitate UK decarbonisation". We have also recently updated the Gas Network Innovation Strategy in March 2020, alongside the Energy Networks Association (ENA) and other network operators. It's our ambition in Gas Transmission Innovation to build and develop the innovation completed in RIIO-T1, learn from the successes and failures of the past, and ensure that collaboration and dissemination across the utilities grows and flourishes. All of this will help us deliver a decarbonised energy system.

Table 5: Outputs and Incentives Performance (primary & secondary)

	Safety			
	Our output	**2019/20 Target**	**2018/19 Performance[3]**	**2019/20 Performance**
1	Comply with HSE legislation	100%	**Complied**	**Complied**
2	Meet requirements for enhanced physical site security	Meet BEIS requirement by 2021	**On track**	**On track**
3	Meet requirements for enhanced data security	Submit six-monthly report on delivery of data centre investments and cyber security enhancement initiatives	**On track / subject to review with the NIS Competent Authority**	**Most initiatives remain on track, however some with minor delays. Subject to review with the NIS Competent Authority**
	Reliability and availability			
	Our Output	**2019/20 Target**	**2018/19 Performance**	**2019/20 Performance**
4	Maintain our security of supply obligations in Scotland (Network Flexibility)	Ensure compliance with 1-in-20 obligations by 2020	**Strategy in place to ensure compliance**	**Strategy in place to ensure compliance**
5	Meet our targets for investing in our assets to maintain their health (NOMs targets)	Deliver network replacement outputs in accordance with the licence	**In aggregate, on track to deliver eight-year target**	**In aggregate, on track to deliver eight-year target**
6	Replace Feeder 9 (pipeline that runs across the Humber Estuary)	Commission new Feeder 9 pipeline by 2020	**On target - Construction underway, commissioning planned for September 2020**	**On target - Construction underway, tunnel completed, commissioning planned for Autumn 2020**
7	Deliver benchmark performance for maintenance outage days	11 days (for Remote Valve Operations)	**0 maintenance day called**	**0 maintenance day called**
8	Minimise National Grid driven changes to maintenance planning	11 days (<7.25% of workload 11.02 of 152 days)	**No changes**	**6 changes due to cancelled ILI**
9	Meet constraint management target	£22m x RPI for entry/exit capacity £30.07m target	**£0m cost**	**£0.69m cost**
10	Meet target for Transmission Support Services and for Constrained LNG & Long Run contracting	This incentive ended 1 October 2018	**£0m cost**	**£0m cost**

[3] As reported in the 2018/19 RRP. Please note that all previous year figures are in 2018/19 price base unless otherwise stated.

	Reliability and availability			
	Our Output	**2019/20 Target**	**2018/19 Performance**	**2019/20 Performance**
11	Deliver existing capacity obligations in accordance with Unified Network Code (UNC), Licence and Gas Act	All UNC, Licence and Gas Act capacity obligations to be met in full	**System issues, including planned outages, impacted a minority of auctions**	**System issues, including planned outages, impacted a minority of auctions**
12	Deliver accurate 13:00 day ahead demand forecasting	9.12 mcm average forecast error	**8.90 mcm average**	**8.55 mcm average**
13	Deliver accurate demand forecasting at the two to five days ahead stage	13.70 mcm average forecast error	**13.44 mcm average**	**12.90 mcm average**
14	Meet target for residual balancing linepack performance measure	<2.80 mcm average daily change	**1.87 mcm average daily change**	**1.73 mcm average daily change**
15	Meet target for residual balancing price performance measure	Average daily difference between max and min price paid, to be within 1.5% of System Average Price (SAP)	**Difference 0.73% of SAP**	**Difference 1.12% of SAP**
16	Procure Operating Margins (OM) in an economic and efficient manner	Incur OM costs efficiently and publish report on the steps taken to promote competition	**Report published on time, £3.6m decrease in cost in 2018/19**	**Report published on time, £0.4m decrease in cost in 2019/20**
	Environment outputs			
	Our output	**2019/20 Target**	**2018/19 Performance**	**2019/20 Performance**
17	Develop an integrated and cost-effective plan to ensure the remainder of our compressor units are compliant with the IPPC and IED legislation	Delivery date 2018	**Integrated plan submitted in May 2018. In process of agreeing needs case for St Fergus and Hatton**	**Integrated plan submitted in May 2018. Needs case approved for Hatton. St Fergus investment included in RIIO-T2 business plan**
18	Undertake works at Peterborough and Huntingdon Compressor Stations as part of IPPC legislation	Delivery date 2020	**On track to deliver one new unit at each site as part of IPPC 3**	**Delays on the project have resulted in rescheduling outages.**
19	Undertake works at Aylesbury Compressor Station to ensure compliance with IED	Delivery date 2020	**Successfully commissioned 2018**	**Successfully commissioned 2018**
20	Report on our business carbon footprint	Publish in annual report	**Published in our annual report**	**Published in our annual report**

	Environment outputs			
	Our output	**2019/20 Target**	**2018/19 Performance**	**2019/20 Performance**
21	Meet greenhouse gas emissions targets	<2,897 tonnes for 2019/20	**2,871 tonnes**	**2,500 tonnes**
22	Meet our targets for the amount and the cost of the energy we use to run the network	<3,633 GWh (Gigawatt hours) gas equivalent usage target in 2019/20[4] <£97.3m cost target for 2019/20	**3,223 GWh** **£77.5m**	**4,536 GWh** **£80.1m**
	Customer Satisfaction outputs			
	Our output	**2019/20 Target**	**2018/19 Performance**	**2019/20 Performance**
23	Undertake annual satisfaction survey with our customers and stakeholders.	Customer 6.9/10 Stakeholder 7.4/10	**7.79 for customer** **8.08 for stakeholder**	**8.00 for customer** **8.40 for stakeholder**
24	Submit annual stakeholder engagement report	Cap of 9 and collar of 4	**Achieved a score of 4.85**	**Achieved a score of 3.11**
	Customer Connections outputs			
	Our output	**2019/20 Target**	**2018/19 Performance**	**2019/20 Performance**
25	Achieve our obligated times for delivering extra capacity on the system	Target of 24 months from the point of formal commitment	**Compliant - No incremental capacity due for delivery this year**	**Compliant - No incremental capacity due for delivery this year**
26	Meet timescales for connection applications as specified in UNC and comply with reasonable requests for a customer connection to the NTS	2 business days for application acknowledgment 5 business days to confirm competent connection application 2 months for initial connection offer 3 months for standard full connection offer 9 months for full connection offer 3 months for Feasibility Study Report	**6 offers progressed in 2018/19** **1 offer is due in 2019/20** **1 offer has had the FCO timescales extended as per the customer request**	**All offers made within UNC obligations**

Key

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

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

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

[4] In accordance with the NTS Shrinkage Incentive Ex Ante Baseline Value Statement usage target and actuals are quoted in GWh gas equivalent, using a factor of three to convert from electricity to gas equivalent.

II. Operational Context

43. Our performance in 2019/20 is contextualised by the continued evolution of the operational challenges the business has faced during the financial year. 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. During 2019/20, we have effectively facilitated the delivery of 99.99% of gas requirements for customers.

44. 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 trend towards the decarbonisation of the economy, manifesting itself as interactions between the gas and electricity systems.

45. Global market effects have resulted in continued high delivery volumes of LNG into the south of the country. A more diversified supply pattern across the network has continued to suppress compressor running hours, compared to those observed in 2018/19. Figure 1 below highlights the reduction in compressor running hours in 2019/20 compared to the previous year, as we have adapted to the changing market conditions.

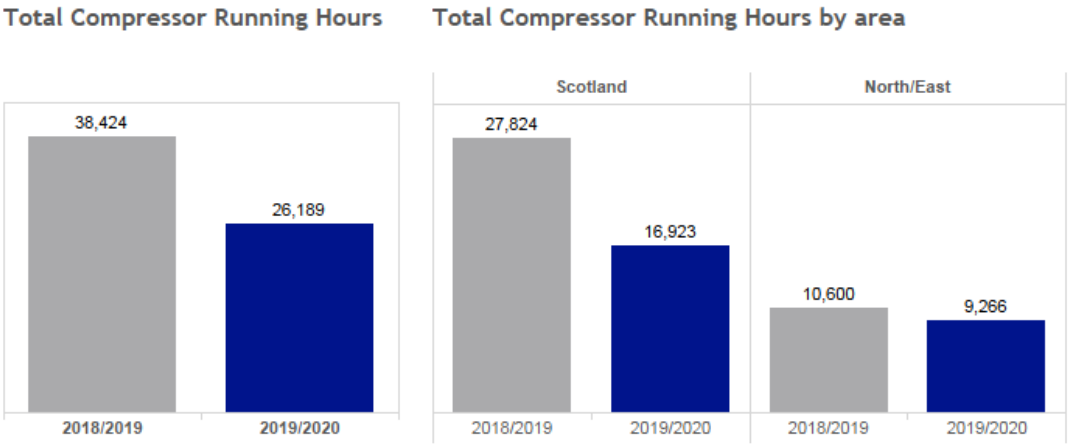


Figure 1: Compressor utilisation in 2019/20 compared to 2018/19.

46. To demonstrate the impact that different supply patterns can have on compressor utilisation, the charts below show comparisons between two days. The first chart has a day with low LNG flows and the other with high LNG flows. The second shows how two days with the same volume of demand are impacted by variations in supply pattern. The level of variation is very material, and the impact on compressor utilisation is significant.

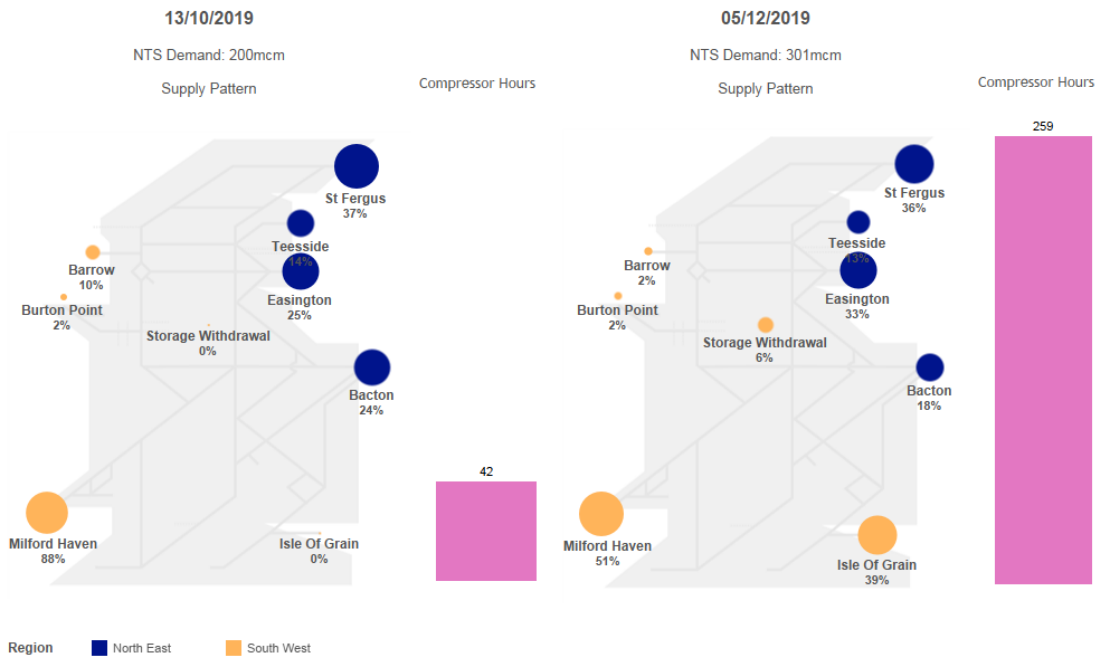


Figure 2: Compressor running hours and NTS demand on two separate days in the 2019/20 winter period.

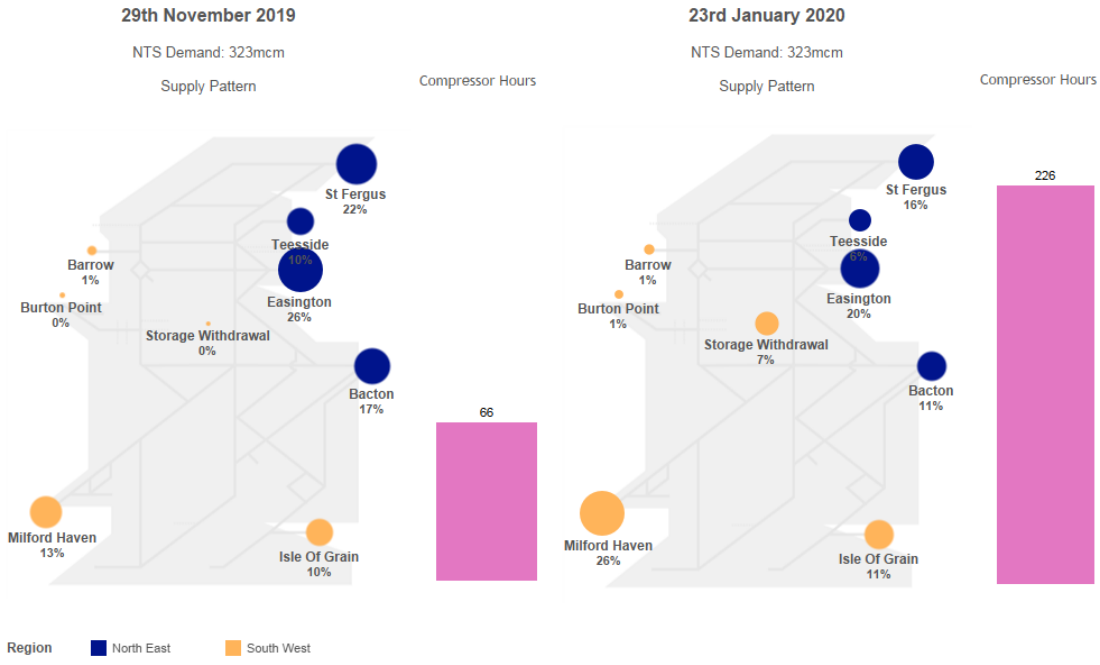
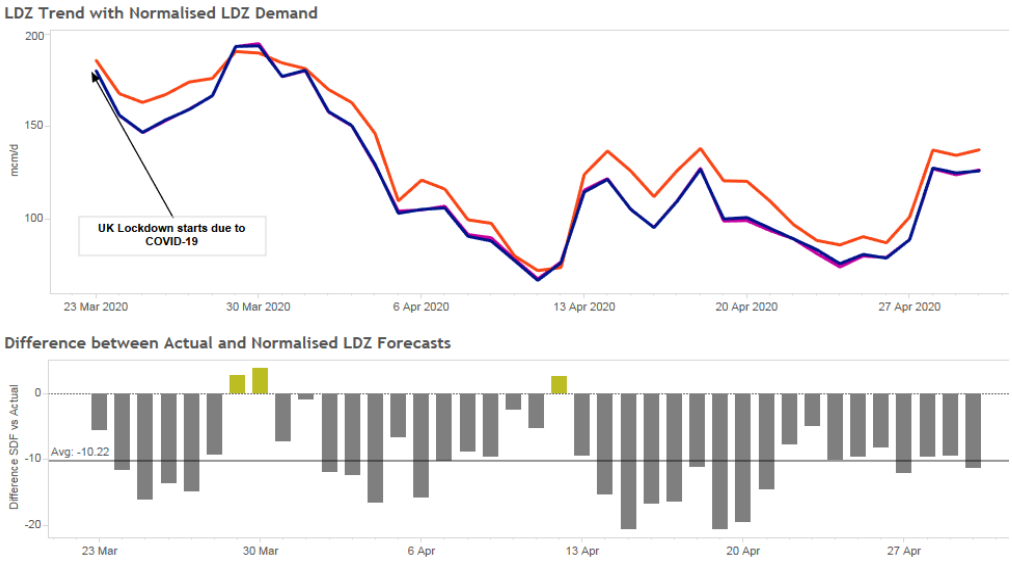


Figure 3: Compressor running hours and NTS demand on two separate days in the 2019/20 winter period.

47. Although only arising in the last weeks of the reporting period, the response to the COVID-19 pandemic and associated control measures has had a significant impact on the supply and demand flows onto the network, with demands supressed compared to what would normally be expected for an equivalent time of the year. This is due to a reduction of industrial load embedded in the Distribution Networks,

as well as a reduction in electricity demand and therefore reduced running of the directly connected gas-fired power stations on the network. The lower demand conditions have not reduced network resilience, with the network operating as expected throughout the period.



Local Distribution Zone (LDZ) Actual Demand

LDZ Demand Forecast - Revised forecast incorporating changes in behavior in response to COVID-19

LDZ Normalised Demand Forecast - Forecast using only CWV and Rainfall to calculate the LDZ demand. This will NOT include changes in behavior in response to COVID-19

Figure 4: LDZ demand and forecasts following COVID-19 pandemic response

III. Outputs

48. Under the RIIO-T1 framework, National Grid's performance as owner and operator of the gas NTS is assessed against five key outputs:

- Safety
- Reliability and Availability
- Environment
- Customer Satisfaction
- Customer Connections

49. These outputs focus on delivery of outcomes that our customers and stakeholders have told us they value most. There are also a series of more specific outputs that sit within each of these five key output areas. These are detailed within Table 5 and have been used in our assessment of our 2019/20 performance.

50. 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 2019/20 performance against these key outputs is outlined further in the Outputs sections below.

IV. Outputs – Safety

51. The safety of our workforce, the public and our assets, remains a top priority at National Grid. We aim to deliver world class safety performance which is crucial to our customers, the communities we serve and to the reputation of our business. Specific outputs under this theme relate to compliance with safety legislation and meeting the requirements for enhanced physical site security. In 2019/20, we were compliant with our safety related outputs. Two serious process safety events occurred in 2019/20 and these have been fully investigated in line with HSE legislation, with measures being implemented to minimise the likelihood of similar issues occurring in the future. We are on track to meet BEIS's requirements for enhanced physical site security.

Gas Transmission Safety Performance

52. Within the Gas Transmission business, there were no public injuries as a result of our activities in 2019/20, but there were three employee and one contractor lost time injuries. All three employee lost time injuries were a result of musculoskeletal injuries – an injured back whilst lifting an access panel, an injured arm whilst lifting an item out of a van and an Achilles tendon injury whilst opening a manual valve. The contractor lost time injury was a result of injuries sustained in a road traffic incident during a business journey. The combined employee and contractor lost time injury frequency rate was therefore 0.15. The combined employee and contractor Total Recordable Injury Frequency Rate (TRIFR) for Gas Transmission closed the year on 0.57, based on 15 injuries.

53. There were two serious process safety events during 2019/20, both which involved the release of gas from the NTS. The first incident occurred in January 2020, when there was a gas release as a result of a failure on a ½ inch fitting on a regulator stream at Ryehouse Power Station Above Ground Installation (AGI). The second incident occurred in February 2020 when there was a gas release through a 10mm diameter drain point from a transmitter manifold at Wormington Compressor Station. Both incidents were reported to the HSE under the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR). Both events have been fully investigated using root cause analysis techniques and corrective actions are being implemented according to the agreed plan to minimise the likelihood of future occurrences. These actions focus primarily on our strategies for managing and maintaining assets of this type and ensuring the learning from these incidents is captured and used to avoid other similar issues. These events support the focus we are giving to the health of our assets with further detail on asset health strategy and delivery provided in Section XI.

54. Throughout 2019/20, we have focused on a number of initiatives to promote and encourage safety and wellbeing at National Grid. These include:

- Behavioural Safety Training – 'Your Choice' behavioural safety training was delivered through an interactive workshop to supervisors and managers across

Gas Transmission, demonstrating how leadership decisions can directly impact on safety at all levels of an organisation.

- Asset Condition Information – A new asset defect module with enhanced recording and reporting has been implemented. The new defect module has improved the asset condition data captured and how it is reported to improve overall risk management and investment prioritisation of those assets.

- Health and Wellbeing - Mental and physical health has continued to be a focus for National Grid. From a mental wellbeing perspective, developments include a new mental wellbeing standard, three mental health campaigns (to raise awareness, provide guidance and highlight available support) and the roll out of two new courses - Managing My Mental Wellbeing (for all employees) and Managing Mental Wellbeing in the Workplace (for managers). From a physical wellbeing perspective, a musculoskeletal campaign was run throughout 2019 (providing general information and advice and delivering workshops dedicated to protecting and improving musculoskeletal health).

55. Throughout 2019/20, there have been a number of innovation projects that have continued our emphasis and drive to improve safety in everything we do. The Mobile Condensate Tank project which was launched last year has continued to develop and is on track to deliver in 2020/21. The project is developing a novel solution to replace our fleet of condensate storage tanks with safe, easy to use mobile condensate drain tanks rated for the full NTS line pressure. If proven to be a viable solution, it will mitigate the process safety risks associated with managing the pressure boundary that otherwise exists when connecting high pressure systems to the existing low pressure storage tanks.

56. In addition to applying innovation to protect against physical risks, innovation has been successfully applied in the field of cyber security. The successful rollout of our Open-Source Supervisory Control And Data Acquisition (SCADA) projects on one of our gas compressor stations has resulted in not only the development of a vendor-agnostic standard SCADA package, but also the enhanced compliance of the site SCADA system which is now aligned with the IEC 62443 cyber security standard. This further increases National Grid’s resilience to potential malicious cyber-attacks and creates a blueprint architecture that supports this compliance and enhances cyber security. This will form the basis of future site upgrade work.

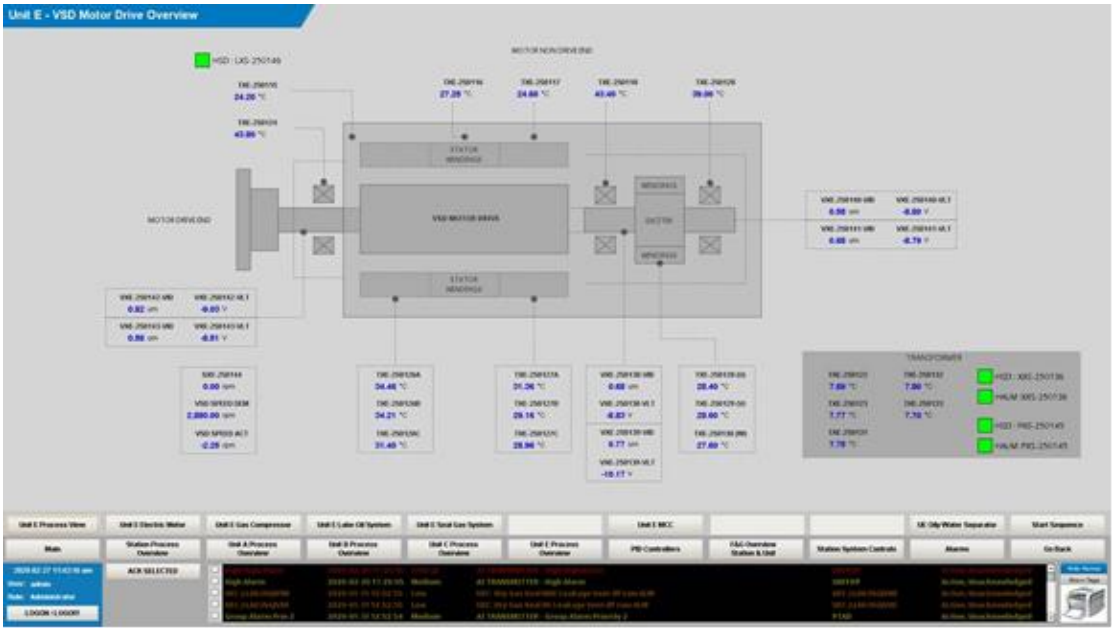


Figure 5: A screenshot of the HMI (Human Machine Interface) from the Open-Source SCADA NIA project.

57. We also promote and encourage Business As Usual innovation to help drive the safety agenda. We are currently trialling the application of an Electronic Permit to Work system covering one of our terminals, a compressor station and the interconnecting pipeline network. The trial has identified a number of benefits with work preparation, planning, control and work conflict as well as highlighting some learning points which need to be addressed as part of any future rollout of the system. We have also introduced a sustainable version of our third-party pipeline marker posts, to help mitigate the risk of third party interference which always remains one of the most significant risks to our assets.

58. Safety remains a key driver of innovation. To find out more about our projects and how they help to support and improve the management of the NTS, please visit: www.nationalgrid.com/gasinnovation

V. Outputs – Reliability and Availability

59. The reliability and availability of our transmission network and the service it provides is vital to our customers. In 2019/20, we continued to provide high levels of reliability and availability for our customers to input and offtake gas from our system. The section below details how we have performed against our Reliability and Availability outputs outlined in Table 5. In summary, most of our outputs in this area have been met, and all are on target to be met within the remainder of the RIIO-T1 period. The only area where an issue has been experienced is with regards to 'Capacity Obligations' (Output 11 in Table 5), with further details available in the 'Constraint Management Incentive Scheme' section below. Reliability and Availability outputs not discussed in the below section, are covered in X. Load Related Capital Expenditure and XI. Non Load Related Capital Expenditure.

Network Output Measures (NOMs)

60. The reliability and availability of the NTS to our customers depends predominantly on the health of our assets, both today and into the future. NOMs are currently being used as a proxy for network risk to measure the risk across the RIIO-T1 period. As per previous submissions, we have identified that the current NOMs approach for predicting asset condition over-predicts for some asset groups and under-predicts for others. This is still the case and it is therefore important to note that our asset health investment planning is not based on the modelled view but targeted to address actual network condition/issues and minimise disruption to customers. This approach has also formed the basis of our RIIO-T2 asset health business plan submission.

61. We have spent £66.4m on asset heath works in 2019/20, compared to £116.1m in 2018/19. This spend is £6.9m lower than the £73.3m forecast in the 2018/19 RRP, as delivery has slipped into the 2020/21 programme for final completion and close-out. The 2020/21 forecast has increased from £71.5m to £78.3m as a result of this reduced actual spend in 2019/20 and the need to finalise and close-out projects before the end of RIIO-T1. There is also significant spend, estimated to be £8.9m, associated with feasibility studies and survey work in preparation for our enhanced programme of work in preparation for RIIO-T2. This also includes preparatory work for projects that were reprioritised and deferred and will be delivered at a later date.

62. Our overall forecast for RIIO-T1 asset health expenditure remains at £710.9m (including Feeder 9 planning costs), in line with the 2018/19 RRP and our RIIO-T2 business plan submission. This is £102.5m above our RIIO-T1 allowance of £608.4m.

63. We have delivered 484 Replacement Priority 1 (RP1) and RP2 outputs over the year which has resulted in a reduction of 108 RP1 assets when compared to 2018/19, the difference being accounted for by more assets moving into the RP1 band through asset deterioration.

64. Based on the restated numbers and comparing the end of 2019/20 with the end of 2018/19, the number of RP1 assets across the NTS has reduced from 2,153 to 2,045. We predict that there will be 2,311 RP1 assets by the end of RIIO-T2. This is an increase from the number of RP1s (2,053) forecast last year, the increase being due to asset deterioration, improved project forecasting and deferral of non-essential works. We are currently assessing the risk benefits delivered by the proposed disconnection of the Warrington and Moffat compressor sites. This will result in a lower number of RP1s at the end of RIIO-T1 than currently stated.

65. We continue to favour refurbishment interventions over full asset replacements, which reduce network risk and extend the life of the asset, but with the consequence that the refurbishment intervention may not be sufficient to claim a network output. The implication is that a significant proportion of Asset Heath spend does not apparently reduce NTS risk as the Secondary Asset Class (SAC) unit of measure is too large to record an intervention benefit and reduce the numbers of reported RP1s.

66. We have developed a new taxonomy for defining an asset unit of intervention, named Equipment Units, which is based upon an industry-standard asset definition (ISO14224). We aim to migrate towards using Equipment Units rather than SACs to plan and report upon investment costs and benefits in RIIO-T2.

67. We are still forecasting to meet the Network Replacement Outputs targets outlined in our current Licence (Special Condition 7D.8) by the end of the RIIO-T1 period, although this will be superseded by a monetised risk target. We discuss the progress with moving towards this new monetised risk target, approval of our new NOMs Methodology and the use of monetised risk for RIIO-T2 Network Asset Risk Metrics (NARMs) target setting in Section XI.

Maintenance Days Used Incentive Scheme

68. The Maintenance Days Used incentive is designed to reduce the impact we have on our customers when we undertake our routine maintenance activities. For 2019/20, the incentive only included maintenance days for Remote Valve Operations (RVO); the In-Line Inspections (ILI) element of the scheme ceased in 2015/16.

69. We have sought to align all of our routine valve maintenance work with customer outages where possible, and only ten Maintenance Days for RVOs were requested ahead of the summer maintenance period (April to October). However, this was reduced down to zero after realigning the work with customers. This ensured that zero Maintenance Days were called in 2019/20 (as in 2018/19).

70. We have continued to build upon the improvements made in previous years to help us to improve the service we provide to customers.

Maintenance Day Changes Incentive Scheme

71. The aim of the Maintenance Day Changes incentive 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 which were initiated by customers, only those initiated by us.

72. The Maintenance Day Changes incentive includes any maintenance days called; it is not limited to RVOs. In total, there were 152 days of planned maintenance in 2019/20, compared to 184 days in 2018/19. This decrease, driven in part by a higher volume of internally impacting works that do not have a third-party impact, led to an updated benchmark for changes of 11.02 days in 2019/20, which is 7.25% of all Maintenance Days and Advice Notice Days[5] called. This compares to a benchmark of 13.34 days in 2018/19.

73. In 2019/20, there were six changes initiated by us during the maintenance period. This is an increase from zero changes in 2018/19. The six cancellations were all related to the same cancelled ILI, due to an issue with an inspection chamber, with the learning from this event being implemented across the relevant teams. The incentive was more challenging this year because nine of our ILI impacted our customers, compared to four the previous year. Ensuring we minimised the impact of these Inspections was crucial in demonstrating our continued commitment to be flexible to customers' requirements.

74. We have continued to look at ways of improving performance and in 2019/20 introduced a number of changes to our planning processes. This included a continued increase in face-to-face meetings with customers and telephoning/emailing customers eight weeks prior to the planned maintenance affecting them, allowing us to capture any changes to customer outages earlier.

75. Minimising the use of Maintenance Days throughout 2019/20 has ensured minimal impact to our customer's operations through taking on additional risk through increased aligned works, saving them approximately £15 million[6] in potential lost time revenue. This provides a better value service for our customers and the wider energy industry.

76. Our annual maintenance programme review for 2019/20 can be found on our website from 1 June at:

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

[5] Where a single maintenance activity affects multiple NTS Exit Points on a day, this is construed as a single day for the purposes of the Maintenance Incentives.

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

Constraint Management Incentive Scheme

77. The Constraint Management Incentive is designed to drive National Grid to maximise 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 Industry and end consumers, who share in the benefit of strong performance. The National Grid overall 2019/20 Constraint Management Incentive scheme performance was £33.2m, which resulted in £18.5m being returned to customers.

78. In 2019/20 (pre-sharing factor) overall revenue from Entry Capacity products, including Entry Capacity Overruns, increased to £3.0m from £1.3m in 2018/19. In 2019/20 there were no single significant overrun revenues generated through Shipper capacity trade errors, however, there was a significant charge for Daily Obligated Entry Capacity owing to a Shipper capacity bid which resulted in an overall trade value of £1.47m. (At the time of writing, the Shipper is disputing this charge and discussions are on-going.)

79. We have seen a minor reduction in revenue across all Entry Capacity products (excluding overrun revenues), decreasing by £0.1m from 2018/19, owing to a milder winter and lower overall demand on the gas network, compared to that experienced in 2019/20.

80. Revenue from Exit Capacity products increased to £1.0m in 2019/20 from £0.9m in 2018/19. Although 2019/20 was a mild winter, there was an increased level of LDZ offtakes and Moffat export, compared to 2018/19.

81. One of the ways in which we aim to reduce constraint management costs is by assessing the impact of maintenance planning: either the planned maintenance that is part of the annual maintenance plan, or ad-hoc maintenance resulting from an unforeseen concern or event. The commercial risks are then assessed alongside the physical risks, and a decision taken collectively as to whether the work should go ahead or be rescheduled, or other options considered. There is always some level of risk associated with taking assets out of service either partially or fully, though also an appreciation that maintenance work needs to take place. Across Gas Transmission, proactive management and communication of all aspects are considered and are fundamental to arriving at the right decision 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.

82. In 2019/20, we proactively managed several potential constraints. Three examples are provided below:

- In May 2019, we actively managed a constraint risk by securing a turn-down contract for June to September, to mitigate the risk of constraints at Milford Haven. High LNG flows were seen through the Winter period and continued through and beyond Q1 2019. This increased the level of constraint risk, which was further exacerbated by essential, planned engineering works, due to commence at the end of May on Feeder 2.

- In November 2019, we managed an unplanned extension to the scheduled critical asset work on Peterborough compressor station, alongside high national demands and therefore a heightened risk of constraint. The demand/supply dynamics at the time, and forecast, presented a risk that either entry or exit constraints could occur during the period of ongoing physical works. A bespoke commercial and physical strategy was developed for either eventuality, and additional support secured for other assets critical to maintaining capability levels in the wider area. The situation was closely monitored throughout the period, and managed effectively using operational and commercial tools, with minimal impact to customers.

- In January 2020, commercial tools were used to manage high entry flows at Milford Haven, when an issue developed at one of the Felindre compressor units. On 20 January, interruptible entry capacity was scaled back and Locational Sells taken to manage entry flows until the assets were fixed and proven to operate at normal levels. Commercial, operational and on-site teams collaborated to expedite a resolution, and limit the impact to customers as far as possible.

83. We continually strive to improve and maintain our customer relationships, and to support industry across 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 a number of different approaches as a means of raising awareness and offering support, all with the objective of managing network capacity in a more efficient way.

84. In 2019/20, we presented at several Operational Forums on capacity-related topics:

- In June 2019, we ran the Constraint Management simulation as a breakout session, to increase understanding of how we manage capacity constraints, and the considerations and process decisions involved.

- In November 2019, we provided a Commercial Tools Overview to explain the different tools at our disposal when managing an entry or exit capacity constraint. We also explained how the processes work, how we communicate these, and how Shippers can then respond and participate.

- In January 2020, we presented an overview of the annual Monthly System Entry Capacity (MSEC) and Quarterly System Entry Capacity (QSEC) auctions to raise awareness of the respective timelines and process, and offer support to potential participants.

- We have also provided material relating to specific "interesting days," giving industry the opportunity to ask for more information and to enhance understanding on how and why we have used any commercial and operational tools.

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

- Frequently Asked Question (FAQ) document. We have continued to build on the initial list of frequently asked capacity-related questions, and to raise awareness of this document with our customers. This is published on the National Grid website and is a comprehensive go-to document that provides answers to many capacity auction-related questions. We continue to evolve the content as we receive further feedback, or where we identify a trend in topics being raised by our customers.

85. During 2019/20, where we were provided with an indication that there could be a system issue with Gemini and/or Gemini Exit, which could impact Industry being able to place capacity bids in any one of the numerous capacity auctions, we ensured that we mitigated any automation issues and took steps to process auctions manually.

Transportation Support Services Incentive Scheme – scheme ceased Oct 2018

86. The Transportation Support Services (TSS) scheme incentivised National Grid to minimise the cost of procuring specific tools to support gas demand in the South West as an alternative to network investment. This incentive ceased in October 2018 with no spend incurred during 2019/20.

Demand Forecasting Incentive Schemes

87. 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 ensuring the economic balancing of gas supply and demand. The provision of timely and accurate forecasts aid 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 increased consumer benefit.

88. From a demand forecasting perspective, 2019/20 proved to be a challenging year as global supplies of LNG became increasingly volatile. The volatility of this supply component causes complexity when forecasting storage injection and interconnector exports as they in turn become more changeable. BBL becoming bi-directional was also a further and new consideration this year.

89. Power Station gas usage continues to be volatile with variable renewable generation being a direct factor on our demand forecasts. New sources of electricity generation from the greater availability of renewables, to the increasing capacity of our electricity interconnectors, has had a significant impact on typical gas for power requirements. Continued uptake of smart heating systems, and increasingly efficient insulation has continued the divergence in domestic demand from our traditional temperature-based models.

90. These factors have resulted in the day-on-day average change in demand remaining high, increasing slightly to 13.79mcm from 13.77mcm in 2018/19, with 18 days this year showing a greater than 40 mcm change from the previous day. The most extreme of these daily demand changes was 65.85mcm. With process changes and additional staff training, the average forecasting error has improved from last year.

91. In 2019/20, the weighted average error on the D-1 incentive was 8.55 mcm against a target of 9.12 mcm (Fixed target of 8.5 mcm + storage adjuster of 0.6205 mcm). The weighted average error has decreased this year from 8.90 mcm in 2018/19. The associated incentive revenue for 2019/20 is £0.99m, compared to -£0.86m in 2018/19.

92. The D-2 to D-5 incentive weighted average error was 12.90 mcm in 2019/20 against a target of 13.70 mcm. The weighted average error has decreased from 13.44 mcm in 2018/19[7]. The associated incentive revenue for 2019/20 is £0.58m, compared to £0.19m in 2018/19.

93. Throughout 2019/20 we have embarked on several activities to drive improvements in the accuracy of our demand forecasts, including:

- Ongoing staff development and process improvements to improve both demand and supply forecasting.
- Increased LNG ship monitoring as the UK market becomes a more attractive prospect for global LNG deliveries.
- The implementation of a project to develop demand forecasting models in-house to enable ongoing agile development of algorithms in response to the changing energy markets.

[7] The weighted average error was incorrectly reported as 12.44 mcm in the 2018/19 RRP, however the associated incentive revenue was accurate.

Residual Balancing Incentive Scheme

94. 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 National Grid 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 National Grid 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.

95. The LPM element for 2019/20 achieved a daily average linepack performance of 1.7 mcm/d over the year, compared to the 2.8 mcm/d incentive target. This was slightly better than the level for 2018/19 (which was, on average, 1.9 mcm/d). LPM was better than the target of 2.8 mcm/d on 293 days during the year (80% of days), a slight increase compared to 2018/19 (292 days, 80% of days).

96. The PPM element achieved an average price spread of 1.12% of SAP, compared to the 1.5% incentive target. This represented a decrease in performance on the 2018/19 value of 0.73%. In 2019/20, we were required to take residual balancing actions that enabled the system to balance on 221 days (60%) compared to 158 days (43%) in 2018/19.

97. On the days when we took balancing actions, the average price spread was 1.8%, compared with 2.0% in 2018/19 and 5.0% in 2017/18. This demonstrates an increased value to the customer despite a more challenging environment. Multiple factors have been identified which when combined created the more challenging backdrop for balancing, namely Linepack swing and Shipper behaviour. The NTS now accommodates much wider imbalances in supply and demand 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.

98. Shipper behaviour continues to have a substantial impact on balancing the NTS especially on weekends and holidays. The top 10 over and under delivered Shippers continue to represent approximately half of the imbalance volume over the year. There were twelve Shippers with an imbalance of greater than 1 GWh on more than 100 days throughout the year. We continue to engage with these shippers to understand the changing drivers behind habitually leaving an imbalanced position.

99. There were a number of challenging days throughout the 2019/20 period. For example, on 25 October 2019, a particularly challenging day for balancing on the NTS, the top five Shippers were 14.0 mcm light resulting in a 7.7 mcm loss in

Linepack after residual balancing actions. Despite National Grid setting System Marginal Price (SMP) Buy at 2.7 pence per therm (p/th) above SAP (32.5p/th), there was limited reaction from the market.

100. Following the implementation of Operational Balancing Accounts (OBAs) in October 2015, we have continued to work with adjacent Transmission System Operators (TSO) to ensure OBA operations do not materially impact residual balancing.

101. In 2019/20 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.

Operating Margins (OM)

102. We are required to procure our OM requirements on an annual basis in accordance with, TPD Section K of the Network Code, the obligations set out in National Grid's gas transporter licence, and the obligations detailed in National Grid's Safety Case.

103. OM may be used in the intermediate period following operational stresses to allow market actions to take effect and during the potential run-down of the system in the event of a Network Gas Supply Emergency. There were no OM service utilisations in the 2019/20 incentive year.

104. All costs incurred for the procurement and utilisation of OM are cost pass through within the Licence. Under the RIIO-T1 regime, we have a reputational incentive to promote competition in the procurement of OM services for our customers. We aim to meet the OM requirement in the most economic and efficient manner.

105. OM procurement costs have decreased from £7.5m for the 2018/19 incentive year to £7.1m for the 2019/20 incentive year despite a marginally higher OM volume requirement (676 GWh May 2018 – April 2019 increasing to 699 GWh for May 2019 – April 2020).

106. We continue to focus on stimulating a more competitive market response, through industry engagement to identify and secure new service providers.

107. Key achievements for the tendering event that took place in 2020 for OM year 2020/21 include:

- Contract enhancements – including the revision of Service Availability arrangements and with simplification of indexation principles.
- Through industry engagements, we received an increase of ~40% of sites tendering for OM services.
- The total bids increased from 25 to 30 this year, resulting in contracts being placed with 5 new service providers.

- Over half of our requirement was met by demand reduction; this is higher than previous years and reflects the increased competitiveness in this area.
- Enhanced pressure cover for locational requirements compared to 2019/20, due to more volume being offered at a number of sites.

108. Although increasingly challenging, we continue to see potential for further competition, particularly from gas fired power stations for OM service provision.

VI. Outputs – Environment

109. As one of our key outputs under RIIO-T1, minimising the impact our business has on the environment is important both to us, and our customers.

110. In 2019/20 we have made good progress against our environmental outputs outlined in Table 5. As a result of the lowest utilisation of the compressor fleet in this price control period, we have outperformed against our GHG emissions target and reduced CO_2 emissions from compressors by 46%. We have reported appropriately on our Business Carbon Footprint. The delivery of works at Peterborough and Huntingdon has been subject to delay due to the impacts of COVID-19 and negotiations that has led to the recent mutually agreed exit from the contract with the provider. However, despite these issues we still aim to meet our IED legislative obligations

111. at both sites. Further information about IED and works at our compressor stations can be found in Section XI. Non Load Related Capital Expenditure.

Emissions

112. IED has been in force since January and February 2013, in Scotland and England/Wales respectively. We updated our plan to comply with this legislation following both the May 2018 Reopener and the St Fergus and Hatton Needs Case submission this year. We report on progress within Section XI.

113. In addition to IED, the Medium Combustion Plant Directive (MCP) was transposed into UK legislation in December 2017 and January 2018 in Scotland and England/Wales respectively. As part of these changes in UK legislation, the time derogation for gas driven compressors has been confirmed as 2030 from the original 2025, in part influenced by National Grid lobbying EU stakeholders.

114. The MCP Directive applies to the smaller gas compressors and affects 27 of the NTS compressor units, with a compliance date of 2030. Other combustion plants, such as pre-heat systems, are also captured as part of this Directive with a compliance date of 2025. The investment strategy plan for RIIO-T2 has been submitted as per required timelines.

115. In 2019/20, compressor utilisation has reduced by 32% compared to 2018/19, this is the lowest utilisation of the compressor fleet in this price control period and is a direct consequence of changes in supply patterns across the network (further detail can be found in Section II. Operational Context). Consequently, we have seen a reduction in CO_2 emissions from gas turbine powered compressors of 45.8%, and also a decrease in NOx emissions by 36% from 2018/19 levels. The improved NOx performance is also due to the increased utilisation of electric drive compressors (from 29% to 38% of the overall hours).

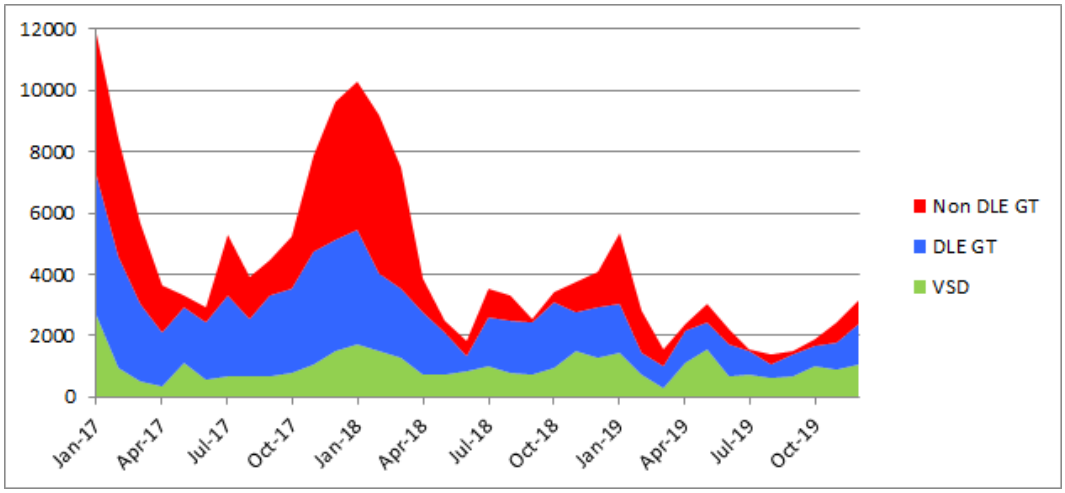


Figure 6: 2017 to 2019 Utilisation by Unit Type, hours

Business Carbon Footprint

116. As a Group, we have set a voluntary target to reduce our Scope 1 and Scope 2 GHG emissions across our UK and US businesses to 'net-zero' by 2050. The 'net-zero' target set in November 2019, replaces our previous target of an 80% reduction by 2050 from a 1990 baseline. At Group level, our baseline emissions level was set at 21.6m tonnes of carbon dioxide equivalent. We have an interim target to reduce our GHG emissions by 70% by 2030, which we are on track to achieve, and are reviewing our interim targets in light of our net-zero goal. All our business units, including Gas Transmission, are developing pathways to achieve net-zero Scope 1 and 2 emissions.

117. Scope 1 and 2 emissions in Gas Transmission can be broken down into sources including compression, venting, leakage, buildings and transport. Scope 3 emissions are from business transport only

118. The majority of the emissions in Gas Transmission are from fuel use in gas and variable speed driven electric compressors. Emissions from compressor stations are largely dependent on the locational balance between supply and demand conditions, driven by market forces.

119. Scope 1 emissions have fallen significantly in 2019/20 when compared with the 2018/19 emissions, from 295 $KTCO_2e$ to 185 $KTCO_2e$. Most of the reduction is due to changing supply and demand conditions which have contributed to a 32% reduction in operational running hours for our compressor fleet. We have also increased the utilisation of electric-drive compressors. The volume of methane vented from the compressor fleet has also reduced by 13%. We continue to focus on reducing venting within operational and maintenance outage periods, with the reduction in compressor running hours also a contributory factor. More detail on our venting performance and the actions and initiatives undertaken to reduce vented gas can be found in the narrative on our GHG emissions incentive scheme.

120. Scope 2 emissions have also fallen significantly, from 51 $KTCO_2e$ to 45 $KTCO_2e$ with running hours of our electric drive compressor fleet also falling by 10%. Electric-drive compressor units made up a bigger proportion of the overall running hours this year, from 29% to 38%. This increased utilisation and the falling carbon intensity of electricity means that this shift has had a positive effect on emissions.

121. Scope 3 emissions have increased from 1.9 $KTCO_2e$ to 2.5 $KTCO_2e$.

122. We provide our annual emissions performance as part of our CDP submission. This enables us to benchmark our performance against other organisations. In 2019 (for 2018/19) we achieved an 'A' rating for our CDP submission, putting us in the top 3% of over 8,300 global companies who submitted a response. This recognises us for our actions to reduce emissions and mitigate climate change.

123. Our GHG inventory, measurement, data collection, aggregation and reporting processes are verified by an independent third party providing assurance of relevance, accuracy, consistency, transparency and completeness.

Shrinkage Incentive Scheme

124. The aim of the Shrinkage incentive scheme is to minimise the costs we incur in our role as NTS Shrinkage Provider. These costs are recharged back to users as part of NTS commodity charges.

125. The overall volume of shrinkage gas and electricity procured for the combined elements of Shrinkage (Compressor Fuel Usage (CFU), Unaccounted for Gas (UAG) and calorific value (CV) shrinkage) was 4,536 GWh gas equivalent in 2019/20. This represents an increase in overall volume of 1,313 GWh gas equivalent from 2018/19. This is largely due to an increase of 1,814 GWh in the volume of UAG, outweighing a decrease of 543 GWh gas equivalent in the volume of CFU. (This is pre-reconciliation UAG, which includes some energy that is reconciled to particular users after close-out - refer to the UAG Incentive section for further detail).

126. The volume of CFU was 32% lower than in 2018/19, driven by a continued decline in the supplies at the St Fergus terminal, with NTS demand relatively low and higher LNG supplies. 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 CFU. We continued to manage the operation of electric units over periods of peak electricity demand to reduce Transmission Network Use of System charges (often referred to as Triad charges).

127. In forward trading for 2019/20, we adapted our strategy to be more agile in managing gas and electricity procurement following market movements and enable greater flexibility in decision making. We achieved EU Emissions Trading Scheme (ETS) compliance for 2019 for gas compressor emissions, having sold allowances

ahead of a potential no-deal Brexit to mitigate the risk for the customer of stranded assets.

128. In managing the NTS Shrinkage incentive scheme we incurred costs of £80.1m, including £60.4m for gas trades and £15.7m for electricity trades. This is slightly higher than costs for 2018/19 (£77.5m), with higher gas volumes outweighing lower overall market prices. Against the total incentive target of £97.3m, this represents a £17.2m outperformance that is shared with customers.

Unaccounted for Gas (UAG)

129. UAG is a reputational incentive with a requirement to undertake projects and initiatives to investigate the causes and reduce sources of UAG, as defined in Special Condition 8E of the Gas Transporter Licence in respect of the NTS.

130. UAG continues to be reported as post-reconciliation UAG, enabling a more accurate representation of UAG performance from the start of the RIIO-T1 period. This is calculated using closed-out corrected measurements after meter or data error has been detected and reconciled. Please note; due to these UAG values being reported as post-reconciliation UAG, they will differ to the Shrinkage RRP Tables which use pre-reconciliation UAG values.

131. The annual UAG energy has increased from 1,517 GWh reported in 2018/19, to 3,378 GWh in 2019/20, which is an increase of 123%. This is mainly due to a trend in UAG that has been observed between October 2019 and March 2020 which has increased both the frequency of positive UAG days and the magnitude of high UAG.

132. We review and investigate high UAG, paying particular attention to days where UAG exceeds ±20 GWh. During 2019/20, there were 85 days that exceeded the ±20 GWh tolerance, which is 32 days more than 2018/19. A dedicated project has been established to investigate the cause of this positive UAG trend.

133. We have carried out 58 reconciliations during 2019/20 equating to a net energy of -9 GWh. This is a reduction of 58 GWh in comparison to 2018/19. Most of these reconciliations adjusted the 2018/19 and 2019/20 periods with a minimum and maximum energy spread of -51 GWh and +43 GWh respectively.

134. In 2019/20 we have continued to look at ways to improve our UAG management and performance, the main focus areas have been:

- Continued development of data dashboards and visualisation to improve the data validations within the Entry and Exit close out periods, which improve the ability to identify erroneous data; and
- A dedicated UAG project to further investigate the high UAG trend that has been observed; and

- Maintaining a close relationship with all meter asset owners and validation agencies, providing a consistent and effective platform to receive metering system validations and to solve measurement issues.

135. In 2019/20, we received 100% of the meter validation reports for all the NTS entry and exit points, which is an improvement on the 99% received in 2018/19. These validation reports have been reviewed, and where necessary, queries raised with the asset owners. For the sites that had equipment failure, were close to failure or are of particular interest, we have added them to the 2020/21 witness schedule programme. We acknowledge that it may not be possible to witness the validations due to the working arrangements being imposed as a result of COVID-19. However, we will continue to work with the meter asset owners to assess the schedule programme as the current situation progresses.

136. We have continued to improve the accuracy of the data to a gain a greater level of confidence in the system measurements within the entry and exit close out periods. Understanding the end-to-end data flows continues within the scope of the UAG project.

137. We have participated in a global UAG benchmarking exercise with a number of Network Operators to help improve the overall understanding of UAG and its causes. We have started to receive some of the other TSO's findings which will be compared to our own data in due course.

Greenhouse Gas Emissions Incentive (GHG)

138. The aim of the GHG incentive scheme is to incentivise National Grid 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 us, our customers and stakeholders.

139. The emissions allowance is set each year by Ofgem, the allowance for 2019/20 is 2,897 tonnes. For each tonne of natural gas vented over the allowance we are subject to a price and cost payment, which is based on our NTS GT Licence formula using the latest non-traded carbon reference venting price published by BEIS. For 2019/20, this price was £1,487 per tonne of natural gas vented, this is an increase of £40 or 2.7% from 2018/19.

140. 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.

141. The total amount of natural gas vented from compressors in 2019/20 was 2,500 tonnes, which is 86% of the target allowance and the lowest level in the RIIO-T1 period to date. This is a reduction of 13% compared to the total amount of natural gas vented from compressors in 2018/19, and the second year running that we have not exceeded our allowance. The average venting through compressors in

the RIIO-T1 period including 2019/20 is 3,140 tonnes, with a maximum venting of 3,928 tonnes (2017/18) and a minimum 2,500 tonnes (2019/20).

142. The volume vented further decreased from 2018/19, which was primarily due to two factors; continued high focus across our business to reduce compressor pressurisation and venting within operational and maintenance outage periods, and a reduction of compressor running hours.

143. Although the volume vented has reduced, there has been an increase of the within-day and end-of-day variability flow patterns and less steady state operation, which in turn can lead to changing/additional compressor use.

144. The focus for 2019/20 was to further improve venting performance from previous years, and build on the initiatives to reduce controllable emissions identified through project work completed from 2017 through to 2019. Specific strategies to focus on key controllable areas to reduce Static and Dynamic Seal emissions with collaboration between Operational Sites and Control room activities.

145. 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 2020.

146. The NIA funded project Monitoring of Real-time Fugitive Emissions (MoRFE) which came from the successful delivery of Special Conditions 8J and 3D.47, Greenhouse Gas Investigative Mechanism (GHGIM) is ongoing and currently due for completion at the end of September 2020. The project will provide a full solution for improved imagery and quantification of fugitive leak detection including venting, source cost-effective materials and components, gas detector sensors and refine the original sampling methodology to support cost based decisions on asset repair and replacement programmes.

147. The first field trial of three has been completed. Savings were identified in the materials of the reference fugitive emission monitoring system as were improvements to the sampling methodology. The gas sensors also showed promise as a low-cost alternative to the reference system, with natural gas detection at the same rates, locations and magnitudes.

148. The second trial of the refined system is currently taking place at a gas compressor station where the improvements identified in the first will be tested. The final trial, scheduled for May 2020, will take place at a gas terminal.

149. An additional work package is looking at low cost, new to market Optical Gas Imaging (OGI) camera technology for detection of specific leaking components and the design of a proficiency testing scheme for personnel undertaking leak detection survey. If successful, the monitoring and camera survey technology is planned to be adopted into the delivery of RIIO-T2 with the objective of quantifying and reducing methane emissions.

VII. Outputs – Customer Satisfaction

150. The RIIO-T1 price control recognised the need to encourage network companies to respond to the changing requirements of an evolving customer base and develop strategies to drive improvements in customer and stakeholder satisfaction.

151. Our customer satisfaction output is supported by two separate financial incentives:

- customer and stakeholder satisfaction survey; and
- stakeholder engagement incentive scheme.

152. This year we have continued to apply our successful actions to improve response rates and achieved a significant increase from previous years. Our CSAT response rate increased to 49% from 34% last year, and our SSAT increased to 56% from 37%. The overall volume of responses was 91 in CSAT, down from 126 in 2018/19 and 98 in SSAT, down from 160 in 2018/19. Responses were affected by a slight dip in number of unique customer contacts to survey across some areas such as Customer Liaison and Operational Forums, and Future Energy Scenarios (FES) moving from a shared System Operator activity between gas and electricity to NGESO. This meant we could no longer include the scores of gas customers and stakeholders in our results this year. FES accounted for 13 CSAT and 58 SSAT responses in 2018/19.

153. In 2019/20, we achieved a customer satisfaction score of 8.00 against a baseline of 6.90. This has increased by 0.21 since last year's score of 7.79 and we have achieved a steady year on year increase in customer satisfaction since 2017/18, whilst continuing to engage with a broad range of customers.

154. The stakeholder satisfaction score was 8.40 against a baseline of 7.40, an increase of 0.32 from the 2018/19 score of 8.08. We have achieved a significant increase in stakeholder satisfaction this year reflecting our improving services across all GT areas and our increasing stakeholder engagement.

155. We received increasing scores in five service areas for both customers and stakeholders from 2018/19, and we received scores for the first time in a further four service areas this year. The area that received the highest increase in Customer Satisfaction since last year was Gas Maintenance which scored 8.63, an increase of 0.92pts. The customer feedback highlights a better working relationship and responsiveness to their needs. The Connections (application to offer) score, which had dropped last year, recovered to 8.41, an increase of 0.64 pts. Feedback highlighted an improvement in our understanding the impact of our actions and a timelier response. The highest increase in Stakeholder Satisfaction was Operational Forums, which scored 9.00, an increase of 1.00 pts, feedback highlighted a marked improvement to being responsive and clarity of information provided.

156. We have been working in the following areas:

- In response to customer feedback in 2018/19, our Customer Experience Governance Board sponsored a new agile sprint approach for initiating solutions to underlying issues raised. This included a new approach to our query management, sponsored by Nicola Shaw, CEO of National Grid UK. A lack of or slow responsiveness was the most prevalent issue for our customers according to their feedback, cutting across the majority of our service areas. We saw a 0.22 pt satisfaction improvement for customers and stakeholders who raised a query or request during 2019/20. This represented 61% of our overall customer and stakeholder Satisfaction responses

- We continue to monitor our performance against our five Customer Principles (Care, Agility, Transparency, Value and Trust). We focussed on collaborating and understanding our impact as part of our RIIO-T2 engagement, and in doing so we achieved the largest improvement to our stakeholder satisfaction score since introducing the measurement, moving up to an average score of 4.0 in 2019/20 from 3.8 in 2018/19.

- During 2019/20, we created a company-wide stakeholder engagement strategy and delivery plan that addresses all aspects of how we can effectively manage activity fit for RIIO-T2 business plan execution and beyond. From process design, capability and the skills required, to the systems and data management practices that will enable it, so that it is fit for future.

- We have now completed a year of our full customer experience strategy, which was endorsed last year by our Group Executive Board. The focussed sprints that were delivered, not only looked at customer issues such as query management, but also the employee experience that impacted on their own ability to provide the experience customers needed. The first employee journey that was worked through was the ‘I Join’ onboarding journey, concentrating on ‘Day One’ of starting a new role, to ensure our people are fully enabled from the start.

- Our Net Promotor Score (NPS) programme is now in its third year and covers Voice of the Customer (VOC) at an Executive peer to peer level and Voice of the Employee (VOE) at National Grid UK management level. This year VOE moved from just looking at issues specifically attributed to a single support function, to addressing the cross functional employee experience, starting with the onboarding journey. Our Executive VOC continues with strategic meetings between executive level contacts within our customer organisations and their equivalent peers at National Grid UK. This is followed by an NPS survey at year end. This year we saw a substantial increase in our overall NPS, reflecting our efforts made through all our engagements and service improvements. Our NPS improved by 38 pts to +29.

RIIO-T2 Stakeholder Engagement

157. The stakeholder engagement as part of our RIIO-T2 business planning process, led by Director of Gas Transmission, Phil Sheppard, was the largest we have ever undertaken. It has directly influenced our business plan submission and encouraged us to be more ambitious and strategic in both our thinking and our approach. This included all members of the NGGT Board signing a Stakeholder Charter setting out their commitment to stakeholder engagement, which formed part of our RIIO-T2 business plan. The engagement process we developed to enable a robust stakeholder-led business plan for RIIO-T2 had three phases:

- Phase 1: Establish priorities of consumers and stakeholders
- Phase 2: Build plans by priority with consumers and stakeholders
- Phase 3: Iterate a holistic business plan with consumers and stakeholders

158. With Phases 1 and 2 largely complete in 2018/19, the final Phase 3 began with the publication and consultation on a directional plan in February 2019. This gave stakeholders early sight of how their feedback from previous phase was being built into the plan. Our first draft business plan was published in July, and these were tested through extensive consumer engagement in the form of acceptability testing, consumer listening and service valuation research. The outputs were triangulated to ensure we truly understood consumers' views. Alongside this, we undertook stakeholder engagement in the form of workshops, webinars and 1-1s to gain detailed feedback across all stakeholder segments. This feedback was then incorporated into the final business plan submission in December 2019.

159. The independent user group, chaired by Trisha McAuley OBE, is made up of senior representatives from consumer, environmental and public interest groups, as well as large energy users, large-scale and small-scale customers, and distribution networks. They have played a key role in challenging how we engaged with stakeholders in developing our RIIO-T2 business plan and scrutinising the outputs we're committing to deliver, our costs, incentives and how we plan to deal with uncertainty in RIIO-T2. The independent user group has raised over 100 challenges across all areas of the RIIO-T2 business plan and provided a report to Ofgem on areas of our RIIO-T2 business plan they agree with, as well as areas of concern.

160. Since submitting their report to Ofgem in December and following our commitment to the group continuing in an enduring role, the group has been reviewing its role and purpose in this interim period and in advance of when RIIO-T2 begins. The group are finalising their forward workplan and governance to ensure they hold us to account on our RIIO-T2 commitments and continue to review strategic areas such as engagement and innovation.

VIII. Outputs – Customer Connections

161. Delivering timely capacity and connections to our customers is a Licence obligation and key output under RIIO-T1. In 2019/20, we received 10 new NTS connection applications. There were seven further customer applications received in 2018/19 that were carried over and were due to have an offer made in 2019/20.

162. Under this output our performance can be split into two main areas:

- the Connection Application to Offer (A2O) process[8]; and
- the Planning and Advanced Reservation of Capacity Agreement (PARCA) process and the delivery of incremental capacity.

The NTS Connection Application to Offer (A2O) Process

163. In total, there were 10 NTS connection applications received within the A2O process during 2019/20. Of these applications, eight were for exit connections and two for entry connections. One application did not proceed past Competency Assessment to Clock Start.

164. Of the nine competent applications received, four Full Connection Offers (FCO) were not due within this period and have been carried over to 2020/21. Two proceeded only to Feasibility stage and, therefore, no FCO offer has yet been made so will also carry forward. One application was not progressed by the customer beyond Feasibility.

165. The remaining two applications had FCO made along with seven FCO made for applications received in 2018/19.

166. In 2019/20 we issued nine FCO within the timescales set out in the UNC, of which four offers were accepted and have progressed to detailed design and construction. Of the remaining five, three lapsed and two were agreed extensions.

[8] Details of the NTS Connection Application to Offer (A2O) process can be found at the following link.

Connection Applications		Offers made in 2019/20	
Received in 2018/19	5	Offer accepted	6
		Carried over to 2019/20	7
Received in 2019/20	10	Applications not progressed	2
		Offers accepted	4
		FCO Extensions	2
		FCO Lapsed	3
		FCOs not made Application carried over to 2020/21	6

Table 6: Summary of the NTS Connection Applications and Offers

167. A trial self-lay connection offer made in 2016/17 has now commissioned and is operational. We are reviewing the lessons learnt from the trial to establish the necessary processes and standards required to allow self-lay as a future option for project developers.

168. During 2019/20, we have been progressing the connection of the first Bio-methane site to the NTS at the Murrow offtake. This is the Project CLoCC trial site which will be another first for NTS connections.

Disconnections

169. In 2019/20 we have received no new applications for disconnection and have continued to progress one disconnection application received in 2018/19.

Future Connection Requirements

170. We have continued to work with our customers and stakeholders to understand their future connection requirements. During 2019/20, we have continued to embed and publicise the new Gas Connections Portal and work with customers to find more efficient ways of connecting to the NTS. We have continued to receive interest in connections and use of the new Portal Cost Estimator.

Incremental Capacity and PARCAs

171. Four new PARCA applications were received in the 2019/20 formula year.

172. The four applications received were as follows:

Proposed new NTS connections

- Entry - none.
- Exit - Medway PS, Tilbury PS, Grain North PS and Keadby 3 PS.

173. Three of the PARCA Phase 1 Works outputs were delivered within the timescales set out in the UNC. The fourth PARCA application, Keadby 3, was withdrawn by the PARCA applicant in financial year 2020/21 and before the PARCA Phase 1 Works outputs were due to be delivered.

174. In the 2019/20 formula year, PARCA Phase 1 Works were completed and offers made to the PARCA applicant for four PARCAs. The outputs for these applications were completed successfully within the timescales set out in the UNC.

- One of the PARCA applications, Saltholme PS, was submitted in the previous, 2018/19, financial year.
- The other three PARCA applications, Medway PS, Tilbury Marshes PS and Grain North PS were submitted within the 2019/20 financial year.

175. Enduring Annual NTS Exit (Flat) Capacity was reserved for two PARCAs, Saltholme PS and Medway PS, which therefore proceeded to PARCA Phase 2. The other two PARCA offers for Tilbury Marshes PS and Grain North PS have carried over into the 2020/21 financial year.

176. For the one PARCA application received in the previous financial year 2018/19, Saltholme PS, Enduring Annual NTS (Exit) Flat Capacity was reserved, proposed to be provided for via the release of three months of Non-obligated Exit Capacity followed by substitution on Non-incremental Obligated Exit Capacity. This reserved capacity has now been allocated to the NTS User.

177. For one PARCA application received in the financial year 2019/20, Medway PS, Enduring Annual NTS (Exit) Flat Capacity was reserved and proposed to be provided for via substitution on Non-incremental Obligated Exit Capacity. This PARCA has been requested to be terminated by the PARCA Reservation Party and the termination will be effected in the 2020/21 financial year.

178. For one PARCA application received in the financial year 2019/20, Tilbury Marshes PS, Enduring Annual NTS (Exit) Flat Capacity was proposed to be provided for via substitution on Non-incremental Obligated Exit Capacity. This PARCA has not been signed by the PARCA applicant, however, and capacity will not be reserved.

179. For one PARCA application received in the financial year 2019/20, Grain North PS, Enduring Annual NTS (Exit) Flat Capacity was proposed to be provided for via the release of a short period of Non-obligated Exit Capacity followed by substitution on Non-incremental Obligated Exit Capacity. Capacity is expected to be reserved during the 2020/21 financial year.

180. None of these PARCAs were proposed to be satisfied through the release of Funded Incremental Obligated Exit Capacity.

181. There were no PARCA terminations during the 2019/20 formula year.

PARCA Applications received or offers made in Financial Year 2019/20			
Received in 2018/19	1	Offers made and accepted in 2019/20	1[9]
Received in 2019/20	4	Offers made and accepted in 2019/20	1[10]
		Offers made in 2019/20 and carried over to 2020/21	2[11]
		Withdrawn	1[12]

Table 7: Summary of the PARCA Applications and Offers

[9] Saltholme PS
[10] Medway PS
[11] Grain PS and Tilbury Marshes PS
[12] Keadby 3

IX. Totex (TO and SO)[13]

182. In 2019/20, our Totex spend was £411m compared to £490m last year. The year-on-year change is predominantly associated with the TO:

- Baseline Capex decreased by £61m, primarily due to a reduction in asset health spend (£50m) and emissions (£18m) offset by increases in Non Operational capex (£1m) and Pipelines (£6m).
- Uncertainty Capex has decreased by £15m, primarily due to decreased spend on Feeder 9.
- Controllable Opex has decreased by £7m, primarily due to a decrease in Closely Associated Indirect spend (£23m) and Faults (£1m) largely offset by an increase in Business Support costs (£2m), planned inspections (£4m) and a pensions adjustment from FY19 (£11m).

183. Our updated forecast for the eight years is £3,221m compared to allowances of £2,956m. We have restated RRP Table 2.4 to align allowance with spend categorisations. This impacts TO Non Load Related Capex and TO Opex, SO Capex and SO Opex. The adjustments are a recategorisation only and do not alter Totex spend or total allowances.

Overview Transmission Owner (TO)

184. The TO Totex forecast for the eight years is £2,442m compared to an allowance of £2,077m.

185. In comparison to the 2018/19 Table 2.4, our forecast spend has decreased by £59m overall and our adjusted allowances have decreased by £42m. The key changes to our allowances and the spend changes are listed below:

Allowances:

- In 2018/19 we forecast additional IED allowances of £53m for Hatton and St Fergus. Following Ofgem's decision on the needs case in November 2019, this has been reduced to £9m. This reflects the decision not to approve the need case for St Fergus, and whilst for Hatton the assumption used is that allowance is equal to spend.
- There has been no change to the allowances forecast for Pipeline Diversions (£11.5m).
- Our forecast allowance for Enhanced Physical Site Security includes a return of £24m but a request for an additional £7m for specific sites which is a net decrease of £17m. This broadly aligns to 2018/19.

[13] All numbers in this section are in 2019/20 price base unless otherwise stated

- There have been no changes to forecast Quarry & Loss allowances since last year's submission.

Spend:

- Baseline TO Capex spend over the eight year RIIO-T1 period has reduced by £54m. This is due to reductions in emissions £32m and Load Related Capex £22m.

- Uncertainty TO Capex spend has reduced by £5m, primarily related to Feeder 9.

- Baseline TO Total Controllable Opex spend has decreased by £1m which is primarily due to Closely Associated Indirects £13m which is offset by increases in Planned Inspections and Maintenance (£6m), Business Support costs (£5m) and Other Direct Costs (£2m).

- There was no material movement in Uncertain Opex.

186. The above items are covered in further detail within the relevant table narrative and in Section X. Load Related Capital Expenditure, XI. Non Load Related Capital Expenditure, Section XII. Non Operational Capital Expenditure (TO) and Section XIV. Operating Costs (TO and SO).

Overview System Operator (SO)

187. The overall GSO forecast Totex costs for the period are £779m against allowances of £879m. The main areas of difference on a restated basis are:

- SO Capex – we are forecasting to spend £69m less than allowances as a result of lower forecast spend on Xoserve and Telemetry separation. The lower Xoserve spend is driven by a change in strategy for Gemini investment and a lower level of EU driven Gemini change work.

- SO Opex – the underspend to allowances for Opex of £32m is largely driven by a higher proportion of Xoserve allowances being allocated to direct Opex following the outcome of the review of agency costs.

188. Compared to the performance of cost against allowance reported in 2018/19:

- SO Capex – our performance compared to last year has improved by £11m, with a reduction in forecast spend.

- SO Opex – performance is broadly in line with that reported in the prior year. Our Opex forecast for the eight years has reduced by £4m in real terms.

- The above items are covered in further detail within the relevant table narrative and in Section XIII. Capital Expenditure (SO) and Section XIV. Operating Costs (TO and SO).

Summary of Spend and Allowances

189. The non-restated table below shows forecast spend and allowances against the six main activity areas as per RRP Table 2.4.

Activity	Spend (£m)	Allowance (incl. uncertainty mechanism) (£m)	Cost vs Allowance (£m)
TO Load Related Capex	24	47	23
TO Non Load related Capex	1,367	1,080	(287)
TO Non Operational Capex	149	74	(75)
TO Opex	901	876	(26)
Total TO	**2,442**	**2,077**	**(365)**
SO Capex	272	350	78
SO Opex	507	529	22
Total SO	**779**	**879**	**100**
		-	-
Total	**3,221**	**2,956**	**(265)**

Table 8: Overview Eight-Year Forecasted Spend and Allowances (as per Table 2.4)

190. In order to better understand the underlying position of spend versus allowances, Table 2.4 is restated to better align allowance with spend categories. The adjustment made to the baseline position in Table 8 are detailed below:

- IED allowances of £98m are currently included within baseline Opex in Table 2.4. All IED spend is captured within the Non Load Related Capex category. Therefore, the IED allowances within Opex are reallocated to Non Load Related Capex to be consistent with the treatment of spend.

- SO allowances of £10m for the data and cyber security reopener are recategorised between Capex and Opex to better align with the actual categorisation of spend. The allowance split is based on generic allocations set at the beginning of RIIO-T1 with all allowance deemed as Capex.

191. See the restated Table 2.4 and main reasons for differences between costs and allowances in the Performance Summary.

Consumer Bill Impact

192. In RIIO-T1, less than £10 (2019/20 prices) of the average domestic consumer gas bill of £572[14] will relate to the gas network services we provide. In 2019/20, the proportion of the bill attributable to National Grid services was approximately £7.60

[14] Figure taken from the Ofgem publication 'Bills, Prices and Profits'

which equates to 1.3% of the typical gas bill. This is an increase compared to 2018/19 where the National Grid portion of the domestic consumer gas bill was £7.26, but remains a decrease on the first five years of RIIO-T1 where this value ranged between £7.97 and £9.92. The increase from last year is largely driven by an increase in in allowed revenue from 2018/19 to 2019/20 by circa. £58m.

193. 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.

194. Our calculation of the customer bill impact is aligned to the above approach (allocating entry charges to the wholesale sector).

195. Our current estimate is that the Gas Transmission element of an average domestic customer bill will rise by £0.39 from the start of the RIIO-T1 period.

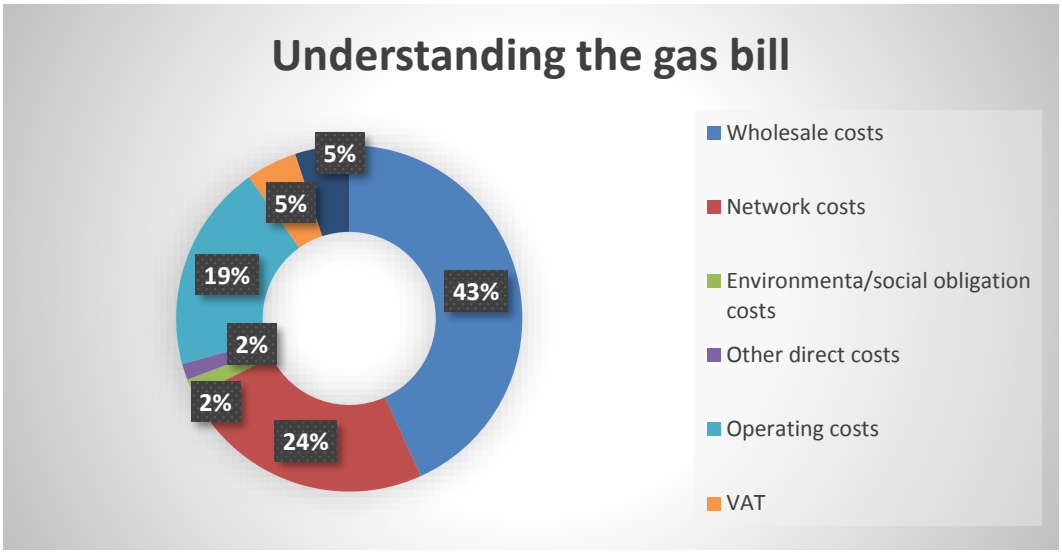


Figure 7: Breakdown of the Customer Gas Bill[15]

[15] Gas bill breakdown available from Ofgem: https://www.ofgem.gov.uk/publications-and-updates/infographic-bills-prices-and-profits

X. Load Related Capital Expenditure (TO)

Introduction

196. This section covers our Load Related Capital Expenditure. In 2019/20 our expenditure was £8.3m and our updated forecast for the eight years is £24.2m[16], against an allowance of £46.9m. Compared to last year, forecast spend has decreased by £21.9m on a constant 2019/20 price base.

197. This is mainly due to a reduction in the spend to meet our Scotland 1-in-20 demand obligations, by £22.9m, which is offset by small increases in cost at Felindre and project close out costs at Tirley PRI.

System Flexibility

198. In 2019/20, we continued with our system flexibility project which was initiated to re-assess the needs case utilising the 'seedcorn' funding received under RIIO-T1. Although the baseline allowances for this activity are included within Load Related Capital Expenditure, the spend incurred during 2019/20 falls within SO Opex, further detail can be found in Section XIV. Operating Costs.

Scotland 1-in-20

199. Our 1-in-20 demand obligation is associated with meeting agreed Assured Operating Pressures[17] (AOP) at the Distribution Network offtakes. As set out in our RIIO-T1 plan, analysis on changing UK flow patterns and reduced flows at St Fergus would impact our ability to meet our obligations in Scotland. We have continued to assess the ability of the network and expected supplies to meet this requirement and where necessary, the detail of any need case for the associated investment solutions.

200. The natural uncertainty of future flows from the terminal remains. If the current levels of supply remain or decline further, this could lead to a situation where it is no longer possible to maintain the current AOP obligation.

201. During 2019, the flows through the St Fergus terminal peaked at 75 mcm/d; 17 mcm/d less than the previous period. The average flow through St Fergus reduced to 56 mcm/d, from 68 mcm/d in 2018/19.

202. Following the 2018/19 RRP submission which included a supply loss scenario, we undertook further work and determined this scenario to be beyond the scope of our obligations, and the latest analysis has demonstrated that at the worst-case minimum we continue to meet our 1-in-20 licence condition obligation. Consultation with our customers at the terminal has also given us assurances that the site has

[16] The £8.3m expenditure and £24.2m forecast exclude Offtakes
[17] A minimum pressure at an offtake from the NTS to a DN that is required to support the downstream network. AOPs are agreed and revised through the annual Offtake Capacity Statement process.

a long-term future at flows above the worst-case minimum. With these drivers removed, the proposed investment was deferred for review once the 2019 FES was published.

203. Updated Network Capability analysis to improve the accuracy of the analysis has completed during 2019. This has been used to assess the capability against the 2019 FES.

204. The worst case credible supply level (35 mcm) at a peak demand (374 mcm) has been assumed based on the 2019 FES. Under this scenario, it is not possible to achieve the AOP in 2028/29. This is six years later than indicated by the 2018 FES.

205. An updated Cost Benefit Analysis (CBA) was completed on a full range of solutions, including options to invest on the Gas Distribution Network (GDN) and/or use commercial contracts. The most economical solution was confirmed to be the same as determined in 2018. This is to invest on the NTS and enable the reversal of compression at both Carnforth/Nether Kellet and Bishop Auckland. With a three-year design and build, the project would start in 2025/26.

Environmental Aftercare

206. The planning consent conditions for two pipeline projects completed during the Transmission Price Control Review 4 (TPCR4) (Wormington to Sapperton and Milford Haven to Tirley) included undertaking environmental monitoring and aftercare regimes for a period of 10 years after project completion. Both projects are now closed. The environmental aftercare category also included funding to complete the Tirley PRI and associated works that were delayed into RIIO-T1 due to difficulties obtaining planning consent at Tirley. The associated works included commissioning of Felindre compressor station.

Felindre

207. Felindre Compressor Station was built as part of the South Wales Expansion Project (SWEP), triggered by the requirement to connect the Milford Haven LNG terminal to the NTS.

208. The compressor station was designed as one electric variable speed drive (VSD) with two gas turbine units as back-up. Construction of the compressor station was completed in 2010 but final commissioning could not commence until completion of Tirley PRI. This was achieved in September 2012. However, the volume of gas for which the assets had been designed did not materialise, and flows were not high enough to commission the VSD compressor although progress was made in commissioning the smaller gas turbine units.

209. Since Tirley PRI was completed, work has been ongoing to complete the associated works. All work specific to the Felindre gas turbine units has now been completed, allowing unrestricted use of the units. Full commissioning of the control system will be completed with the VSD commissioning. Total outturn cost of the

Tirley works (including Felindre gas turbine unit commissioning) in the RIIO-T1 period is expected to be £5.5m.

210. The Felindre VSD unit was put into preservation from 2014 to 2016, due to the continuing low flows through Milford Haven. In January 2016, the decision was made to progress with commissioning the VSD due to higher flow forecasts. The decision was also made at this time to proceed with creating a loop within the network for recycling gas to the compressor. The loop will reduce dependence on the unpredictable Milford Haven flows for commissioning the VSD, as well as operational and environmental testing of any of the Felindre units.

211. Construction of the new Alltwern site, the cross connection that will create the loop, was completed in winter 2019/20. Full project closure is expected in 2020.

212. Work to prepare the VSD for commissioning has progressed in parallel with works at Alltwern. During 2019, the VSD rotor (motor shaft) was removed and shipped to the original equipment manufacturer (OEM) for repair of corrosion. Other issues with the rotor and stator (rotor housing) were subsequently identified by the OEM; namely defects on both the rotor and stator that may have been present since manufacture and must be addressed for safe operation of the unit. These issues have further delayed commissioning of the VSD. Sharing of costs due to latent defects was pursued with the OEM but was not successful given the time passed since manufacture. All remaining scope has been critically reviewed and opportunities to reduce the critical path have been investigated. Final commissioning is now expected in 2021, with full project closure in 2022. Final cost in the RIIO-T1 period for Felindre VSD, including preservation, de-preservation and commissioning, is expected to be £17.1m.

XI. Non Load Related Capital Expenditure (TO)

Introduction

213. This section covers our Non Load Related Capex. In 2019/20 our expenditure was £155.5m and our updated forecast for the eight-year RIIO-T1 period is £1,367m compared to an allowance of £1,178m. Compared to last year our forecast spend has decreased by £37m on a constant 2019/20 price base. Asset health costs remain largely unchanged the key variances in forecast are due to:

- A reduction of £35.8m in IED related costs, largely due to the removal of the St Fergus LCP project £24.5m, plus a deferral of the majority of LCP spend at Hatton into RIIO-T2, £18.4m and a reduction of £2.9m in MCP costs. This is offset by an increase in IPPC costs at Peterborough and Huntingdon of £9.5m.
- Costs associated with compliance against the NIS directive have resulted in an increase in spend of £6.2m.
- Decommissioning costs have reduced by £2.3m.
- Uncertainty costs have reduced by £4m relating to Feeder 9.

Asset Health

214. In 2019/20, we delivered £66.4m of asset health investment. This expenditure underpins our work to mitigate the risks of an ageing asset base and to continue to provide a reliable and safe network for our customers and stakeholders. A large proportion of our RIIO-T1 projects have now completed their delivery phase and we are progressing these to closure. We are also now preparing RIIO-T2 works in line with the business plan submitted in December 2019. We have established ‘theme teams’ for our capital works aligned to our proposed funding and output streams for RIIO-T2. These teams are cross-functional stakeholder groups accountable for delivering the requirements of our business plan within the associated constraints, whilst managing risk and driving innovation.

215. Throughout this year, we have continued to target our capital expenditure to provide the most efficient risk reduction. We have undertaken a pilot of our ‘Refurb and Re-Life’ survey and repair programme with Pipeline Maintenance Centre (PMC). The intention of this pilot was to address high priority corrosion and valve defects at twelve sites by undertaking surveys to determine and implement low-cost/high-value interventions to reduce risk. Following a successful demonstration, we have rolled this forward into our RIIO-T2 plans. We have also rolled out our new Defect Module within our integrated data analysis systems. This replaces our current Plant Status records system and allows real time updates to the status of the defects on the NTS with individual risk scores being allocated in the form of our Operational Risk Assessment and Mitigation. We are seeking to incorporate this

into our investment planning processes and grow its use and analysis of the live network risk position into business as usual.

216. The largest proportion of capex spend in 2019/20 was associated with the following projects:

- Bacton £11.4m
- St Fergus £9.9m
- Asset Engineering Compressor Campaign £7.5m
- National AGI Renovation Campaign (NARC) £4.7m

217. More details on each of these project is provided in the 'Key Projects' section below.

Developing our Asset Management Capability

218. We have re-defined our approach for translating our stakeholder priorities into a long-term asset management strategy; a new Strategic Asset Management Plan (SAMP). This is a key enabler for continuous improvement in line with our ISO55001 accreditation. We have developed a set of long-term objectives for our assets to deliver against these priorities and set out a plan to consider how we best intervene on our assets individually and the NTS as a system of individual assets. This strategic planning approach covers a period of 10 years and beyond, enabling us to be clear about how we need our assets to perform, as well as how and why they need to be managed, to achieve these long-term asset management objectives. This allows us to clearly define our plan to grow our asset management maturity and adopt industry-leading and world-class asset management practices.

<u>NOMs Methodology Development</u>

219. We reported last year that we had submitted our initial rebasing analysis to convert our volume-based RIIO-T1 licence target into an equivalent target based on monetised risk. Ofgem have undertaken rigorous testing and the proposed new Network Replacement Outputs and the associated notice of intention to modify Special Condition 7E of our Gas Transporter Licence have been submitted for consultation with stakeholders to approve our new targets. We have responded to the consultation and are awaiting the final decision.

220. We reported last year that a draft validation report document was submitted to Ofgem. We have undertaken additional work to finalise this validation report, specifically to address a query raised concerning the robustness of the approach to current and future NTS supply and demand conditions. The improved availability and reliability analysis have been subjected to a further expert review and a final validation report has been submitted to Ofgem. This validation report has been published alongside the proposed change to our licence targets.

221. This consultation process is the final step in our NOMs methodology development and we anticipate that reporting against the new monetised risk target will commence formally from the 2020/21 RRP. Further work is required to upgrade the NOMs Methodology to a NARMs Methodology, which will include the method for calculating long-term risk benefits as used for the NARMs targets proposed alongside our RIIO-T2 asset health business plan submission.

Data

222. We have completed implementation of our new asset management decision support system, C55. This enables us to manage data flows through the whole investment management lifecycle, including more granular control of project costs and outputs. C55 allows us to refresh asset risk data much more frequently allowing us to monitor the impact of our planned investment programme on network risk levels more closely.

223. Through our Asset Management Data Lifecycle (AMDL) project we have completed work to re-define our assets in terms of an industry-standard (ISO14224) taxonomy, which we have termed Equipment Units. This will allow our costs and benefits to be managed in more detail and facilitate cross-industry benchmarking. Moving into RIIO-T2 we intend to monitor and report all investments using this new asset definition. This will require us to restate our RIIO-T2 asset health business plan submission. The timescales and process for this restatement will be discussed and agreed with Ofgem during 2020/21.

Key Project Delivery for 2019/20

224. This section of the narrative details key project deliveries in 2019/20.

Bacton Campaign

225. The Bacton terminal is a key gas entry point into the UK, both currently and into the future. The site commenced operation in 1968 in a coastal environment which accelerates degradation. Bacton as a site had 237 Plant Status issues as a starting baseline and these are being progressed through our investment process. By examination of the risks and consideration of the needs case work at Bacton, we have identified issues that should be prioritised and are assessing options to maintain safe operation of the site whilst we complete the final stages of the need case review. At Bacton there is a strong interaction between asset health and the needs associated with the Future Operating Strategy (FOS). The works undertaken at Bacton in 2019/20 were:

Bacton AH-1A: Installation of eight new valves

226. During the summer 2019, a total of eight new main line valves were installed. These valves were predominantly associated with the Feeder 4 and 5 areas of plant and represent some of the most critical interface points with our customers and connection to the wider network. This work necessitated considerable interaction

with our close neighbours and customers, such that we could share outage periods on our respective assets and minimise disruption to both parties.

227. The highly invasive nature of the replacement of many of these valves necessitates outages that can only be commenced when gas demand is sufficiently low, since significant areas of the plant and the wider network are required to be out of commission.

Figure 8: Installation of Valve FM4/4 approaching installation completion

228. We are now commencing the closure and associated approval stages for this project. This is an ongoing process that will see documentation closure ramp up for the earlier phases of this project, whilst the latter phases complete delivery during 2020/21. The collation of asset acceptance criteria has gained approval during winter-spring 2019/20.

229. The use of 3D Building Information Modelling (BIM) is part of business as usual within the Bacton projects. BIM has considerably reduced the likelihood of fabrication issues and on-site ‘clashes’ with other pipework or assets. It has been used during design review meetings to aid the discussion on plant layout. BIM is also key in associated review processes, required as part of the Formal Process Safety Assessment (FPSA).

Bacton AH-1A: Painting

230. The corrosion protection painting works commenced in 2017 and were further progressed during summer 2019. This generally utilises the depressurised areas of the plant that have been shut down to facilitate other works.

231. Work has also continued on the repair of wind/water-line corrosion features. An earlier survey of the site had shown evidence of early coating failure on all of the surveyed sections. Whilst undertaking pipework preparation works during summer 2019, it became apparent that some of the very earliest construction phases of terminal have pipe riser sections, originating from the main pipework around three metres below ground, that have coatings that are below acceptable levels of thickness.

Figure 9: Wind/waterline paint inspection in progress in Perenco manifold area

Bacton AH-1A: Pipe supports and bolt replacement

232. Due to the coastal environment and its ability to accelerate corrosion issues, the AH-1A scheme is required to replace bolts on the flange faces onsite. This phase of works is currently suspended following discovery of an issue affecting coating resilience.

233. Work has continued throughout 2019/20 on the inspections of pipe supports. An alternative pipe support design has been developed which reduces the onsite time associated with shuttering, concrete cast and cure times traditionally required.

Figure 10: New-style steel pipe supports installed in Feeder 5 area of site

Gas Robotic Agile Inspection Device (GRAID)

234. Separate to the asset health works onsite, is the installation of the GRAID connection launch facility. With physical works and the test launch completed in 2019, the past year has seen an update of drawings and asset management information. This administrative exercise has been conducted at the same time as similar phases for works associated with the AH-1A project.

Preheat 3

235. The site Preheat system provides heat to the incoming gas supplies, prior to entering flow control equipment, to prevent the formation of liquids in the pipework and ice build-up on the external surfaces. There remain a number of Asset Health Plant Status Issues associated with the Preheat systems. Preheat 3 passed from detailed design to the build and installation phase in 2019/20. New heaters have been installed within the Shell 4 incomer and the bulk of new regulator skids and pipework have been installed awaiting revised plant outage to permit tie-ins of a new gas supply. The project has suffered some programme slippage as a result of high Milford Haven LNG flows that have had consequential effects at Bacton, with

high differential pressures necessitating pre-heat at a time where it would not normally be anticipated. This slippage is typical of the constraint management that is necessary for projects at this site. This project addresses the prioritised asset health preheat works ensuring continued safe operation of the preheat system and associated plant.

Human Machine Interface (HMI) replacement

236. The HMI provides the control room operator with the means to control the site via visual displays and associated keyboard and mouse. The system installed at Bacton is 18 years old, and is therefore past its useful life with a depleting set of spares available and lack of technical support available from the OEM. It has required some stabilisation works during recent years in order to be able to effectively recover from any loss of hardware. Another partial system failure was encountered during the past year. The Bacton HMI project has been within detailed design and offsite build stage during the past year. Preparations are currently ongoing for a Customer Factory Acceptance Test, prior to shipment to site for installation during summer 2020.

237. Since the original installation, there have been a number of developments to the requirements associated with design of such systems. The HMI replacement scope has been designed for compliance with both Human Factors and Cyber Compliance requirements. Given the critical delivery timescales involved, the scope is centred around those key deliverables, whilst ensuring systems have sufficient baseline architecture to accommodate future requirements.

Ongoing ORAM review for Bacton

238. Operational Risk Assessment & Mitigation (ORAM) assessments are conducted for Bacton on a 3-monthly basis. The output of these Risk Assessments aid the prioritisation and scoping of future work requirements and also feature in the day-to-day priorities for the on-site Operations Team. The ORAM output and associated reviews of Plant Status Indicators are studied to inform future asset health planning requirements and to ensure the plant remains safe and effective in its operation.

St Fergus Campaign

239. St Fergus Terminal is a key gas entry point into the UK. The terminal was built in 1975 in a coastal environment which accelerates corrosion degradation. Across the site, investment continues to be made across various work streams, largely prioritised through the ORAM process which has been in place since late 2016. The investment onsite focuses on management of existing asset issues that may pose a potential safety risk, whilst in parallel retaining appropriate levels of compression availability and capability, and meeting environmental targets. The ORAM continues to prioritise corrosion remediation as a critical theme, therefore this has formed the primary area for investment at St Fergus during 2019/20.

240. Corrosion remediation has focussed on reducing the defect population, which had been obtained through the corrosion and coating management visual inspection of

the assets on the site. Four isolations have been undertaken this year, during which planned defects were addressed in full, and a further isolation has enabled temporary repairs to make safe until permanent repairs can be undertaken. Some of these isolations were reliant on short customer outage windows for access to plant. Through collaboration and stakeholder engagement, we achieved timely completion of these works, enabling the equipment to be returned to service for customers.

241. We have also qualified a new technology to address corrosion defects at the terminal. A new type of repair for corroded 2” class 600 flanges has been qualified and utilised as a permanent repair on two locations at the site.

242. In terms of subsidence, the full site has been surveyed by use of a laser scan and a report developed to document the next steps. A particular area of subsidence in an excavation in the vicinity of valve V22013 has been monitored through the course of the year with ongoing inspection, risk assessment and analysis to determine next steps.

243. Additional work was also undertaken on the flanges at the plant 1 scrubber condensate tank, where these were inspected and assessed. Where further intervention was required or associated corrosion defects needed remediation, this was undertaken and the plant returned to service. In the latter part of 2019/20, works have continued on the plant 1 scrubbers where some delays had been experienced with the replacement of scrubber 1A and 1B. This work remains ongoing.

244. Remaining activities from the plant 1 outage have been undertaken through 2019/20. Defects and flanges on the plant 1 aftercoolers underwent inspection and assessment, with a number of defects requiring more substantial intervention. On commissioning, additional issues were encountered resulting in some additional work for 2020/21 which will then enable the plant to be returned to service and the next phase of planned works to be carried out.

245. In preparation for future works, the remediation and isolation plans have been developed, including for the planned next isolation on the plant 6 mixer. Issues during commissioning of the plant 1 aftercoolers has meant that access to the plant for undertaking the next planned phases of work on the plant 6 mixer and associated replacement electrical actuation system has been delayed. The revised programme for the delivery of these investments have been produced and are due to progress next year.

246. The remaining scopes within the cab refurbishment and associated cab Dangerous Substances and Explosive Atmospheres Regulations (DSEAR) compliance programme for plant 1 have been progressed. Residual snagging list items have been worked through during the course of the year and the project is now working towards closure.

247. During 2019/20, we have taken the opportunity to review our asset health programme at St Fergus, with a view to reassessing our approach. It is intended

that future works will be bundled into more substantial packages of work, enabling greater efficiencies and economies of scale to be achieved.

Compressor Programme

248. The compressor machinery used on our gas turbine driven compressor units is made up of three main component parts. These parts are the gas generator, power turbine and centrifugal compressor. We also have our electric variable speed drive compressors which are made up of the VSD, motors and the compressors. Below is a detailed explanation of works carried out on these parts in 2019/20.

Gas Generator

249. There are five different variations of gas generators making up the national fleet of 61 currently in operation across the NTS. In addition, we have spare gas generators to provide resilience to the 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.

250. Relatively low utilisation of the Baker Hughes LM2500+DLE gas generator fleet over the past year has left it in good condition, with no machines except the fleet spare currently near the overhaul limit.

251. The Solar Titan gas generator fleet is also in good condition, despite increased utilisation over the last year due to the location of the units making them critical to support gas flows from the Milford Haven LNG terminals.

252. The SGT400 gas generators at Avonbridge are currently in a state of mothball. Both units at Nether Kellet are approaching major part replacements and the spare requires overhaul. Three units at Kings Lynn and Cambridge are in good condition but saw very little use over the last year.

253. The SGT A-35 (Rolls-Royce RB211) gas generator fleet reduced in size again over the last year, as single compressor trains at Moffat and Warrington were isolated to reduce maintenance requirements. The remaining compressor unit at each site is expected to be isolated early in RIIO-T2, which will be followed by the decommissioning of compression capabilities at these sites. After that, only eight SGT A-35 units will remain across four sites: St Fergus, Carnforth, Hatton and Wisbech. One unit at both Carnforth and Hatton are approaching their overhaul intervals which will be required in RIIO-T2. One overhaul of a different SGT A-35 at Hatton was undertaken this year when an engine failed its borescope report due to unexpected damage in early engine life.

254. Finally, the SGT A-20 (Rolls-Royce Avon) gas generator fleet had one engine overhauled in the last year to be added to the fleet spares. It was later installed at Peterborough, where an engine had failed a borescope inspection. Of the four engines that were overhauled in 2018/19, three of these were installed at St Fergus in 2019/20 as part of the ongoing asset health work to increase reliability of plant 1

prior to plant 2 decommissioning. The other was installed at Diss to replace an engine that had emissions problems.

Power Turbine

255. There are eight different types of power turbine making up the national fleet of 61 currently in operation across the NTS. In addition, we hold a few spare power turbines to provide resilience to the operational units. Power turbines convert the stream of hot pressurised 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.

256. During 2019/20, power turbine overhauls were carried out on three units. Wooler A, which has a Baker Hughes PGT25+ high speed power turbine, and St Fergus 1A and 1B, which have Siemens (previously GEC) EAS1 power turbines.

257. Due to the utilisation and age of our power turbine fleet, an increased amount of power turbine work is expected in RIIO-T2, as many of the power turbines will approach the overhaul intervals.

Centrifugal Gas Compressors

258. Compressors are the machinery that drive the natural gas through the NTS. All of the 69 NTS compressors are centrifugal compressors. They are driven either by a gas generator and power turbine or an electric motor.

259. During 2019/20, we completed the overhaul of two Siemens (previously Dresser-Rand) PDI70 gas compressors at Bishop Auckland and Carnforth.

260. The dry gas seals were overhauled on a Wooler compressor as part of the same scope of work as the power turbine overhaul mentioned in the previous section.

261. A resolution was found to seal a leakage issue at Felindre, which will improve reliability and environmental performance of the compressor. This is a temporary fix until the seals can be upgraded to a more suitable seal for the process conditions seen at the site.

262. A refurb was carried out on a Huntingdon compressor after a leak was found. Using a combination of scope, spare parts from other sites and independent service providers, costs were minimised whilst ensuring the compressor operates safely and efficiently through to its expected decommission date.

Electric Drive Compressors

263. We have eight electric drive systems in total, seven are Siemens Ex ‘P’ type and two are MOPICO type. The rated power ranges from 8MW to 35MW. The VSD drives the electric motor, which in turn drives the compressor.

264. Unit E at Churchover had the replacement and configuration of two faulty Hard Drive Disk (HDD) within the control server. We also replaced an anti-surge valve controller and had a new valve positioner fitted. Faulty timer relays were replaced and system configured. Unit C at Wormington also had two HDD replaced in 2019/20.

265. At both Wormington and Churchover, maintenance was carried out on the resistance temperature detectors (RTD) to keep them DSEAR compliant, due to failures.

266. Most of the works on VSD in 2019/20 were maintenance works. These involved checking the VSD cooling system, harmonic filter checks, capacitance check.

267. For Motors, last year we carried out maintenance works. These involved borescopes on the motor, mechanical inspection on the coupling and standard maintenance on all auxiliary equipment (motors/pumps/fans).

National AGI Renovation Campaign (NARC)

268. Since commencing in 2017, NARC has accelerated asset health works across the NTS. The campaign approach aims to change and revolutionise the way National Grid asset health works are delivered, by batching work into asset classes for survey and delivery. This helps to increase delivery volumes and improve efficiency and delivery, which in turn maximises value from complex, time limited and expensive feeder outages. NARC is now in its third batch of works and to date has isolated over 555 km of NTS and recompressed gas back into the system for re-use, saving around 17.5 mcm of natural gas being emitted to atmosphere.

269. NARC renovates Above Ground Installations (AGI) and sections of compressor stations to resolve asset defects (captured in our Plant Status system). The campaign covers invasive work requiring gas outages, such as valve replacement, pipe-throughs and replacement block valve assemblies. It also undertakes actuator replacements, valve enhancements, such as new vent and sealant lines, various integrity based work and an element of civils that is associated with the mechanical work.

270. Safety is our first priority when designing and delivering the NARC Campaign. In 2019, NARC achieved a world class safety record, completing this reporting year without a Lost Time Injury (LTI), Non Lost Time Injury (NLTI) or RIDDOR reportable incident. In 2019/20, the team maintained their focus on safety, which included a safety stand down day took place at Fiddington. Challenges and key learning was shared amongst the whole team, and lessons for future were discussed in an open forum.

271. In 2017/18 we successfully implemented the Campaign Decision Panels (CDP), which have the responsibility to agree the scope and approve construction works outside of usual governance cycles, increasing efficiency and pace of delivery. In 2018/19, the CDP were streamlined with full support by Main Works Contractors (MWC) from the asset health framework. The CDP further evolved with greater

inclusion of PMC as a permanent panel member. The decision panels were further supported by PMC's advance site visits to verify the maintenance and operability of the site and conduct enhanced maintenance techniques (where possible), which were fed into the NARC design process. CDP in this form remained an integral part of NARC decision making and project progression.

272. An overview of the sites completed in 2019/20 is shown in Figure 11.

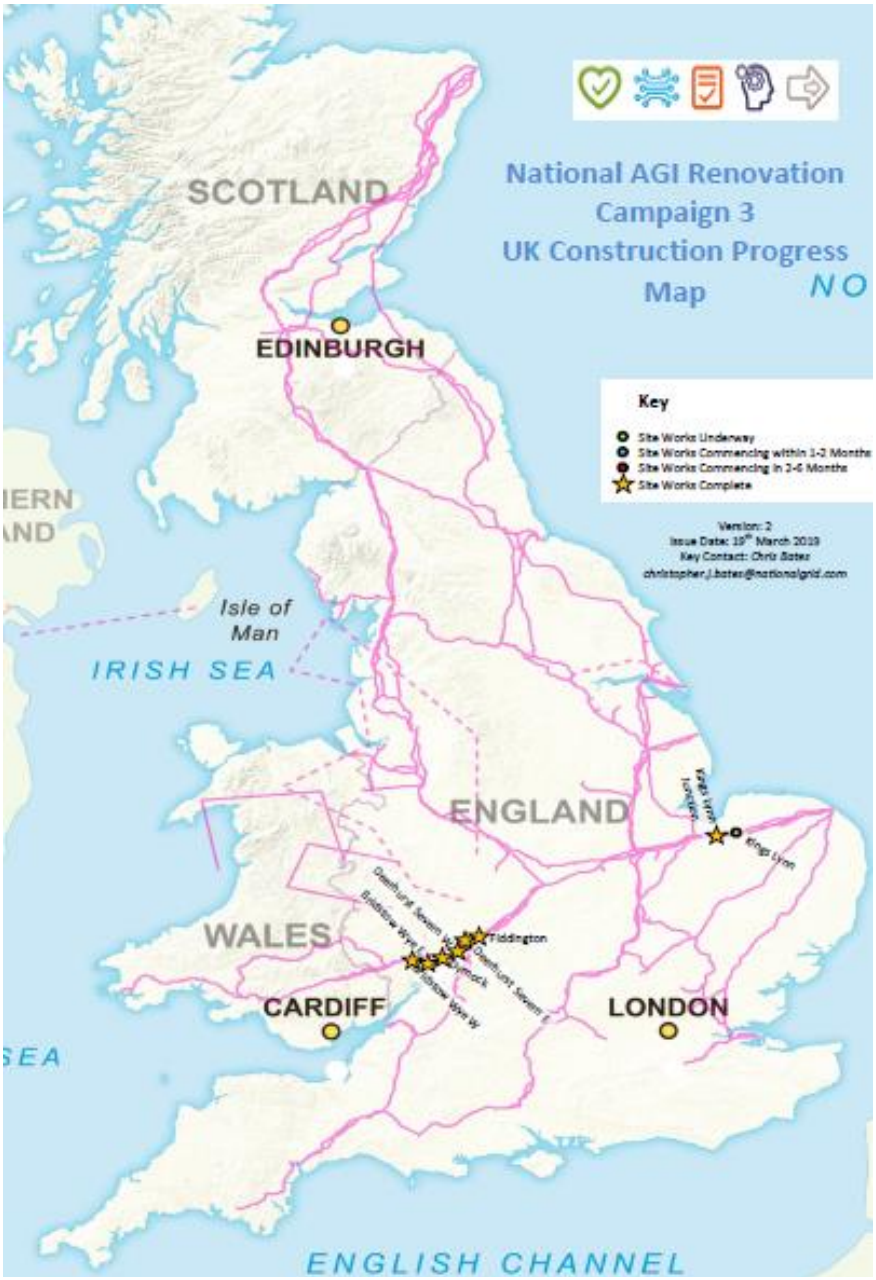


Figure 11: NARC 2019/20 Progress Map

273. Work delivered in 2019/10 used visual outputs from BIM to supplement and improve briefs, inductions and Risk Assessment & Method Statements (RAMS).

NARC also successfully used strategies to deliver work on several sites within an outage section ensuring environmental, financial and safety efficiencies we realised. Learning from previous NARC phases is utilised, for example the standard offtake design developed in NARC 2 and standardised block valve arrangement were improved. The following paragraphs describe examples of work successfully delivered by NARC 3 in 2019/20.

Building Information Modelling (BIM)

274. Drone footage and point cloud surveys were used again on NARC 3 to develop models of the sites with accurate dimensions, reducing the need for repeated site surveys. The expanding digital plant rehearsal library was used to develop accurate BIM, which was used in stage by stage visual planning of the works. This has improved engagement through the FPSA process, reduced costs through the realisation of more effective construction methods and has improved the onsite visualisation of safety.

Figure 12: Digital rehearsal example

275. An example of where BIM Construction rehearsal has been successfully used was for the Fiddington AGI rebuild, which required several high-risk construction activities. Using BIM, the positioning and slew of machinery and lifting equipment can be accurately modelled, eliminating potential lifting and excavation hazards. BIM was also used to model site establishment and laydown areas, improving planning for segregation of plant and people.

276. These methods were recently presented to the HSE by NARC, and two of our contract partners, who gave positive feedback and have used example materials and models from NARC as part of their drive to develop the use of BIM across the Construction industry.

277. The visual outputs from BIM continued to be a great resource onsite throughout the works to supplement and improve, briefs, inductions and RAMS, this allowed all parties to feed into the discussions. As before BIM also benefited visitors and stakeholders, helping them to grasp a clear understanding of the process and stages involved in completing a complex task such as Fiddington AGI rebuild.

Figure 13: BIM displayed at the work place for reference, instruction and stakeholder engagement.

NARC outage strategy (Feeder 2 Ross – Fiddington)

278. The NARC 3 project continues to follow the previously successful strategy to deliver work on several sites within an outage section ensuring environmental, financial and safety efficiencies are realised. The asset strategy was to remove unreliable and inaccessible river crossing block valve arrangements, whilst ensuring adjacent block valves sites were replaced and reinforced as necessary to maintain emergency response capability in future. This led to the removal of four river crossing block valve sites on Feeder 2 and included site re-builds at Fiddington AGI and Dymock AGI.

279. To allow this project to begin, a section of approximately 54 km of the pipeline was isolated and de-gassed. In collaboration with Wales and West Utilities we reduced the pressure in the pipe as much as possible, down from 70 Bar to 23 Bar.

280. Thanks to this collaborative approach, the line was depressurised and purged in time for the project work to commence, significantly reducing the running time of the recompression rigs, and the teams managed to save 433,000 m3 of natural gas from being vented.

Site Rebuilds at Fiddington AGI and Dymock AGI

281. As mentioned above the rebuild of Fiddington Offtake was carried out in 2019/20. The offtake arrangement was showing signs of degradation and corrosion, and the remotely operated Shafer gas-over-oil actuators were obsolete and did not operate effectively. Pressure containing assets such as valves were located in pits which were inaccessible and flooded, posing significant health and safety issues. There

was redundant pipework which was removed during the excavation works in line with BAT (Best Available Techniques).

Figure 14: Photos of Fiddington site valve pits and excavated pipework

282. The standard offtake design developed in NARC 2 was utilised as a basis for the Fiddington design solution. This provided two 600mm main line valves allowing future feeder isolations to be possible whilst maintaining supply to Wales and West. The new pipework arrangement is above ground, designed to alleviate the necessity for deep pit entry.

283. The remote actuators were replaced with high performance gearboxes as part of a future campaign. To enable cost saving, this was adopted by the project and two mainline valves were installed with two high performance gearboxes.

284. Previous NARC batches have highlighted that when new actuators or gearboxes are needed it becomes difficult to know whether existing valves are suitable. This learning has been applied during NARC 3, new gearboxes were tested and the results recorded as a base line figure for comparison of future valve performance and health.

Figure 15: The completed Fiddington site

285. Dymock block valve site contained several below ground valves located in concrete pits, valves were leaking and actuators required replacing. The site was also situated close to a busy road.

Figure 16: Dymock AGI with deep pits exhibiting gas leaks

286. Dymock block valve was replaced using the standardised block valve arrangement. This provided consistent benefits of bringing all the pipework and maintenance out of pits and above ground with high efficiency gearboxes used. The pipework coating protection, which is at risk when passing through pit wall transitions, was removed.

Figure 17: Installation of Dymock pipework arrangement

287. Maintaining our previously successful fabrication strategy, valves and gearboxes were Factory Acceptance Tested (FAT) at RMA's facility. The pipework was then fabricated offsite by the MWC, hydrotested and dried as per previous learning. This, as previously highlighted, ensured quality standards could be the highest, and reduced time and safety risks on site.

288. A new security fence complete with vehicular access gate and emergency egress gate was installed within the existing site boundary, all of which carried out as per the agreed planning permission. The existing site roadway was removed and replaced with environmentally-friendly geogrid roadways, comprising a new site hammerhead section outside of the security fence for turning of vehicles away from the public road whilst also improving site drainage. The standard block valve design was improved by providing a single sandbox area for wind and water lines, rather than multiple sandboxes, thus avoiding future trip hazards from settling ground. Additionally, a well-established, 1.2m high native species hedgerow was planted as part of the final site landscaping, both improving screening of the site and adding benefits for local biodiversity.

Figure 18: The completed rebuild of Dymock site, Pipework above ground, ECO Road way, and new security fencing.

Block Valve Removals

289. Deerhurst Severn East and West are buried block valve sites located either side of the River Severn at Deerhurst, Gloucestershire. The sites consist of three valves contained within separate buried valve pit structures, each of which is contained within a separate wooden post and rail fence and access to the sites is poor. Historically, the site contained two river crossings, one of which has been abandoned and nitrogen filled. Following the abandonment, two of the valves are no longer used.

Figure 19: Deerhurst remote location and flooded valve pit

290. NARC completed works to remove these sites from the network. Redundant valves and pipework were removed and piped through, leaving only the abandoned river crossing section in situ. All pits were removed, returning the river bank to pasture land which avoids future visits to the site for maintenance and removes the gas sites which were in close proximity to the public footpath.

Figure 20**: Excavated Deerhurst West site with previous block valve, and new pipethrough**

291. The pre tie-in checklist that was developed in NARC 2 was utilised for the pipe throughs, the checklist confirmed all materials, equipment and personnel were in place to undertake the tie-ins smoothly. This enabled all tie-ins to be completed in one shift.

292. Bridstow East/West are buried block valve sites located either side of the River Wye at Bridstow, Herefordshire. The sites consist of three block valves contained within separate buried valve pit structures, each of which is contained within a separate wooden post and rail fence. Historically, the site contained two river crossings, one of which has been abandoned and nitrogen filled. Site access is poor, via adjacent farmland and a steep 4x4 track. The east site is also prone to flooding and as such becomes un-usable.

Figure 21**: Bridstow East, difficult access, area prone to flooding annually.**

293. The NARC project worked with the Environment Agency (EA), through regular liaison and obtaining the required environmental permit, to ensure the correct control measures were in place to minimise environmental risks to the River Wye during our works. This involved installing silt mitigation and associated monitoring for silt run off into the adjacent river, ecological checks for protected and invasive species and controlling noise and dust. The River Wye, an area of outstanding natural beauty, is also protected under statutory designations such as Site of Special Scientific Interest (SSSI) status, therefore environmental protection considerations were an area of focus from design through to construction. With the work locations being situated in flood zones, the project also signed up to EA flood alerts and specific control measures were adopted during the works e.g. no storage of materials in the flood area. Due to the discovery of an active badger sett during initial surveys on the Bridstow East access, an alternative route had to be used to avoid disturbance and for the project to maintain environmental legal compliance.

294. The three valves and valve pits were removed and new 750mm pipework installed to pipe through the site. This avoids future valve maintenance visits and reduces the corrosion risk within the pits. With the site reinstated to pasture land, this reduced the likelihood of working next to the River Wye in future.

Figure 22: Access track to site after project improvements, flooding of Bridstow west site

Naturally Occurring Radioactive Material (NORM) Waste

295. As part of the project, redundant pipework and valves were removed from the river crossing sites. At Bridstow East, unexpectedly, NORM was detected from this redundant pipework. Following samples and testing, the presence of NORM was proven, so all the waste pipework was treated as contaminated and removed to an authorised facility for decontamination.

296. This work has highlighted the NORM within the river crossings and successfully removed the NORM containing pipework from the river crossing sites.

Figure 23: NORM contaminated waste pipework quarantined and removed from site.

King's Lynn compressor station

297. Phase 1 of the multi-year King's Lynn compressor station bi-directional area was completed during 2019. Two new 900mm ball valves were installed in a difficult location. The ground conditions required twelve concrete piles - 300mm diameter and 16m deep - for the valve foundations. In addition, the deep pipework (~3m) required a large sheet piled excavation and the working area was constrained. These two new valves allow for double block and bleed isolations between Feeder 2 and the King's Lynn station in preparation for future phases of work and during emergency situations.

Figure 24: New valve installation at King's Lynn onto piled concrete foundation

298. Working together, PMC, operations and our MWC undertook recompression activities and control of a complex isolation on two Feeder 2 pipeline sections. A best practice notice was issued detailing the successful and well controlled steps undertaken by our principle contractor to install nitrogen filled bags mitigating against gas vapours during hot works operations. This was the first time a principle contractor has undertaken this activity for National Grid, a requirement due to this technical design.

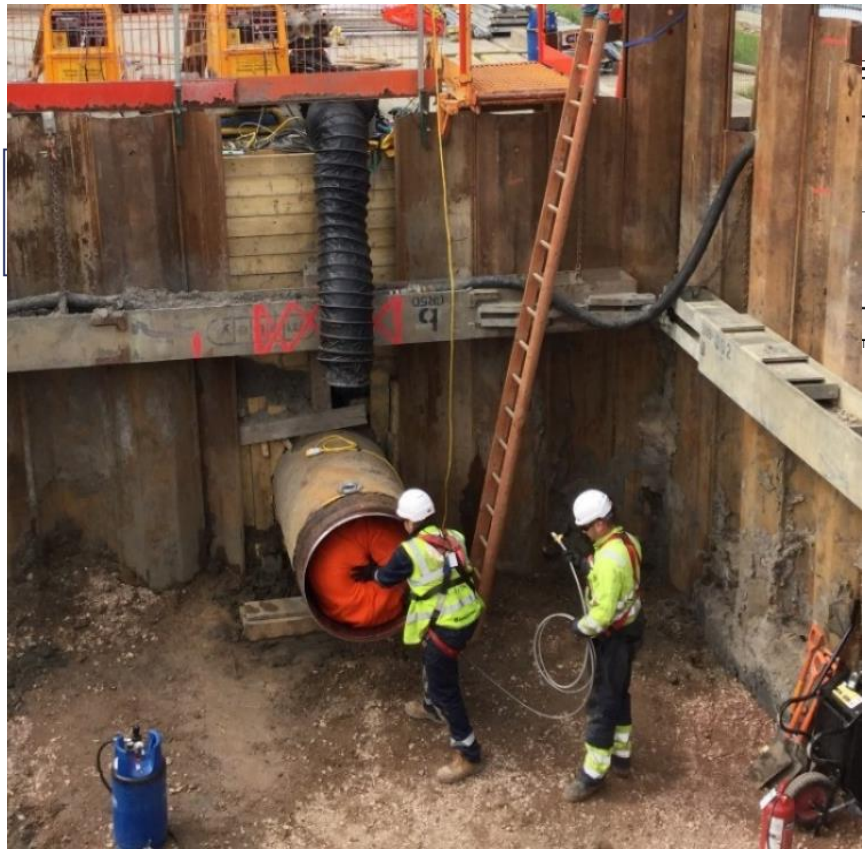


Figure 25: Bagging process completed at King's Lynn

299. Additionally, collaborative working between NARC and the Cathodic Protection team has resolved a number of Cathodic Protection non-compliances; multiple potential fault P2 category and PS/3 A2 faults identified in the OLI/4 Survey. The installation of two new test posts improves the accuracy of CP testing on the Feeder 2 lateral pipelines into King's Lynn station, so we are now able to positive confirm protection of those pipeline sections. The installation of these test posts on the exposed pipework, as part of the NARC scope saved approximately £350k.

Figure 26: Completed King's Lynn valve works including new test posts

300. Multi-discipline detailed design and planning for the permanent disconnection of King's Lynn unit 2A has been completed. Whilst the station is on outage the remaining assets from unit 2C will also be removed

Figure 27: Unit A cab and valves at King's Lynn

301. NARC worked closely with the Bacton project to develop an efficient outage program, allowing both the Bacton project works and the King's Lynn project works to be undertaken within the same summer outage period. The complex King's Lynn NRO involves two stages of pressure reduction and then purging, the only way of ensuring both works can be completed in 2020.

Pipelines Campaign

302. Work undertaken as part of the pipelines campaign aims to maintain and improve the pipework that connects the NTS. Improving the lifespan of the current network is critical to maintaining low costs to consumers, as replacement of the network would entail extreme expense and significant disruption to the UK.

303. ILI is the primary tool for inspecting the condition of the NTS, using pipeline inspection gauge inserted into the pipeline. ILI runs produce data which shows the wall thickness of the pipeline and can indicate any locations which are lower than expected. In total, 1025 km of pipeline was in-line inspected in 2019/20. The selection of the pipelines requiring inspection is driven by Intervals 2, a condition and risk based approach which considers pipeline condition, criticality and performance of corrosion prevention.

304. The ILI Runs data is analysed by subject matter experts who determine which features need to be investigated by excavation. If either coating damage or metal loss is found to the pipeline, this will be remediated by replacing the coating or putting a reinforcing shell over the affected section. There were 33 significant pipeline features investigated and remediated in 2019/20. The features were identified from 2017/18 ILI runs, this is the first year we moved from a one year to two-year remediation process to allow for more efficient planning and delivery.

305. In 2019/20, 66 locations over 13 pipelines were surveyed for possible reduced depth of cover risks, caused by changing environmental factors over the course of the NTS lifespan. Third party risk is increased if the pipeline is at a shallow depth through direct contact e.g. a plough hitting the pipeline or compressive fatiguing via frequent traffic over it. The areas surveyed included rural areas in which three locations were found to have third party mechanical damage to the pipeline requiring a sleeve or coating repair on top of reduced depth of cover protection. The results of the surveys were assessed by National Grid pipeline experts to develop a selection of cost effective risk mitigation measures. The mitigation measures will be implemented during 2020/21 and have continued the use of low cost options such as installing polyethylene (PE) protection slabs over pipelines in ditches and fencing off areas of low cover by agreement with the landowner.

306. There were two river crossing locations that were re-lifed in 2019/20, one requiring reinstatement of a collapsed gabion wall and a second requiring coating repair and river bank reinstatement.

Dangerous Substances and Explosive Atmospheres Regulations (DSEAR) Compliance Campaign

307. The DSEAR 2002 is the United Kingdom's implementation of the European Union ATEX (ATmosphères EXplosives) directives. The intention of the Regulation is to reduce the risk of a fatality or serious injury resulting from a dangerous substance igniting and potentially exploding. The Regulation requires operators to create an

Explosion Protection Document (EPD) for any installation activity involving flammable or explosive atmospheres. Through this process the operator must prove compliance of equipment for continued use, otherwise it must be replaced with correctly certified equipment.

308. The DSEAR compliance campaign was sanctioned by National Grid in April 2017 to ensure that our assets fully comply with the Regulation. The campaign completed the upload of circa 150,000 EPD documents by April 2020. The overarching summary of each EPD is the DSEAR site specific risk assessment (SSRA). The approval of these documents will be complete by June 2020.

309. The EPDs consist of the following documentation:

- A validated hazardous area drawing
- Hazardous area inspection records in compliance with BS EN60079-17
- ATEX certificates
- Intrinsically safe loop calculations
- Hazardous area asset register
- Site specific DSEAR risk assessment
- Schedule of responsibilities document for shared sites

310. Our initial approach to completing the EPDs required detailed physical inspection of all hazardous area assets to assess their compliance. This allowed sufficient defect data to be gathered to adopt a risk based inspection programme from September 2018 onwards. The type of inspection required is determined by the hazardous area zone and ignition potential of the asset. Under the new approach, assets that are classified as high/medium risk receive a ‘detailed’ inspection i.e. electrically intrusive, and low risk assets receive a ‘close’ inspection i.e. external inspection only.

311. AGI electrical/instrument (E/I) inspections were completed by August 2019 and compressors and terminal E/I inspections were completed by December 2019. Circa 43,000 E/I assets were inspected in total.

312. Non-compliances identified during the inspections were prioritised in accordance with The Energy Institute guidance. High/medium risk non-compliances were either rectified or suitable mitigation measures were applied. Due to the high volume of assets at St Fergus, the prioritised list of non-compliances will be resolved by December 2020. Low risk non-compliances will either be addressed during routine maintenance or bundled into the relevant RIIO-T2 campaign

313. In order to deliver this campaign, we utilised a combination of agency personnel and specialist ATEX inspection contractors to undertake the inspections and identify non-compliances. Using contractors from the new ATEX inspection

framework has realised significant savings over other contracting strategies (circa £1.2m).

314. In January 2020, the eight agency inspectors transferred to Plant Operations to undertake the first year of periodic inspections. The EPD's will now be updated as part of business as usual processes

Cab Infrastructure

315. The Cab Infrastructure works aim 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 for each of the three issues as described below.

HSE Publication PM84

316. 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

317. 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

318. 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.

319. The following works have been completed in 2019/20 on our Cab Infrastructure:

Avonbridge (Units 1A & 2A) HSE Publication PM84 Works

320. There were problems on both A units, whereby the bellows were damaged and dampers were sticking. These have been replaced resolving issues with functionality of the anti-icing system.

321. The combustion air intake and plenum chamber on both units were showing signs of corrosion and paint flaking on internal surfaces, increasing the risk of debris entering combustion system. Repainting and coating of the internal filter house, extending from the downstream side of filter banks to the upstream side of splitters,

has been undertaken to improve integrity and prevent foreign object damage for PM84 requirements.

Avonbridge (Units 1A & 2A) Emission Sample Lines Works

322. Emissions sample lines were unfit for the intended purpose. These have been replaced with suitable equivalent and tested to comply with IED.

Kirriemuir (Units A, B & C) HSE Publication PM84 Works

323. There was no gas detection at ventilation outlets. Existing gas detectors in each cab have been repositioned to provide better detection and coverage at the ventilation outlet.

324. Air intakes on all units were showing signs of corrosion and paint flaking on internal surfaces, increasing the risk of debris entering combustion system. Repainting and coating of the internal filter house, extending from the downstream side of filter banks to the upstream side of splitters, have been undertaken to improve integrity.

325. Cladding on all units were 40 years old and losing coating and integrity and allowing water to ingress. Due to aging condition of the cladding, these have been replaced to give additional lifespan to the compressor cabs.

Kirriemuir (Units A, B & C) Fire Suppression Works

326. Both units are equipped with separate nitrogen propelled fire suppression system. Solenoids, fittings, hoses and fire suppression heads were old and have been replaced to enhance life span, integrity and asset condition. Water cylinders have been re-pressure tested as part of Pressure Systems Safety Regulations (PSSR) requirements.

Bishop Auckland (Units A & B) HSE Publication PM84 Works

327. Horizontal exhaust sections were showing signs of cracks as identified on PM84 survey. New exhaust sections have been installed, reducing the risk of further deterioration on Unit A only. Unit B will be addressed in the 2021/22 portfolio of works.

328. Anti-icing Dampers and actuating motors on both units have been non-operational and needed replacement to improve functionality in winter. These have been replaced on Unit A only, Unit B will be addressed in the 2021/22 portfolio of works. Structural supports for the anti-icing system have been replaced to prevent the re-occurrence of sagging and other associated failure.

Bishop Auckland (Units A & B) Emission Sample Lines Works

329. Emissions sample lines were unfit for the intended purpose. These have been replaced with a suitable equivalent and tested to comply with IED.

Bishop Auckland (Units A & B) Fire Suppression Works

330. Both units are equipped with separate nitrogen propelled fire suppression systems. Solenoids, fittings, hoses and fire suppression heads were old and required replacement to enhance life span, integrity and asset condition. Water cylinders have been re-pressure tested as part of PSSR requirements.

Diss (Unit B) HSE Publication PM84 Works

331. Ventilation system improvements, including the replacement of fans and motors, and a re-evaluation of systems in line with BS21789 were undertaken. The addition of gas detection capability to detect the gas as a result of air flow change has been completed.

332. Air-intake splitters were corroded and could lead to particles getting into the engine. The splitters were replaced for stainless steel equivalents.

333. Smoke tests revealed that gases can migrate from inner cab to the outer cab. Additional seals and protection have been installed to reduce gas creepage that can go undetected.

Diss (Unit B) Fire Suppression Works

334. Unit B is equipped with a separate nitrogen propelled fire suppression system. Solenoids, fittings, hoses and fire suppression heads were old and required replacement to enhance life span, integrity and asset condition. Water cylinders have been re-pressure tested as part of PSSR requirements.

<u>Gas Quality, Metering & Telemetry</u>

335. Several GQMT related projects were completed in 2019/20 at various locations on the NTS. The focus therefore has been on closing out the projects which included work to update data books and drawings. The key work for 2019/20 is as follows:

Gas Analysers

336. Replacement of gas analysers were carried out at Abson and St Fergus.

Local Gas Treatment

337. These works are required to prevent loss of containment and loss of odorant injection capability to ensure compliance with gas safety management regulations (GSMR). There are ongoing discussions with the various customers on the ongoing need for the assets. For example, in 2019/20 the system at Moffat Compressor Station was replaced as there is an ongoing need for the system.

Metering and Fuel Gas Metering

338. Work to carry out metering upgrades started at Aberdeen, Nether Kellet and Abson including the installation of ultrasonic meters (USM). At Longtown, work was

carried out to upgrade the metering associated with the flow control valve (FCV) and at Alrewas the flow control computer was replaced.

Telemetry

339. Work was completed to replace obsolete telemetry equipment and related systems at 20 AGI. Also, within the year, work was completed at Aylesbury Compressor Station. The replacement works at Wormington were delayed as a result of prioritising an ILI run to ensure compliance with PSSR. It is now planned for completion in 2020/21.

The River Humber Gas Pipeline Project (Feeder 9)

340. In 2019/20, we have continued to progress the replacement of the Feeder 9 pipeline where it crosses the Humber estuary. This is driven by our continuing concerns over the integrity of Feeder 9 due to rapid and unpredictable estuary movements that are reducing the depth of cover over the pipeline.

341. 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. Network analysis using FES demonstrates that there is a long-term requirement for the Feeder 9 pipeline to perform this function.

342. If Feeder 9 was to become unavailable, UK Security of Supply would be significantly impacted and there could be substantial entry capacity buy back costs. Capacity buy back costs and the increase in wholesale gas prices associated with a long term unplanned supply loss would result in increased costs for the industry and the end consumer.

343. Through our strategic optioneering process and extensive stakeholder engagement including a national Development Consent Order (DCO) planning process, we have determined that a replacement pipeline in a tunnel is the most economic and least environmentally harmful long term solution. We are therefore progressing with a replacement pipeline solution as well as continuing to monitor and, where appropriate, conduct remediation activities on the current pipeline crossing.

Existing Feeder 9

344. Throughout 2019/20 we have maintained the two-monthly survey regime to continue close monitoring of the crossing. Latest survey results show that the frond mattresses remain in place, but that the level of silt build up is not as envisaged. Some areas of the mattresses appear to be more exposed than other areas. We will therefore continue to monitor every two months and take further remediation action if required.

Feeder 9 Replacement Project

345. The Tunnel Boring Machine (TBM), christened 'Mary', broke through into the pre-constructed reception shaft at Paull on 10 September 2019. This marked the completion of 18 months of continuous tunnelling activities. This is the first time a tunnel has been excavated beneath the River Humber where the TBM and associated team have had to deal with some extremely complex geological and environmental conditions. The ground had a high water bearing capacity, being extremely variable and included old deep incised river channels formed after the last ice age. All of this has meant the design, construction and monitoring of the tunnel has been highly challenging, as all the materials and resources that fed the TBM were supplied from one, now distant point in Goxhill; this being over 4.8km from the face of the TBM cutter head.

346. During this reporting period, the TBM has progressed the remaining 1,463 metres to the reception shaft at Paull, this having created an additional 51,262 tonnes of arisings. The remaining 7,350 tunnel segments were installed during the reporting period.

347. During tunnelling operations spanning the period April 2018 – September 2019 the totalised tunnel statistics are as follows:

Classfication	Destination	Tonnes	Percentage
Hazardous	Landfill	3,681	2%
Non Hazardous	Landfill	9,074	6%
	Landfill Restoration	2,117	1%
Inert	Landfill Restoration	147,744	91%
	Total tonnes	**162,616**	100%

Table 9: Tunnel arisings

Tunnel construction statistics

- Total distance tunnelled: 4,864.880m
- Total of tunnel rings/segments installed: Rings 4,047 / Segments 24,282
- Average tunnelling rate: 8.43 rings per day (inclusive all delays / down time)
- Total project hours expended on project to 31 March - 1,835,496.2

348. The nature of tunnelling, and conveyance of its abrasive arisings, impart wear on the TBM, associated service vehicles and ancillary plant (e.g. grout booster pumps), necessitating TBM and plant outage interventions to affect repairs and replacement of components. These activities impact the average tunnelling rate stated above. When the outage interventions are removed from the calculation the average tunnelling rate is 10.05 rings per day.

Figure 28: TBM in reception shaft at Paull (September 2019)

349. The TBM was dismantled in sections within the reception pit and removed from site for transport back to the TBM manufacturers and re-use on a future project. The full TBM from cutter head through to the final gantry sections were removed from 20 September, with the last section leaving site on 8 October 2019.

Figure 29: TBM (minus cutter head) being transported offsite

350. Following TBM strip down and removal, the ancillary systems that have fed the TBM during its operations had to be stripped out of the completed tunnel. This included booster pumps, HV cabling, slurry and primary water feed lines which were removed by 30 November 2019.

Figure 30: Completed tunnel section prior to lighting removal

351. Other equipment required to remain in the tunnel during installation of the Cathodic Protection system and ongoing repair of tunnel rings. The bulk of remaining

lighting, ventilation, access and safety equipment was removed from the tunnel by 13 March, leaving only a small amount of equipment on the south side of the tunnel to assist tunnel ramp preparations ready for pipeline install later in 2020.

352. Following the removal of equipment from the tunnel, the installation of the complex and bespoke Cathodic Protection system, designed in previous years, was installed prior to commencement of tunnel water filling operations.

353. The filling operation has been impacted by higher than expected levels of impurities in the fill water. We are taking steps to recover the time lost due to delays on this aspect of the works.

354. The pipeline sections remain in storage, in the stringing yard, since fabrication completion in September 2018. Each measuring approximately 650m long, they have sat upon wooden chocks. These are loaded onto the bespoke pipe handling system, consisting of a network of rails and associated bogies, ready to be hydraulically 'jacked' into the tunnel. This activity is currently scheduled to commence during summer 2020.

Figure 31: Coated line pipe sections (8 August 2018)

355. Separate to tunnelling operations work has remained ongoing to prepare the final design and outage co-ordination requirements for the short pipeline sections associated with final tie-ins on the Paull AGI later in 2020. These tie-ins are currently scheduled for completion and commissioning in early autumn 2020.

Feeder 9 Innovation

356. The River Humber Gas Pipeline, once constructed will be the longest pipeline in a tunnel in Europe. This unique combination of civil and mechanical construction

requires the highest standard of planning. Throughout the project development we continue to look for opportunities to explore innovative ways of working and delivering efficiencies.

357. BIM 360 is the chosen software platform to perform the field BIM solution. This application, which is installed on the project iPads, enables the project team to view all the models, drawings, specification sheets, certificates, and mark-up on site 'in the field' off line when not connected to the Wi-Fi. The iPads are synced when back in the office after use to ensure the information is up-to-date. This technology will continue to be used where appropriate to drive efficiencies throughout the duration of the project.

358. In order to provide the correct Asset Management data for handover, Skanska have developed a tool that can collect welding and tunnel data in the field and link-back to the BIM model via the production of data sheets. With the aid of a data validation and collection tool, and via the help of the tunnelling telemetry consultants, data is collected and linked this back to the model. This will form part of the handover data pack upon project completion. As the process was trialled on this project, further work is required to make the pipeline data more effective.

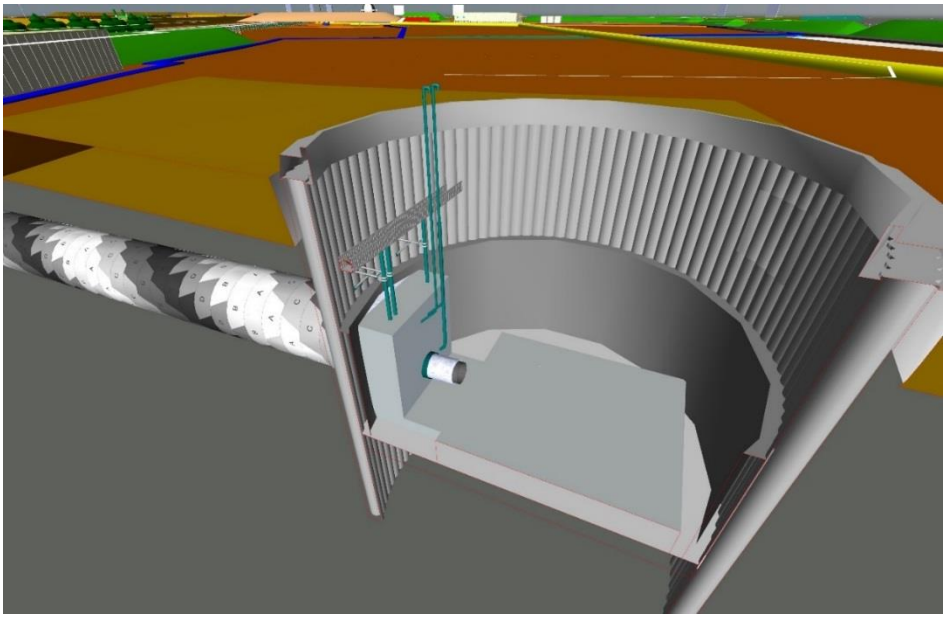


Figure 32: BIM image of TBM reception shaft

<u>Paull AGI – preparation for revised Feeder 9 connection</u>

359. As previously reported, all physical work associated with the rationalisation of the Paull Above Ground Installation is complete and the site has been handed over for access to the Feeder 9 Humber Crossing construction team to progress tie in requirements. Work associated with the close out of this project remains ongoing, with the completion of project data books complicated by the need to split the asset data and history between National Grid and Northern Gas Networks. The current programme has suffered some slippage, although this has not affected the financial

position. Revised closure of this rationalisation and asset transfer project is projected for mid-summer 2021.

Decommissioning (formerly Quasi-Capex)

360. As our network changes, some assets are no longer required for operation whilst others can be rationalised reducing the asset health investment on these sites.

Churchover Compressor A and B units

361. At Churchover Compressor Station, Orenda (A and B) units were previously replaced by one gas turbine and one electrically driven unit. Physical isolation of the A and B units, in accordance with our policies and procedures has been completed. Physical work to ensure safety and compliance of the disconnected assets left on site has also been completed. The remaining disconnected assets will be removed at a later date.

362. We are now undertaking an additional review of the updated data to determine ongoing maintenance requirements and associated risk assessment, since these assets now fall outside of normal maintenance processes for assets still connected to the NTS.

Feeder 1: Easington to Paull pipeline

363. As part of the rationalisation works being undertaken at Paull AGI, and in preparation for the connection of the new Feeder 9 Humber Crossing, an efficient bundling opportunity was identified. This involved the disconnection of the ex-Feeder 1, 600mmm diameter Easington-Paull pipeline, measuring some 23.28 km in distance. The pipeline was disconnected from the NTS, capped and filled with nitrogen during summer 2018.

364. With the physical works complete, finalisation of data books and drawings work has been ongoing. This project is currently forecast for financial closure in spring 2021.

Former Block Valve sites

365. A cost-effective option was identified to remove some block valve sites from the network as part of the optioneering phase of the NARC 3. These sites were assessed for distance compliance against pipeline design obligations. Four sites were removed on Feeder 2 as part of the NARC 3 programme in summer 2019.

Figure 33: Bridstowe Wye East site excavated prior to removal – summer 2019

Emissions

366. We engaged with stakeholders through 2014 to 2018 to develop an integrated plan for compliance with the IED legislation. The regulatory submission to Ofgem in May 2018 confirmed the outputs for the works at Peterborough and Huntingdon and investment at Wishbech. In 2019, we subsequently provided a Needs Case submission on the requirements for Hatton and St Fergus which was approved for Hatton. For St Fergus and also the other sites within the 2018 plan, these works are no longer considered to be driven by IED compliance and have therefore been descoped and reprioritised with existing investment plans. Proposals to ensure our assets are compliant with the Medium Combustion Plant Directive (MCPD) were submitted to Ofgem as part of our RIIO-T2 business plan in December 2019.

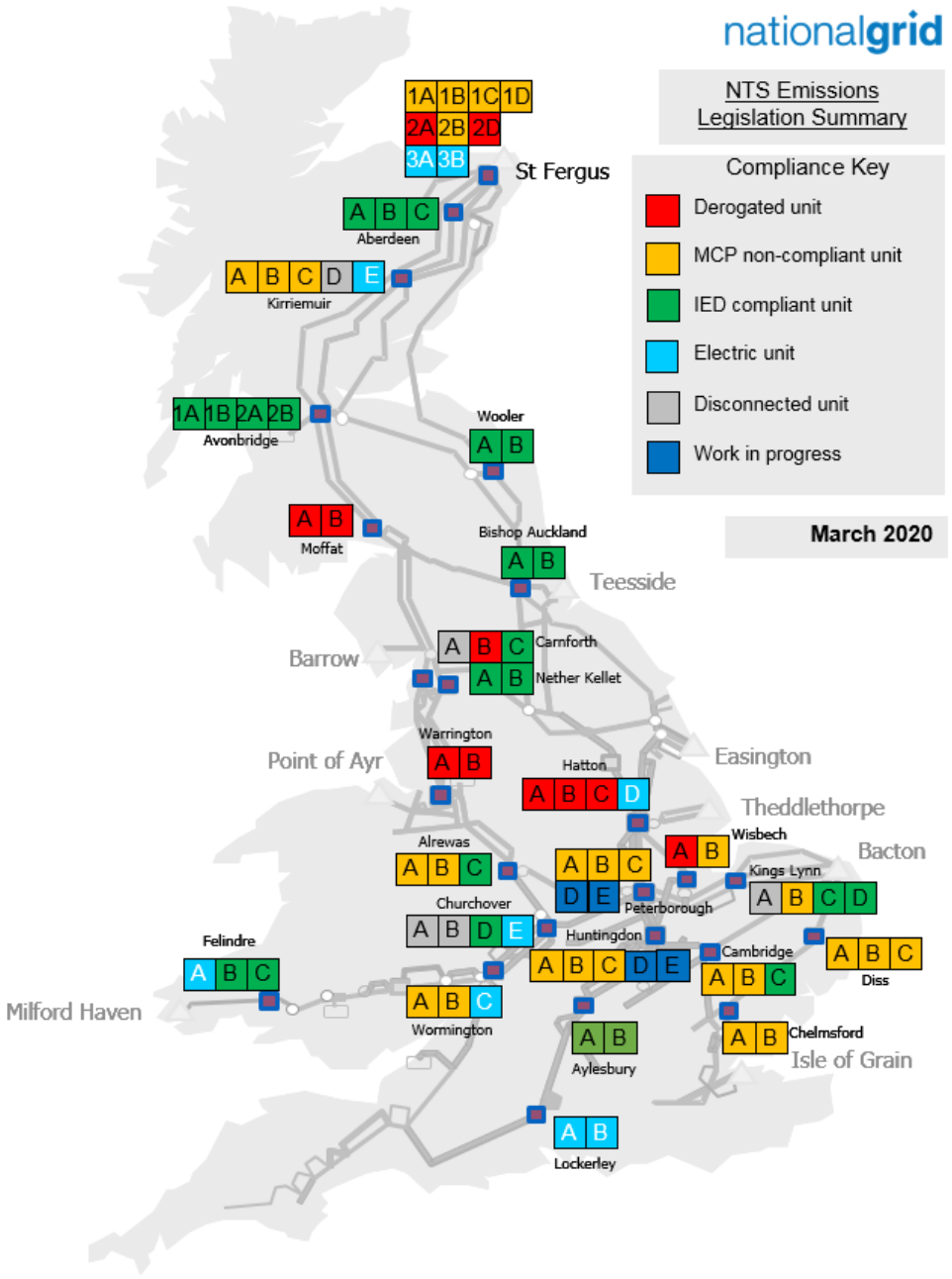


Figure 34: Compressor unit type and compliance with environmental legislation

Peterborough and Huntingdon Compressor Stations (IPPC)

367. At the start of the RIIO-T1 period, Peterborough and Huntingdon consisted of three Avon machines each. Both sites are critical to efficient transmission across the centre of the network. They also ensure we meet south east and south west exit capacity obligations. We continue to advance the programme of works to deliver two new gas turbine compressor units at each site under IPPC.

368. At Huntingdon, the programme of works was sanctioned internally in late 2016 and the MWC mobilised to site in 2017. This included core and extraordinary work scopes, such as new station control buildings and new electrical supplies.

369. During 2019/20, the key activities completed onsite consisted of progressing work with the interconnecting pipework and steel work for the new units, and continuing with the construction of the control building structure, which is now near completion.

Figure 35: Ongoing Site Works at Huntingdon

370. At Peterborough, the compressor machinery train packages from Solar Turbines and the MWC mobilised to site in 2018.

371. During 2019/20, the key activities completed at site included installing the two new compressor units in concrete bases and beginning work on the interconnecting pipework. Construction also commenced on the new station control building.

372. Work at both sites was significantly impacted by COVID-19 restrictions and changes to working practices. We have therefore been assessing the customer and consumer impact of undertaking the works during summer 2020 and the risk that the sites would not be available for winter demand, which would result in an unacceptable security of supply risk. There have also been important contractual developments, resulting in the mutually agreed exit from the contract with the Main Works Contractor, which we believe is in the best interest of both parties and the consumer. We are retendering the remaining works to minimise any risk to security of supply over the 2020/21 winter period and to ensure we still meet our environmental commitments.

373. Upon completion of the IPPC works, there will be three remaining Avons at Peterborough which are non-compliant with MCPD. In our RIIO-T2 business plan, our proposal to comply with MCPD is to undertake Front End Engineering Design (FEED) studies to build one additional new, gas–driven compressor unit (of similar rated power to the existing Avon units), with an uncertainty mechanism in the RIIO-T2 period to agree the final solution.

374. In 2019/20 we have therefore undertaken the development of preliminary Process Duty Specification (PDS) and preliminary BAT outputs. Based on our plans, including the Ofgem touchpoints, investment at the site will be within the Engineering, Procurement and Construction (EPC) tender phase by Q1. Completion of the construction phase and operational acceptance for new compressor machinery trains is currently expected in 2029.

Figure 36: Ongoing Site Works at Peterborough

Aylesbury Compressor Station (LCPD)

375. We operate two Rolls-Royce Avon 1535-190G Dry Low Emissions (DLE) gas turbine driven compressor machinery trains at this site (Units A and B). The two units are unique prototype DLE engine units that were installed in 1999. They are compliant with the 'existing plant' Emission Limit Values (ELVs) contained in the IED for NOx. The station is required for moving gas towards the South West and to provide backup capability to electric drives at Lockerley.

376. In 2016, we completed the construction phase of a catalyst installation to reduce Carbon Monoxide (CO) emissions to achieve the new CO ELVs. Unit B was successfully commissioned to Operational Acceptance stage in 2017 and Unit A followed in 2018. Asset acceptance and project closure were concluded in March 2020.

Wisbech Compressor Station (LCPD)

377. Wisbech compressor station, constructed in 1980, has two gas turbine driven compressor units designed to operate independently of each other. The station was primarily designed to provide network compression to move gas from the entry terminals at Easington, Theddlethorpe and Bacton into the south and west of the country. The use of compression at Wisbech has become increasingly variable over the last ten years. The site is now predominantly used to provide back up to other East area compressors, particularly Peterborough and Huntingdon, during outage periods.

378. At Wisbech, we previously reported how we have retained the RB211 Unit A on an Emergency Use Derogation (EUD) 500 hour/year derogation and exchanged the gas generator in Unit B from a Maxi Avon to a currently compliant Avon, which was agreed with Ofgem as funded following the May 2018 reopener. We have continued to review the longer term need of this station, balancing asset health costs against the resilience provided by the station. The network resilience provided by the station while IED emissions related works are ongoing at Peterborough and Huntingdon confirms the need for the station to at least 2023. With further IED works required at Hatton and potential MCPD compliance works at other East area compressors in RIIO-T2, Wisbech will continue to provide valuable network resilience.

St Fergus Gas Terminal (IPPC/LCPD/MCPD)

379. As one of the highest utilisation compressor sites on the NTS, St Fergus enables UK Continental Shelf (UKCS) and Norwegian gas supplies entry onto the NTS. Compression is required to raise the pressure of the gas supplied via the North Sea Mid-Stream Partners (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 VSD.

380. Our plans to achieve compliance with the requirements of the IED legislation have evolved following Ofgem's decision not to approve the St Fergus needs case submission in November 2019. The previously phased IPPC, LCPD then MCPD compliance approach has now become a combined LCPD / MCPD compliance approach.

381. In terms of LCPD, we had gained approval from the Scottish Environment Protection Agency (SEPA) to enter the RB211 units, 2A and 2D, into the Limited Life Derogation (LLD) from 1 January 2016. We will continue to utilise the Avon units until the end of 2029, whilst replacement compression is installed by the MCPD compliance date of 1 January 2030.

382. With investment for MCPD compliance proposed as part of our RIIO-T2 business plan, key activities currently being undertaken include development of preliminary PDS and preliminary BAT outputs. These will be key in defining our Gas Network Development Process (GNDP) Stage 4.1 outputs.

Hatton Compressor Station (LCPD)

383. Hatton is a high utilisation compressor station enabling the efficient movement of gas from the northern and east coast terminals towards demand centres in the south of the network. In addition to the electric VSD, the site consists of three RB211 machines which supplement the VSD and provide backup capability. The RB211s are not IED-LCP compliant.

384. A new compressor impeller was installed on the VSD unit and commissioned in 2019, after the unit had suffered damage to the compressor rotor assembly. The new impeller was manufactured using a process which would avoid the weld manufacturing defect, which had been identified as the cause of significant cracks, leading to the unit being taken out of service in back in December 2017.

385. On 1 January 2016, one RB211 was placed on the 500-hour EUD and the remaining two units on the LLD. 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. Our current investment plan is based on installation of new compliant gas-powered compression of equivalent capability to the 35MW Electric VSD and the decommissioning of the two LLD machines after 2023.

386. Following Ofgem's decision on the Hatton needs case in November 2019, the project is now in stage 4.3 ('Conceptual Design Development') of the GNDP. We have so far carried out options assessment, OEM tender, CBA and BAT assessments. We have also undertaken a detailed assessment of greenfield vs brownfield build options. We are seeking to agree the overall allowance for the investment at Hatton investment as part of the RIIO-T2 business plan determination. National Grid are awaiting Ofgem's view in draft determinations ahead of making a tender decision.

387. We will continue FEED activities to deliver a conceptual design that details the integration of the physical interfaces and the interaction between any pre-defined OEM packages and the balance of plant (BOP) equipment.

Wormington Compressor Station (MCPD)

388. Wormington compressor station comprises two Rolls Royce Avon compressors (Units A and B) and one electric driven Siemens VSD compressor (Unit C). Units A and B are non-compliant with MCPD.

389. The use of compression at Wormington is strongly linked to the supply and demand levels in South Wales; critical in supporting NTS gas entering through the Milford Haven terminal and utilisation is forecast to remain high over a wide range of network conditions. Due to bi-directional flow capabilities, it is also used to support the extremities in Wales when demands are high and Milford Haven inputs are low.

390. As part of our RIIO-T2 business plan submission, we propose replacing two Avon 1533 compressor machinery trains to reduce NOx emissions. Key activities

undertaken in 2019 included development of preliminary PDS and preliminary BAT outputs.

391. Based on current proposals, including the Ofgem touchpoints, investment at the site will be within the Engineering, Procurement and Construction (EPC) construction phase by Q1 2026, with full compressor machinery train commissioning planned for 2027.

King's Lynn Compressor Station (MCPD)

392. King's Lynn comprises four existing compressor units of which the two Rolls Royce Avons (Units A and B) are impacted by MCPD.

393. Unit A was disconnected from the network in 2017 after becoming life expired and beyond economical to continue investing in for current requirements. This means that current site capability is lower than its designed capability.

394. King's Lynn provides several functions on the network including supporting the Bacton terminal exit flows through the interconnectors and moving gas away from the South East when combined flows from the Bacton and Isle of Grain terminals exceed local demand.

395. As part of our RIIO-T2 business plan, we propose proceeding with FEED studies to build building two new, gas–driven compressor units (~15MW each), with an uncertainty mechanism within the RIIO-T2 period to agree the final solution. Key activities currently being undertaken include development of preliminary PDS and preliminary BAT outputs.

396. Based on our plans, including the Ofgem touchpoints, investment at the site will be within the EPC construction phase by Q1 2026, with full compressor machinery train commissioning planned for 2027.

Diversions

397. National Grid has various agreements for the location of our pipelines (e.g. Deed of Easement or Deed of Grant), so that we can undertake maintenance and gain access to the asset. A number of these easements contain existing liabilities or other obligations to divert pipelines, for example "lift and shift clauses". In some instances, we are required to pay the costs associated with the pipeline diversion.

398. Some of these types of deeds do not have extra liabilities and thus the developer pays for the diversion on a cost pass-through basis. At all times, we endeavour to work with developers to ensure costs are kept to a minimum.

Diversions (non-customer funded)

399. No significant work on non-customer funded diversions had been completed during 2019/20.

400. Several third-party enquiries have been received in relation to land with National Grid pipelines where loss of development and / or lift and shift type clauses could be taken forward, but as yet these enquiries have gone no further. At this early stage of a third party's project, National Grid provide support via the Plant Protection team and the Land and Consents team if necessary.

Diversions (customer funded)

High Speed 2

401. We have been working with High Speed 2 (HS2) since 2012. Five feeders are affected by the HS2 route from London to Birmingham and all require diversion.

402. Close working relationships have been established with the HS2 team to ensure that diversions are designed and developed with a view to minimising overall cost and align with stakeholder requirements. Examples of areas that have been taken forward with the HS2 designs are:

- Alignment with HS2 site accommodation / access routes to minimise cost and impact on the local community.
- Working with HS2 designers to request modification of the HS2 civils design such as the location of balancing ponds, drainage that would be lower cost than to extend diversion routes.
- Alignment of diversions with other utility providers ensuring coordinated approach to land requirements.
- Re-route to avoid removal of mature trees.

403. Of the five diversions scheduled to take place during 2018, 2019 and 2020, TX05 was completed during summer 2018. TX01 and TX02 were successfully completed during summer 2019 to enable the HS2 MWC to mobilise on agreed programme dates. TX03 and TX04 are due for completion during summer 2020.

404. The design for the Diversion and especially the pipeline route across the new HS2 track has been designed working with HS2. Specific requirements in relation to the depth of cover and backfill above the pipe to ensure the HS2 track foundations meet their required standards was necessary. The pipeline was installed into a cutting, rather than by non-open cut crossing techniques such as a micro tunnel. This technique was selected as it allows for the installation of a concrete slab, which in turn allows the depth of cover from the pipeline to the HS2 track to be reduced. The cost benefit analysis of this technique and overall land take impact is preferable.

405. Both TX01 and TX02 Diversions were completed under a full outage with recompression used to ensure the gas within the section being diverted wasn't vented. Since the two pipelines run in parallel, scheduling of the works was aligned so that a single MWC was appointed and the works on recompression minimised by the team and equipment swapping directly from the one pipeline diversion to the other.

406. The National Grid project team also worked with HS2 and Thames Water to ensure a Thames Water main was diverted prior to the National Grid works.

Figure 37: TX01 Diagrams. (a) Auger Bore Set up at road crossing; (b) Site Establishment; (c) and (d) – Ariel view of pipeline routing following top soil strip and pipe string activities

Figure 38: TX02 Diagram, Deep dig excavation, post pipeline installation and showing the protection slab and marker tape being installed prior to backfill

407. Work has now commenced on the assessment of Phase 2a from Birmingham to Crewe and 2b to Manchester and Leeds. Seven Diversions are currently identified as being required for Phase 2a and provisionally scheduled for delivery from 2022 – 2024. Sixteen Diversions have been identified as required for HS2 Phase 2b with delivery expected 2025 – 2028.

A13 Thurrock

408. A diversion of Feeder 5 was required to ensure the heavy walled section of pipeline extended sufficiently in an area where the A13 is currently being widened. Work was completed during summer 2019.

409. The works were completed via single stopples to isolate the relevant section. Use of existing valves for the shutdown wasn't possible due to the requirement to continue supplying Coryton Power Station and the local distribution network. Although requested, it wasn't possible to secure an outage at the power station

410. The diversion was completed via a two stage micro-tunnel without disrupting traffic on the road. The micro-tunnel has been extended to under the areas where the road is currently being widened allowing these works to continue throughout.

411. Due to the presence of a Cadent High Pressure Gas Main with welds of an unknown quality (P18 pipeline), engagement and agreement of the process for the micro-tunnel was provided via the Cadent plant protection process.

Figure 39: Diversion works completed via micro-tunnel

A1 Morpeth

412. Work with Highways England in relation to the proposals to divert the A1 at Morpeth has been ongoing. This will require a Diversion of Feeder 13, a key Feeder for flows from St Fergus. The Customer contract for the works has been signed and works have been issued to tender, with the build scheduled for summer 2020.

413. The project team have undertaken a visit to a resident neighbouring the diversion site to re-assure the resident that works would not significantly impact on them. Following this engagement, the project team took away a number of actions in relation to traffic management, noise and bunding requirements to ensure the local community are not adversely affected by the works.

414. Initial analysis indicated that the diversion should be completed via stopples, due to the impact on entry capacity at St Fergus. The additional cost of a stopple compared with a full pipeline outage was estimated to be greater than £2m. However, although undertaking a diversion via stopples allows for the flow of gas

to continue, the impact of flow restrictions during the process also carries a risk of capacity constraints and has a greater safety risk. The lower cost, higher financial risk pipeline outage option has now been agreed and the diversion contract with Highways England places a limited liability on them for any associated St Fergus Entry capacity constraint costs. Final pre-works and local agreements in relation to consents and enabling works are ongoing prior to mobilisation to complete the diversion during June 2020.

A500, Cheshire East Council

415. A Conceptual Design Study for the Diversion of Feeder 21 (required due to the widening to a dual carriageway of the A500), has been completed for Cheshire East Council with full support to planning provided. Confirmation of the highways scheme funding is now required prior to moving forward to Detailed Design and Construction.

416. During initial discussions in relation to the road scheme, a Diversion of Feeder 4 which also crosses the A500 was deemed necessary in accordance with the standard criteria stipulated in IGEM/TD/1, the industry recognised code of practice for steel pipelines and associated installations. However, a clause exists within the code of practice which allows for protection of a pipeline associated with a road scheme where ‘not reasonably practicable’ to divert. National Grid instructed DNVGL to complete a Quantitative Risk Assessment (QRA) to determine the impact of a loss of containment from the pipeline using the location and current pipeline parameters of the existing road crossing. The results of the QRA and assessment against the cost to divert have allowed National Grid to determine that in this case, protection, rather than a Diversion can be undertaken. The change from a Diversion to Protection represents a cost saving of approximately £3m for the Customer and is the first example of the clause being used for a Customer Funded Diversion.

Initial Works

417. Preliminary designs have been completed for schemes proposed for the A428 Black Cat road scheme modifications, Lower Thames Tunnel Scheme, West Winch housing access route development, Skelmersdale Development Area, A47 widening and a proposed retail development at Brentwood Gateway. Working with East Riding Council on the Jocks Lodge highways improvement scheme is in the early stages and we are hoping to reduce the overall cost of the work by applying a similar deviation to that used for the A500 scheme.

418. For the A428 we have worked with the Customer and our Designers to ensure level changes associated with the new road scheme avoid the need for a second diversion of the effected pipeline saving the Customer around £2m.

419. We are committed to working with Customers and 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.

Enhanced Physical Site Security

420. 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.

421. The Physical Security Upgrade Programme (PSUP) is a government mandated initiative to enhance physical site security. All works are closely evaluated by BEIS.

422. In 2014, National Grid worked with BEIS and CPNI to identify a number of gas transmission sites as PSUP based on BEIS' pre-defined criteria.

423. Of these gas transmission sites, those identified by BEIS prior to the site review in 2014 formed Phase I of our programme of works. As reported last year, solutions at all these sites were completed as of 31 March 2018, with all sites now being monitored by the Alarm Receiving Centre (ARC). The remaining sites included by BEIS constituted our Phase II programme of works.

Phase II

424. Additional sites were identified within the 2014 site review and these formed Phase II of our programme. With agreement from BEIS a number of Phase II sites were removed from this phase of the programme. Allowances for these sites were proposed to be returned through our May 2018 Reopener, but given the outcome, will now be trued up as part of the RIIO-T1 close out process.

425. The remaining Phase II sites are currently either in delivery or have had solutions commissioned, and connections to the National Grid ARC established. All solutions currently on track to be delivered by 31 March 2021 and as of March 2020, we expect minimal impact to our programme due to the effect of COVID-19.

426. In our RRP for 2018/19, we reported costs for our Phase II programme of £81.9m (2019/20 prices). Our latest cost forecast for these sites is broadly in line with costs last year, at £82.0m

Shared Sites

427. As part of the review of sites in 2014/15, a number of shared sites were classified as requiring PSUP solutions. In this case shared sites are sites owned by GDNs but contain assets owned by National Grid.

428. Responsibilities for funding and delivering PSUP solutions at shared sites vary depending on if there is a single or joint drivers for the sites inclusion in the programme. For a number of sites, we are the sole driver and therefore we submitted original cost proposals to Ofgem as part of the May 2018 reopener process. However, Ofgem challenged the efficiency of this proposal, did not adjust our RIIO-T1 allowances, and the work has subsequently been rescheduled for delivery in RIIO-T2. Our cost proposal in our RIIO-T2 plan represents our response

to Ofgem's cost efficiency challenge – we have pledged savings of £7.7m compared to the original position presented in our 2018 reopener submission.

429. For a further site, there is a shared National Grid/GDN driver for the inclusion in the PSUP. The responsibility for funding for the solution is split between National Grid and the site owner, however the responsibility for the delivery of this solution lies with the GDN site owner. A contractual arrangement with the GDN has been agreed.

Site Extensions

430. 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.

431. Allowances for 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. Due to the interactions with other investments the PSUP projects have continued.

432. All PSUP site extensions are currently forecast to be completed by March 2021. Our latest cost forecast for these projects is £7.67m. This is a slight increase to our forecast last year due to elongation of the design phase. Given the early stage of project delivery we are exploring efficiencies to reduce our project spend. These costs will form part of our closeout submission for PSUP at the end of RIIO-T1.

Phase III

433. In 2017 we worked with BEIS to update the collective understanding of threat to our assets and the impact of this on the NTS. Through further analysis a number of additional sites were identified for inclusion in the PSUP, designated Phase III. Following discussions with BEIS in December 2019, it was confirmed the number of sites included in this phase had been reduced.

434. On site surveys and delivery of Phase III solutions will be completed within RIIO-T2.

XII. Non Operational Capital Expenditure (TO)

Introduction

435. In 2019/20, our Non Operational Capex is £23.7m, a slight increase of £1.2m in expenditure in real terms this year compared with last, but below the adjusted forecast in 2018/19 of £25.0m. The forecast for 2020/21 has increased slightly as some spend forecast for 2019/20 is now expected to occur this year. The Non Operational Capex forecast is £16.5m in 2020/21.

436. Our updated forecast for the eight-year RIIO-T1 period is £148.8m, broadly in line with the 2018/19 forecast. This remains above allowances of £73.8m, driven by additional investment in MyFinance, enhancing enterprise resource planning and transforming finance processes and Cyber Security.

437. MyFinance continues to be a significant driver of IT investment in 2019/20, with expenditure in 2019/20 of £5.7m. This programme has been initiated to drive efficiencies in data management and reporting and involves investing in a new SAP system, which will transform finance processes. Total forecast spend across RIIO-T1 has increased a relatively small amount of £0.2m to £11.6m, with a reduction in 2020/21 compared with prior years.

438. Investment in upgrading software has accelerated in 2019/20, with actual expenditure of £1.0m on the installation of Windows 10 compared with a forecast last year of £0.3m. This has been partly driven by the acceleration of the roll-out of new hardware and software in the final quarter of the year to support increased working outside the office. The rollout of Office 365 has continued this year with spend tapering from a peak in 2017/18. This modernisation of software is important from a reliability, efficiency and security perspective. A total of £2.5m is forecast to be invested in these upgrades during the RIIO-T1 period.

439. Cyber Security is a key area of spend in the latter periods of RIIO-T1 as we continue to implement our strategy around mitigating cyber threats to critical systems and achieving compliance with the NIS EU Directive. Investment in this area has been less than forecast in 2019/20 at £1.3m. There will be an acceleration into 2020/21, when investment is forecast to be £4.1m and 39% of IT expenditure. The total forecast investment in the RIIO-T1 period has increased to £6.0m.

440. Overall total forecast RIIO-T1 spend on transformation programmes, such as the Technology Change Roadmap and Data and Tech GTO Process, has remained stable. The combined forecast RIIO-T1 total this year is £57.2m. The details of transformation programmes are discussed below.

441. As noted last year, the focus has now moved from Data & Tech GTO Process to Technology Change Roadmap and the Richmond programme. As a result, in-year spend in 2019/20 was zero for Data & Tech GTO Process and £6.8m was invested in the Technology Change Roadmap. This investment in Technology Change Roadmap is broadly in line with last year's forecast adjusted for inflation. To reflect

the evolution of direction of the transformation programmes, a larger amount, £4.3m, is forecast for 2020/21 for Technology Change Roadmap and zero for Data & Tech GTO Process.

442. Expenditure on other smaller IT projects in 2019/20 was £3.4m, which is slightly less than the forecast adjusted for inflation of £3.5m. The forecast for these smaller projects for 2020/21 has reduced from £3.5m last year to £2.1m this year. This has led an overall reduction in forecast total RIIO-T1 Other IT Expenditure from £21.0m to £19.5m.

443. Expenditure on vehicles in 2019/20 of £1.8m is both higher than the £1.1m last year and the adjusted forecast of £1.2m. The replacement strategy follows a "whole-life costing model" to determine the optimum replacement for each type of fleet vehicle. Hence this spend fluctuates year-on-year depending on the replacement programme. The forecast investment in the RIIO-T1 period has not changed in real terms with the fluctuation upwards this year to be balanced with a decrease in spend forecast for next year.

444. Investment in Land and Buildings has reduced in 2019/20 compared with 2018/19. Investment is forecast to increase a little in 2020/21 and the overall RIIO-T1 total remains unchanged in real terms since last year at £6.0m.

445. Expenditure on fixtures and fittings and plant and machinery has also decreased in real terms from £3.5m in 2018/19 to £3.3m in 2019/20. Of this sum invested in 2019/20, £2.0m has been invested in plant and machinery and £1.3m in fixtures and fittings across multiple sites. Investment is forecast to increase in 2020/21, but the forecast investment for the RIIO-T1 period remains unchanged since last year at £23.0m. The focus will continue in 2020/21 to be on plant and machinery with forecast investment of £4.2m, compared to £0.3m for fixtures and fittings.

Transmission Foundation System (TFS)

446. We have updated our reporting data structures to enable us to provide flexibility in business reporting. This enables us to create new reports with reduced development time and has been used to create reporting for our new investment management system and defect functionality implemented as part of the Richmond programme.

447. Our geospatial system data has been enhanced by Project AIM (Asset Integration and Mastering). Project AIM redesigned the spatial data architecture to include and visualise the full pipeline asset lifecycle. Several layers representing different breakdowns of the NTS have been created as part of this project. These layers, such as construction sections, supports the dynamic generation of RRP tables 5.1 and 5.7.

448. The project addressed several data discrepancies from multiple data sources which were consolidated into one set of records. Multiple spatial analyses identified incorrect and missing attributes such as Operating Pressures which were corrected. We now calculate length dynamically from geometry, resulting in a

higher decimal place accuracy meaning some lengths have changed due to rounding differences.

Transformation Programme

Richmond

449. The Richmond programme completed in 2019/20, having implemented a number of key changes to systems, data and processes across gas transmission to improve our asset management capability.

450. We have made end-to-end changes to our asset management processes, including more structured capture of asset defects and the implementation of a system to manage our investments and associated monetised risk.

451. Our defect information is now captured in more detail in our core systems against failure modes and includes additional information on risk and the ability to store photographs. These defects can then be linked directly to associated investments and actions.

452. We have established a framework and methodology for a unit cost model which underpins our investment process. To implement the unit cost model, we have created a taxonomy and data mapping which enables us to articulate our asset plans aligned to unit costs. We will continue to validate our unit cost model as we collate costs in this structure over time. The unit cost model has been used to inform our RIIO-T2 business plan submissions.

453. We have reduced complexity in some design specifications, aligning more closely with industry standards, allowing us to reduce the overhead of specification changes. In order to manage our field operations competency more efficiently, we have optimised process and reporting giving greater transparency of training needs.

454. These developments are partially system related Non Operational Capex and partially Opex business change activities and benefits will continue to be delivered through RIIO-T2.

XIII. Capital Expenditure (SO)

Introduction

455. This section covers our SO Capex Investment. In 2019/20, total SO Capex was £37.6m which was £4.0m higher than in 2018/19. The increase is mainly driven by the Gemini Replatforming starting (£8.9m) partly offset by reduction in capex for Telemetry Site Infrastructure Refresh (IRIS) (£1.7m) due to the completion of the project and a reduction in Data Centre Spend due to the migration date being delayed.

456. The total SO Capex forecast for RIIO-T1 period is £271.8m which is £11.4m lower than last year due to reduced spend on IS Security and Risk Management (£7.9m), Telemetry (£4.5m) and Regulatory Driven Enhancements (£6.9m). These decreases are mainly offset by higher spend on Data Centres (£3.9m) and Gemini Replatforming (£6.5m)

Enhanced Security

457. Cyber security is viewed as a critical issue by the Government and this is evidenced by the development of the National Cyber Security Centre (NCSC). This has been formally recognised by the EU Government through the introduction of the EU legislation to enhance the security and resilience of Networks and Information Systems. The NIS Directive places requirements on providers of essential services, including National Grid, to ensure their networks and IT systems are effectively protected from cyber-attack. This new legislation was transposed into UK law in May 2018. As part of the May 2018 reopener, funding was provided to progress our enhanced security requirements. Below we discuss two of these aspects; Data Centres and Cyber Security

Data Centres

458. Work has been undertaken to prepare the two new Data Centres, including the delivery of a highly secure Critical National Infrastructure (CNI) network that connects the new Data Centres to existing operational control rooms and other CNI sites and services.

459. Data Centre spend for RIIO-T1 period has increased for the project in the current year.

Cyber Security

460. We initiated a review of our Security Organisation and portfolio of investments to ensure we remain focused on addressing advancing cyber threats. The work undertook a deep dive of the state of cyber security controls across both our enterprise and critical infrastructure environments. The review resulted in the use

of a more sophisticated cyber security risk approach and applying a new control assessment methodology.

461. The CS1/2 prioritisation was assessed alongside the work being undertaken as part of the GSO NIS Improvement Plan (Network and Information Systems Regulation) which introduces obligations on the GSO business to undertake appropriate measures to manage the cyber risks of our network.

Telemetry

462. Telemetry systems allow us to monitor and control the flow of gas through the NTS; They consist of telemetry outstations and the communications network which connects the outstations to the Gas Control Suites (GCS). This facilitates safe operations and ensures a quality and quantity of gas meets consumer requirements.

463. We continue to invest during RIIO-T1 in the refurbishment and replacement of telemetry outstations, to manage the risk of asset ageing and obsolescence. Phase 4 was completed during 2019/20 and Phase 5 is expected to complete in 2020/21. Cost efficiencies have been made by reusing civil works rather than replacing and also using different telemetry units that were cheaper to procure.

Regulatory Driven GSO System Enhancements

464. The expenditure on regulatory driven changes to systems has centred on being able to deliver the necessary changes to facilitate the Gas Charging Review, predominantly under UNC Modification 0678 and alternatives, for which Ofgem published a decision in May 2020 to implement for October 2020. In order to be able to deliver such significant changes, enabling GB compliance with the EU Tariff Network Code, spend on the necessary system changes was done ahead of a decision to enable delivery in the required timescales.

465. Spend in 2019/20 also included expenditure for re-platforming of the Gemini Solution ensuring security of service and reduction in Operation Expenditure, and enhancements to the Gemini system to improve the service for the gas shipper community and other users.

XIV. Operating Costs (TO and SO)

Introduction

466. This section covers our TO and SO operating costs. The costs and allowances outlined within this section are based on our restated Table 2.4, as referenced in the Executive Summary. In 2019/20, our expenditure was £186m and our updated forecast for the eight years is £1,409m compared to an allowance of £1,317m. Our eight-year forecast spend has reduced by £4m in real terms.

467. Within the TO our eight year forecast is in line with last years forecast.

468. Within the SO our eight year forecast has reduced by £4m in real terms, this is driven by reductions in Direct costs and Business Support costs partly offset by increases in Closely Associated costs.

469. As part of the RIGs consultation process last year, a change was requested in order to ensure a consistent approach across all licence holders to ensure that Operational IT systems in the SO's get disclosed in a consistent manner as currently happens in the TO's. This enables the costs of the operational IT portfolio to be consolidated and narrative to be written using bespoke drivers/trends in the operational estate vs the business support IT portfolio. Many of our operational IT systems are unique to National Grid and by leaving them in Business Support when Ofgem review our cost base, benchmarks are deployed in the Business Support space and having unique system costs potentially distorting the costs would result in an incorrect view of costs versus standard benchmarks. Forecast numbers are included within the Operational IT & Telecoms activity in Closely Associated Costs in RRP table 2.4.

TO Overview

470. TO Controllable Opex spend in 2019/20 was £122m, representing a real term decrease versus prior year of £7.8m. Our updated TO Opex (including uncertainty mechanism spend) forecast for the eight years is £901m which is £25m above our allowances of £778m. Compared to last year our forecast spend in real terms is in line with prior year. The main movements within year are:

- Closely Associated Indirect costs have decreased year-on-year by £23.3m. The decrease has been largely driven by £11.4m GMP (Guaranteed Minimum Pensions) equalisation pension costs following a high court ruling which occurred in FY19, £8.7m PEx value cost efficiency programme and £5.4m of other cost saving initiatives including lower 3rd party costs.

- There is £1.2m decrease in fault repairs.

- Planned Inspections and Maintenance have increased by £4.1m year-on-year. The eight-year forecast of £227m is below the allowances of £256m (2019/20 prices) and £6m higher in real terms than the previous year forecast following a further review of the maintenance strategy.

- Business Support costs have increased year-on-year in real terms by £2.2m. The main increases in costs is £2m due to additional resources required for RIIO-T2 preparation and a reduction in income and asset usage charge from Cadent in FY19 of £3.9m, this has been offset against £1.3m saving in IT Projects for the year and Support Function PEx value efficiencies in the year £1.3m.

- The eight-year forecast of £280m for Business Support costs is now £118m above allowances of £162.7m and is in line with previous year forecast.

- Uncertainty Opex costs have reduced year-on-year in real terms by £0.8m. The eight-year forecast is £30m above the allowances of £32.3m.

SO Overview

471. Total SO Controllable Opex costs for 2019/20 were £64m, which is £1m lower than prior year (including IAS 19 adjustment).

472. Direct costs (including IAS 19 adjustment) were £0.8m lower than prior year. The main driver was a reduction of £2.8m in head count as part of PEx value efficiency initiative. This saving was largely offset by regulatory adjustment to cash cost of severance £0.7m, Xoserve increase £0.6m and other small cost movements versus prior year £0.9m.

473. Business Support costs were £0.4m higher than prior year. This was largely due to a reduction in income and asset usage charge from Cadent (£1.4m), this has been offset against £1.6m saving in IT Projects for the year.

474. Closely Associated Indirect costs were £1.5m higher than prior year. The main driver is associated with Operational IT & Telecoms cost, RIGs adjustment against the prior year (see above).

475. Our eight-year forecast for Controllable Opex of £507m is £4m lower than our prior forecast, reductions in Business Support costs (£2m) and Direct costs (£3m) are partly offset by Closely Associated costs (£1m). Our forecast is £32m lower than allowances in 2019/20 and will be offset by increasing Opex costs from ongoing investment in IT systems.

System Flexibility

476. In 2019/20 we continued with our system flexibility work. There were two specific areas of focus.

477. The first was undertaking network analysis to explore how different levels of supply and demand flexibility may impact the capability of our network. The output of this work has highlighted a need to be able to test more extreme system flex scenarios. Further analysis will be undertaken in 2020/21. As a prerequisite for this work we will undertake a scoping exercise and develop the tools needed to support the analysis.

478. In October 2019, we published a ‘Stakeholder Feedback summary’ document as part of our Gas Future Operability Plan (GFOP) suite of publications. We also attended the Gas Operations Forum to engage with customers and stakeholders over the publication and to seek their feedback. This feedback clarified that there remains a need for us to further define what constitutes a ‘flexibility problem’ and to quantify the impact this has, this will also be considered within the Network Capability process going forward.

479. The second area of focus has been on investigating alternative data and analysis options to enable us to assess how we can measure the impact of flexibility in all timeframes in different ways. This work will continue into 2020/21, we will share our findings and engage stakeholders via the NG Data Community site.

480. We continue to co-ordinate our operability analysis with the Network Capability process defined in the RIIO-T2 proposals which will be trialled in 2020/21.

XV. Innovation

481. Alongside new and innovative ways to maintain and operate our network, innovation in 2019/20 has focused on projects that can facilitate the target of 'Net Zero by 2050' and provide a safe, reliant and efficient decarbonised energy system that delivers value for our customers. In December 2019, we submitted our Innovation RIIO-T2 Strategy setting out our vision to "innovate to create your network of the future and facilitate UK decarbonisation". We have also recently updated the Gas Network Innovation Strategy in March 2020, alongside the ENA and other network operators.

482. In 2019/20, the team undertook 31 NIA projects and we spent £4.75m of the £4.87m allowance. Of this spend, £668k (14.1%) was internal expenditure.

483. Over the past 12 months, the roadmap to decarbonisation for Gas Transmission has accelerated from a small collection of projects looking at the feasibility of network transition, to a point of developed understanding and the formation of a pathway of projects based around our NIC submission – FutureGrid. Throughout the year, we have completed many desktop studies into the regional adoption of hydrogen such as:

- Project Cavendish, focusing on production, storage and supply of hydrogen to the London area.
- Aberdeen Vision, working with SGN to understand how the terminal at St Fergus in Scotland could supply hydrogen into the NTS.
- Many new projects have been started under our hydrogen research banner called HyNTS. These include research projects into the possibility to 'deblend' hydrogen out of a mix of natural gas and physical studies into the impact of hydrogen on the steel pipework, with an offline flow loop storing 30% hydrogen and 70% natural gas.
- We have also carried out a study into the likely locations that a hydrogen trial could be completed on the NTS and this project has fed into our submission for the 2020 NIC process, discussed further below.

484. Our 'Spatial GB Clean Heat Modelling' project will create a prototype modelling platform to better understand the demand for low-carbon energy – on both a national and regional level. The model will aim to integrate the vast amount of information coming from data networks, government and other stakeholders on the impact of low-carbon heating, consolidating it all in one place. With a more coherent view of the road towards decarbonisation, we can develop detailed planning and help our customers make the best choices for the future.

485. Following the successful completion of the GRAID NIC, the robot development has been taken to the next level during 2019/20 with work to replace the sensors for more accurate, faster technology, which in turn will provide better data and reduce the amount of time on site. The project has progressed well this year, completing

a feasibility study into how the new sensors could be positioned on the robot and importantly proving that the Acoustic Resonance Technology (ART) has been improved to allow data to be collected on coal tar enamel coated pipes, a difficult to inspect material. The robot was then transported to the Halfwave workshops in Bergen, Norway ahead of the detailed design and build stages of the project.

486. The 'Geopolymer Resin Injection' project is tackling the challenge of ground settlement and subsidence putting stress on the buried pipework and fittings below. Stabilising the ground currently requires major excavations and concrete underpinning, but this can be expensive and disruptive. Geopolymer resin injection is one possible cost-effective alternative, where resin is injected into the ground, which expands to fill any voids and compacts the soil. It has been proven in industries such as residential, rail, road and airport infrastructure as a reliable way of making the ground strong and stable. We will explore whether geopolymer resin injection can stabilise the ground beneath our pipes more affordably. We'll also test whether it's capable of lifting up a buried pipe to eliminate any points of stress. The project will help us to identify where rebuild costs could be avoided and has potential for significant carbon savings by avoiding the use of concrete for repairs.

487. Through our 'Ultrasonic Time of Flight Detection' project, we are aiming to find a suitable non-destructive testing technique that makes it possible to accurately size and reference defects within pipeline girth welds. This is currently done using ultrasonic inspection techniques that create images of the defects by reflecting the sound energy and then using that to predict the size of the defect. Defect size is important in order to establish if the defect is damaging the weld, but this method can be unreliable. This project will investigate an alternative, more accurate method for determining the size and characteristics of a defect. Time of flight detection (TOFD) is an advanced ultrasonic technique that displays the sound energy that is diffracted from defect extremities, which can then be analysed to provide very accurate measurements of the defect's position and height. If suitable equipment is identified, we will be able to integrate this technology for inspection of welds and accurately assess defect sizes and type of defect for assessment against welding standards for defect acceptance.

488. Following the successful completion of both our NIC projects; Project GRAID and Project CloCC in 2018/19, Ofgem recognised that both projects had met the SDRC set out at the start of the projects. This resulted in 100% reward of £630,500 for Project GRAID and £543,380 for Project CLoCC.

489. In April 2020, National Grid Gas Transmission (NGGT) submitted the FutureGrid project as part of the 2020 NIC process. This has now passed the Initial Screening phase and is being prepared for Full Submission to Ofgem mid-2020. FutureGrid is an ambitious programme that puts our stakeholder's needs at the heart of the hydrogen challenge. Providing an innovative testing facility that allows the design, testing and demonstration of hydrogen within the NTS in order to facilitate live hydrogen transportation and achieve Net Zero by 2050. The NIC project will use decommissioned NTS assets to build a complete transmission scale test facility that allows the testing of entry and exit points, filters, valves, meters and pre-

heaters with varying blends up to 100% hydrogen. The facility will connect to the existing H21 distribution testing facility providing a representative 'beach to meter' set up. As part of the FutureGrid roadmap, additional pre-work was required. This NIA will define the principles and specification of the test facility so that the facility can be built, and testing started, in a timely manner. The design will include the pipeline configuration, the assets to be tested, injection and mixing points, storage capabilities and flows.

490. In 2019/20, we have focused on enhancing our engagement with stakeholders through network specific events as NGGT but also collaboratively, working with the gas and electricity networks.

491. Traditionally we have attended the Low Carbon Networks and Innovation (LCNI) conference, but in 2019/20 following feedback from our stakeholders, engagement with previous attendees and a review of the key conference statistics, the Gas Networks trialled a new approach. Led by NGGT, the Gas Innovation Showcase (GIS) was created at the Utility Week Live (UWL) conference. The event ran from the 21 - 22 May 2019 at the NEC in Birmingham. Together with the ENA, Cadent, Northern Gas Networks, SGN and Wales & West Utilities, we organised the GIS as a joint event within UWL. This involved a combined stand showcasing our latest projects and developments, along with a programme of presentations and talks from the networks structured around the 2018 Gas Strategy Themes.

492. Throughout the two-day event, NGGT presented on several key projects; Secure AGI, Valve Care Toolbox, Project Cavendish, Feasibility of H2 for the NTS. We launched our NGGT innovation model, demonstrating the range of innovation projects in our portfolio and how they impact our network for our stakeholders and provided a talking point to generate further conversations on the stand.

493. The event was very successful, receiving excellent feedback through the UWL delegate survey, along with very positive feedback from our key delegates and stakeholders. The event achieved the key aims for NGGT, free access for all delegates, SMEs or interested parties, greater collaboration and coordination of the networks and a significantly larger footfall, whilst costing 50% less for NGGT to attend. Further statistics from the event including attendee figures and survey feedback are below.

Attendee totals are **up from over 5,000** to **over 6,000** with over **3.5% growth YOY**

43% increase in visitors from the key segment **'gas distribution / transmission'**

30% increase in visitors from the key segment **'electricity transmission / distribution'**

Breakout Sessions – Attendance Figures

Breakout Session	Attendees
Future of Gas Day 1 *(Innovation Theatre)*	100 – 110
Safety, Emergency & Security *(Network Theatre)*	90 – 100
Reliability & Maintenance *(Innovation Theatre)*	90 – 100
Future of Gas Day 2 *(Network Theatre)*	110 – 120
Repair & Distribution Mains *(Innovation Theatre)*	90 – 100
Environment & Low Carbon *(Innovation Theatre)*	80 – 90

Figure 40: Utility Week Live 2019 Delegate Numbers & Gas Innovation Showcase Presentation Session Attendee Figures

1	Overall show rating for exhibitors was up Year on Year (YOY) at 3.65 – above the industry benchmark of 3.52
2	Overall show rating for visitors was up YOY at 3.88 – above the industry benchmark of 3.84
3	9% of exhibitor survey respondents said this year's event was much better than last year, thanks to the addition of the Gas Innovation Zone
4	Visitors in the gas sector were the most satisfied of all, rating the show 4.6 thanks to the Gas Innovation Zone
5	Visitors in the gas sector are the most likely delegate group to return in 2020
6	The gas innovation showcase was the best rated feature/programme at the 2019 show
7	UWL2019 was rated better than LCNI
8	A specific visitor who previously visited The Energy Event said "I am focused on gas and UWL had a better focus and more relevant in depth seminar topics"

Figure 41: Utility Week Live 2019 Delegate Feedback

Figure 42: Gas Innovation Showcase Stand at Utility Week Live 2019

Figure 43: NGGT's Innovation Model on the Gas Innovation Showcase Stand

494. In addition to the Gas Innovation Showcase, we held a new and unique event for our stakeholders and subject matter experts from across the gas industry called the Network Innovation Collaboration Event (NICE). Held in conjunction with the ENA and other gas networks at our Warwick offices in September, with the event presented by Workplace Innovation Europe. Across a day of thought-provoking sessions, delegates heard the latest tips and techniques for empowering their employees to think creatively.

Figure 44: The Network Innovation Collaboration Event (NICE) September 2019

495. Alongside our work to develop our stakeholder engagement events which has proved very successful, we have continued to work closely with the Gas and Electricity Networks. We have shared a number of Gas Innovation Governance Group's (GIGG) developments, such as the implementation and inspiration logs with our electricity counterparts in the Electricity Innovation Managers Group (EIM). In addition, we have come together in a number of joint sessions to work collaboratively across the energy industry to develop and enhance our innovation efforts. The joint NIC calls and our continued engagement and development for our RIIO-T2 plans have benefited from this collaborative working approach.

496. A key achievement of the GIGG and EIM group has been the publication of the revised Gas and Electricity Network Innovation Strategies on 31 March 2020, alongside an 'At A Glance' summary strategy for both Gas and Electricity Networks. The strategies set out to encourage wider participation within innovation, with shared learning and collaboration across industry and coordinated action on priority areas that offer significant potential benefit. The strategy documents can be found here.

497. Another key development of the joint GIGG and EIM group, has been the continued development of the Innovation Benefit Measurement Framework. Progress this year has centred on refining the measures and engaging all networks to trial the framework. NGGT has been trialling the framework, whilst in parallel making the necessary changes to the innovation portfolio management tool to support future

reporting. In 2020/21, the next steps are to develop a standardised CBA approach, collate all learning and feedback to lockdown the measures, establishing detailed guidance for the population of the data and launching the framework across all networks. This approach will ensure that all networks are able to report on innovation value in a consistent and transparent way.

498. Innovation forms a pivotal part of our strategy for the remainder of RIIO-T1 and into the RIIO-T2 period. It's our ambition in Gas Transmission Innovation to build on and develop the innovation completed in RIIO-T1, learn from the successes and failures of the past, and ensure that collaboration and dissemination across the utilities grows and flourishes. All of this will help us deliver a decarbonised energy system.

XVI. Market Facilitation

499. National Grid has a number of roles in facilitating the GB and EU gas markets. This section discusses the areas we have focussed on in 2019/20, including Brexit, the Capacity Access Review and the Gas Transmission Charging Review. One of the RIIO-T2 Stakeholder priorities is "I want you to facilitate the whole energy system of the future – innovating to meet the challenges ahead", this section will highlight examples of how we are aspiring to be ready for our RIIO-T2 ambition and how we have been and are supporting the market through industry change.

Background

500. Over the coming years, the UK energy industry is set for significant change, and it will be important to ensure the GB gas regime remains flexible and adaptable to this change. Within RIIO-T1, our focus has been to manage market change effectively. However, due to the expected increased volume and scale of developments within RIIO-T2, we envisage our role will evolve to leading and driving this change.

501. It has been a significant year for us, as we have worked with our customers and stakeholders to ensure our business strategy fully prepares us for the future. Most notable of these activities include;

- Launching the Gas Market Plan programme with support and collaboration with multiple stakeholders
- Assessing and preparing arrangements for Brexit following the UK's decision to leave the EU
- Gas Transmission Charging Review (GTCR) to deliver significant improvements to the GB charging regime
- Initiating and leading the industry on the Capacity Access Review (CAR) to ensure the regime is fit for purpose and accessible to all in the future.

502. We continue to play an active role in the GB and EU gas market activities by influencing the development of EU change, both in terms of the continued development of EU Network Codes and other legislative developments. Within the GB market we are developing the Capacity Release Methodology, continuing work on gas quality developments and proactively reviewing our Gemini strategy and Xoserve arrangements to ensure that they are fit for purpose and have the ability to operate and manage future industry change.

Future of Gas Project (FoG)/ Gas Markets Plan

503. Following on from the 2016-18 Future of Gas stakeholder engagement programme; last year we tested and gained support from a range of industry stakeholders for the concept of the Gas Markets Plan (GMaP). Stakeholders told us that a long-

term plan with early consideration and development of gas market framework evolutions would advance the energy transition.

504. All stakeholders agreed that consumer benefit needs to be at the heart of GMaP. Its aim should be to deliver efficient, cost-optimal gas market solutions for consumers. This will be achieved by the development of the programme that progressively outreaches to more and more stakeholders over time, allowing for open and free debate from all aspects of the value chain. Such processes will allow for the development of solutions that aid the continuation of an efficient energy market, whilst the technology and the way gas is used transitions.

505. In 2019/20, we officially launched the GMaP programme. To do this, we developed and implemented several core components to aid the programme. This included: repurposing the Future of Gas (FOG) website, delivery of biannual FOG forums, delivery of the FOG Steering Group, publication of the 'Enabling the Gas Market Plan 2019/2020' document and commencement of the programmes' first year focus areas.

506. The website has been updated to still allow stakeholders the rich access to the material developed and included as part of the 2016-18 FOG programme, but now promotes the aims and goals of this iteration of the FOG. This includes front and centre access to the FOG Steering Group information, Forum and landing pages for the 2020 Focus Areas[18].

507. We have held two FOG Forum events since launch, reaching around 110 stakeholders across the two events, a number we will aim to surpass in the following year. These events allow us to have a large outreach to stakeholders who may not, as a matter of course, engage in market change topics. We use these events to both disseminate details on relevant issues that could impact the direction of future market change, and to allow participants to engage with the programme and provide feedback. As we enter the next phase of the programme, we will be focused on expanding the exhibitors to other parties leading on market change topics, for example where innovation projects include direct work on market evolution.

508. Following the first FOG Forum, we initiated an open invite to a nomination progress to become Steering Group members. To aid the process and ensure we achieved an industry wide representation we specified from the outset the categories parties could nominate against. This included non-traditional areas such as consumer, technology developers and environmental representations, as well as energy networks and participants. The full list of the members can be found on the FOG website. Since the formation of the group we have held two meetings. The first meeting in September 2019, which principally set the broad direction for the 2020 programme and the second meeting in February 2020, which helped us narrow

[18] https://futureofgas.uk/homepage/

down the scope of the initial priority projects in both Gas Quality and Hydrogen topic areas.

509. In December, we published the first document of an intended annual publication titled 'Enabling the Gas Market Plan 2019/2020'. This document served outline the What, Why and How of the programme at a high level to ensure accessibility of the publication to the industry at large. Furthermore, it communicated the 2020 focus areas of Hydrogen, Gas Quality and Gas Balancing. The subsequent publications will focus on changes to the long-term gas outlook, reporting on important projects in the last year relating to gas market change including the achievements of the GMaP, together with the forward plan for the following year.

Brexit

510. Following the UK's decision to leave the EU in the referendum held in June 2016, the two-year withdrawal process was triggered in a letter to the EU Council President on 29 March 2017. Following the UK general election on 12 December 2019, the European Union (Withdrawal Agreement) 2020 was finally enacted in January 2020, which enabled the UK to exit the EU on 31 January 2020. A transition period is in place until the end of 2020. During this transition period: (a) the UK and EU are expected to agree a Future Economic Partnership; and (b) existing regulatory arrangements for cross-border UK/EU energy flows remain unchanged. Future UK/EU energy arrangements are expected to form part of the Future Economic Partnership. We have emphasised to Government departments negotiating those future arrangements, that they must provide for mutually beneficial cooperation on gas, to guard against undesirable regulation.

511. During 2019/20 we continued our work to assess and prepare for the UK withdrawal from the EU, focusing on a potential no-deal scenario and collaborating closely and regularly with BEIS, Ofgem and wider stakeholders, including interconnectors and other gas TSOs in Northern Ireland, Ireland, Belgium and the Netherlands. The changes required to industry codes and related agreements to maintain the legal basis for industry processes and commercial arrangements in readiness for a 'no-deal' scenario progressed through normal industry open governance up to the point of final decision. These change proposals have either been withdrawn (if they related to 'no deal') or put 'on hold' pending the outcome of negotiations during the transitional period.

512. We continued to actively participate in the BEIS chaired Markets Operability and Trading Board (MOT) which focuses on making sure there is a clear joined up plan between BEIS, Ofgem and National Grid on managing key Brexit energy-related risks. The experienced manager we seconded to the BEIS Gas Brexit team in 2018/19 has provided knowledge and expertise to support the Brexit transition process. We agreed changes to the Articles of Association of PRISMA which allows NGG to continue to both be a shareholder and user of their services, thereby ensuring that post Brexit, UK shippers continue to have access to interconnection point capacity. Furthermore, we have participated in workshops, bilateral meetings and responded to industry consultations as appropriate.

513. Our active involvement as members of the European Network of Transmission System Operators for Gas (ENTSOG) has enabled us to understand the potential implications of Brexit and future EU policy on longer-term gas market operations. We will continue working with ENTSOG to understand the options for our future membership. We will also seek to maximise our membership of Gas Infrastructure Europe (GIE) and other opportunities to influence the EU's development of market frameworks and pathways for gas, to ensure mutually beneficial arrangements for UK and EU consumers. We will continue our work during 2020/21 to respond to emerging political developments during the transition period, maintaining our close working relationships at all levels with BEIS, Ofgem and other key stakeholders.

Gas Transmission Charging Review

514. The Gas Charging Review continued its development through industry workgroups (NTS Charging Methodology Forum and Modification specific workgroups) in 2019/20. Following Ofgem's decision in December 2018 to reject (i.e. not implement) any of the 0621 proposals identifying EU Tariff Code (TAR) compliance concerns, we presented a new set of proposals under UNC0678 in January 2019.

515. UNC Modification 0678 addressed all the aspects of the charging review that included delivering compliance with EU Commission Regulation 2017/460 (the EU Tariff Code), incorporating changes that address Ofgem's reasons for non-implementation of 0621.

516. Meetings with industry were frequent. National Grid undertook substantial engagement with stakeholders, customers and interested parties. A total of ten alternatives were raised to UNC Modification 0678. All UNC material on the workgroups and modifications can be found on the Joint Office of Gas Transporters website[19].

517. The range of proposals under 0678 proposed either a Capacity Weighted Distance (CWD) Reference Price Methodology (RPM) or a Postage Stamp (PS) RPM. The workgroups concluded on 10 April 2019 with the consultation on the eleven proposals closing on 8 May 2019. UNC Modification 0678 and all alternatives went to the UNC Panel on 23 May 2019 after which a Final Modification Report (FMR) was submitted to Ofgem on 29 May 2019.

518. Following this date, we provided support to Ofgem and its consultants as part of Ofgem's preparations to issue an impact assessment on the proposals. National Grid also, as part of its role as the Transporter, provided the necessary data and support for the provision of required data and analysis.

519. Ofgem prepared and issued an Impact Assessment (IA) on the UNC0678 proposals in December 2019. This also included the required EU consultations (as needed under TAR code). The IA and consultation expressed a minded to

[19] https://www.gasgovernance.co.uk/0678

preference for UNC0678A and October 2020 implementation. Ofgem also highlighted only UNC0678 and UNC0678A were compliant with TAR code.

520. The IA consultation concluded on 24 February 2020. An impact assessment along with the required EU Consultations (required under TAR code) are expected to follow in the proceeding months after submission of the FMR to Ofgem.

521. Throughout the UNC0678 change process, we have provided the necessary support to enable Ofgem and industry parties to carry out the required assessments, including the development and publication of charging tools to enable comprehensive sensitivity analysis to be carried out by any party.

522. We have also taken steps to be ready to implement following an Ofgem decision, being prepared from a systems and process perspective, being able to implement on a date in line with an Ofgem decision and implementation date. We have been in regular communications with Ofgem to be open and transparent on our approach to be able to fully support their decision making and ensuring deliverability of this substantial change under 0678 and alternatives. This is to enable GB to be compliant with TAR code in line with Ofgem's decisions, delivering essential UNC changes and our Licence obligations, and fulfilling our role as the Transporter in being able to deliver and implement such changes.

523. Ofgem published their decision to implement UNC0678A, in line with their minded to position, on 28 May 2020 with an effective date of 1 October 2020. National Grid can implement the necessary process and system changes for October 2020.

524. National Grid will continue to work with Ofgem and industry customers and stakeholders on charging matters and consider UNC modifications as and when necessary. UNC0678A puts in place a methodology without a charge to manage potential inefficient bypass of the NTS. National Grid is leading on a new product for this arrangement to work with the methodology UNC0678A puts in place and raised UNC0728 on 9 June 2020. There are four alternatives and an expedited UNC change process ("urgency") has been requested to Ofgem.

European Market Activities

EU Tariff (TAR) Network Code

525. The TAR code establishes a network code on harmonised transmission tariff structures for gas. It sets out the EU-wide rules which aim to enable market integration, enhance security of supply and to promote the interconnection between gas networks.

526. Over the course of 2019/20, we provided regular updates and held discussions with stakeholders and customers at industry fora including UNC Transmission Workgroup, the NTS Charging Methodology Forum and the Gas Storage Operators Group as well as in a number of bilateral meetings and communications with individual stakeholders. Industry discussions on the TAR code have been incorporated into the Charging Review to ensure a holistic approach is taken in the

development of a GB charging framework that is both fit for purpose and compliant with the TAR code. The TAR Code drives a number of changes to the GB charging regime such as the removal of fixed price capacity tariffs at interconnection points, a drive that most of the allowed revenue should be recovered via capacity tariffs and increased obligations in transparency and consultation.

527. We were proactive in the development of the TAR code both at a European level and by working closely with BEIS and Ofgem by seeking to influence the codes and to ensure they are implemented effectively. The implementation solutions developed for 0678 (Charging Review) have been in consultation with customers and stakeholders as part of the Charging Review. Due to our influencing, the final TAR code enables NGG to largely preserve our current TO/SO model, thereby ensuring, through the proposals for 0678 (and alternatives) that the regulatory reporting under National Grid's Licence is not affected with the introduction of Transmission Services and Non-Transmission Services being implemented through the UNC changes.

528. The TAR code entered into force on 6 April 2017, however elements of the TAR code would be expected to be relevant to be applied to GB for the first tariff year after 31 May 2019 which for GB started on 1 October 2019. Modification 0678 (and the range of alternatives) proposed changes to the GB Charging regime to deliver compliance with TAR in addition to additional benefits for a more fit-for-purpose charging regime.

529. The UNC change process concluded in May 2019. Ofgem issued the required EU consultation under TAR in December 2019 as part of their Impact Assessment on the UNC0678 proposals. The proposal(s) are implementable in line with an Ofgem decision and will therefore be effective from any date Ofgem provide.

<u>EU Interoperability (INT) Code</u>

530. Whilst this EU Code entered into force in 2016, we have contributed to a number of initiatives in relation to the technical areas that this code covers via our membership of ENTSOG's Interoperability Working Group.

531. Several issues were raised on ENTSOG's Functionality Platform related to harmonisation of data exchange:

- Mandate the use of Edigas functionality to enable shippers to submit trade nominations at Virtual Trading Points (such as our NBP). Stakeholders overwhelmingly favoured this change and we expect the EC to propose a change to the Interoperability Code to mandate TSOs to offer this during 2020;

- Mandate the use of Edigas functionality for the interface between shippers and EU capacity booking platform operators. Whilst the scope was limited to interconnection points (hence an issue more for PRISMA rather than Gemini), we contributed to the preparation of a public consultation on this issue for which results are expected to available in Q2 2020;

- Mandate the use of Edigas functionality in relation to other gas balancing related processes, which ENTSOG clarified the scope of with the proposer during 2019.

532. Under this Code, ENTSOG has an obligation to monitor TSO compliance and sharing the output with ACER. We compiled and sent our compliance return to ENTSOG in January 2020, liaising as necessary with our adjacent TSOs.

533. We have also been able to monitor (via BSI and ENTSOG) and periodically report back to GB industry stakeholders on the ongoing work by CEN as it seeks to incorporate Wobbe Index into the EU standard for gas quality EN 16726:2015. In November 2019, we produced a company response to a CEN consultation about the feasibility of de-coupling the system entry and exit ranges for Wobbe Index via a classification system for exit points. Uncertainty remains about a legal and regulatory framework that will accompany the eventual standard.

534. ENTSOG has also been working with TSOs in relation to possible future pathways for increasing hydrogen concentrations within their networks. We contributed to ENTSOG internal assessments, the output of which fed into ENTSOG's 2050 Roadmap for Gas Grids, which was published in December 2019 and for which stakeholder workshops are to take place in spring 2020.

535. In March 2020, we also produced a company response to a joint ENTSOG-GIE consultation about how we have implemented the NIS Directive in relation to cyber-security. TSO responses were sought in order to inform discussions with EC about a potential future EU Code on this subject.

PRISMA

536. The EU Capacity Allocation Mechanisms (CAM) Code introduced market based capacity auctions and the adoption of a Joint Capacity Booking Platform (PRISMA) for the sale and purchase of capacity at Interconnection Points. In 2019/20, we worked with PRISMA and its other TSO shareholders to agree revised Service contracts, Articles of Association and Cooperation Agreements. The revised service contract included an updated Cost Allocation Methodology, which resulted in a saving for NGG in comparison to the previous methodology. The revised Articles of Association ensure that in the event of Brexit, GB can continue to utilise PRISMA services maintaining that important cross border trade. Alongside this we have continued to work with PRISMA to improve system usability and reliability, as well as looking at how they increase their customer base which will result in lower unit costs for all users.

537. Looking forward to 2020/21, we are supporting PRISMA in developing their company vision for 2030 and beyond, looking at the role they can play as the market transitions to Net-zero.

Gas EU Security of Supply Regulation

538. The revised Gas Security of Supply Regulation (amended to Regulation (EU) No 994/2010) came into effect in November 2017 and contains a phased implementation of obligations until 1 March 2019. Some of the new obligations contained within the revised Regulation are direct on TSO's. Other obligations sit with Member States but have an indirect obligation on TSO's to contribute towards their fulfilment.

539. During 2019/20 we have been working closely with BEIS and Ofgem to implement obligations as per the phased implementation timescales contained within the regulation. The most notable of these obligations was the introduction of the "Solidarity" principle which was effective from 1 December 2018. This obliges BEIS to implement measures which triggers action in a Solidarity event. We have been working with BEIS and Ofgem to continue to develop an approach to implementation of the Solidarity principle to assist BEIS to fulfil their obligation. It has been important that we have played a key role to ensure that the implementation approach is compatible with current emergency procedures and minimal change is required.

GB Market Activities

Capacity Access Review

540. In October 2019, along with industry stakeholders, we launched a review of the Capacity Access Regime (UNC 0705R)[20]. The current entry and exit capacity arrangements for Users to access the NTS were built on the foundations of an expanding gas transmission network. Today, this environment has changed and NTS does not experience the capacity signals requiring expansion of the network we were 10 years ago.

541. UNC 0705R was raised to review the principles of the capacity access arrangements to ensure they are aligned to future needs of our customers and allow optimal development of the NTS.

542. In January 2020, we launched an industry wide consultation which concluded in February 2020. In addition, further industry engagement is regularly conducted via sector specific engagement, bilateral discussions, Gas Industry Forum, Gas Storage Operators Group, Future of Gas Forum and industry webinars, to ensure industry views are fully captured in the development of the future regime.

543. As part of UNC Transmission Workgroup and the consultation, an ambition statement has been drafted and the functions required for the future capacity access regime were developed. These will help to guide the direction of the review

[20] https://www.gasgovernance.co.uk/0705

and ensure that short-term problems related to current regime are resolved consistently with long-term goals.

544. In consultation with the industry, we have developed a list of short-term issues which the review will aim to address. These have been grouped into work-streams and include:

- Overruns[21]
- Signalling and Allocation of Capacity
- Capacity Products and Auctions
- Trading

545. We will ensure that Capacity Access Review developments are aligned with the GMaP and facilitate the future gas market frameworks appropriately.

Capacity Release Methodology

546. National Grid produces a methodology describing the processes for releasing NTS capacity. Included in this is an economic test which is used to help justify the release of incremental capacity at an aggregated system entry point (ASEP), by making sure the requesting party funds a sufficiently high enough proportion of the required network investment. We identified a need to review the rules for the economic test to make sure it remains operable following the charging review. At the same time, we have also received customer feedback regarding the current test, based on their recent experience.

547. Amending the economic test has therefore been the main focus for the most recent review of the capacity methodology statements. A new economic test has been proposed that takes account of customer feedback, and that is designed to work with all possible outcomes of the charging review. The new economic test substantially reduces the volume of capacity that customers need to commit to, whilst still upholding the economic principles of the test. This helps reduce the barriers to entry for new sources of gas connecting to the NTS.

548. The formal consultation for the proposed update to the capacity methodology statements took place across April/May 2019. This was the culmination of many previous months of industry discussion and engagement. The updated methodologies were approved by Ofgem and were effective from 24 July 19.

Gas Quality developments

549. Throughout 2019/20, we have been exploring the feasibility of a Gas Quality Blending Service at two NTS terminals. St Fergus and Bacton both have multiple

[21] https://www.gasgovernance.co.uk/0716

sources of supply that co-mingle within the National Grid terminal before exiting onto NTS pipelines, which potentially make them suitable locations.

550. The service being contemplated would be interruptible, whereby we would agree to accept non-compliant gas provided by an upstream party(s) if sufficient supplies of compliant gas were being delivered from other operators at the terminal to blend the gas to meet the GS(M)R parameters. Such a service could help maximise the recovery of UKCS gas to the benefit of GB security of supply and apply downward pressure on GB wholesale gas prices. Declining offshore production, changing supply dynamics and new sources of gas may lead to more requests for blending services in future.

551. This project has progressed across three work streams initiated within 2019/20 and will continue during 2020/21:

- Feasibility Study
- Safety Assurance
- Commercial and Regulatory Principles

552. We have also been exploring a shorter term, limited duration blending arrangement at Bacton under which we would agree to accept low Wobbe Index gas at the Perenco system entry point in Q3 2020 provided that it can be successfully blended within our terminal with other prevailing supplies. This could provide a test case for more enduring blending services and continues to be progressed with industry via UNC Modification 0714.

553. There have been several proposals in recent years by Delivery Facility Operators (DFO) to increase their allowable oxygen content, the latest of which was raised by Ancala at St Fergus via UNC Modification 0712S. We provided network analysis to assess the impact of this proposal in isolation and factoring in recent amendments at other entry points. This Modification was directed for implementation in April 2020.

554. We have continued to contribute to the GS(M)R Review, which aims to make changes to certain technical parameters in the current UK gas quality specification, establish a new IGEM standard within which the specification would be contained and update the remainder of the Regulations.

555. The NIA project to deliver this change required an extension in 2019, at which point we joined the GDNs in contributing to the funding of IGEM to deliver it. We have continued to play an active role in IGEM's Gas Quality Working Group in order to develop proposals for industry consultation in Q2 2020. These include a widening of the Wobbe Index range, removal of other combustion parameters and an increased limit for oxygen on below 37 bar systems. We have also collaborated with stakeholders in relation to implementation issues for the proposed standard which are more particularly described in the GMaP section above.

Xoserve and Gemini

556. Xoserve provide a number of services to National Grid and to our customers, which are predominantly associated with Gemini operation and change management, shipper invoicing, energy balancing processes and shipper lifecycle activities. Under the current regulatory arrangements, National Grid receives a funding allowance for the provision of these services from Xoserve.

Xoserve relationship / performance

557. The customer experience when interfacing with our back-office systems has been a key area of focus for us in 2019/20, working closely with Xoserve to review and seek improvements across a range of operational areas in partnership with Xoserve. This has resulted in implementing a programme of works to design an overarching target experience which spans across both National Grid and Xoserve. The aim is to ensure our business processes are aligned and transparent, resulting in a seamless level of service that drives better efficiencies and the best value for money for our consumers.

558. The scope of improvements was based on feedback, and 'pain points' from our customers and stakeholders, provided via the Customer Satisfaction and Stakeholder satisfaction survey programme.

559. The programme consists of three areas:

- 'Manage my Profitability': this looks to improve the NTS invoicing processes linked to Energy Balancing invoicing.
- 'I Join': Our customers have told us that they want a simple process to join the industry and attain easier process for setting up locations in Gemini when connecting to the NTS. This journey looks to improve the User Admission, and meter creation (entry & exit) processes.
- 'IS System Support': Improvements to the service desk provision, current Key Value Indicators, including alignment on priority of tickets (P1/P2) to ensure they are actioned effectively ensuring system availability.

560. In 2019/20, we have embedded a scorecard report to drive collaborative focus on key issues and a horizon scan, which enables us to understand and plan more effectively future changes taking place that will impact our Gemini system. We have also developed a strategic account plan, to better understand both key drivers & strategies for the future and to help leverage opportunities and to ensure both our business objectives and requirements for RIIO-T2 are aligned.

Gemini Strategy within RIIO-T1

561. Gemini is currently operating on ageing hardware and infrastructure software, which brings increasing risks to its security, availability and resilience. Xoserve therefore identified an investment requirement to sustain Gemini's infrastructure

and we have been continuing throughout 2019/20 to work with Xoserve to re-platform Gemini (to maintain vendor support for the hardware and infrastructure software layers of the Gemini application) as an economic alternative to prolong the life of this system ahead of a full replacement.

562. Mobilisation to re-platform Gemini commenced in January 2019, incorporating a wider change programme both within Xoserve and National Grid. We have worked closely with Xoserve to understand the best re-platform solution. This has included an assessment of the non-functional requirements (e.g. the expected load placed on the system, access to it and its control), data archiving and platform solutions to be delivered, whereby assets are taken as a service rather than National Grid owning the assets has been defined as the best solution, and a hosting partner selected. High level design commenced in March 2019 and is currently on track to be completed within 2020.

563. In parallel with the re-platform activity, Gemini System Enhancements continues along with the longer–term roadmap to adapt and improve Gemini, based on the needs of a changing industry to meet customer expectations. 21 requirements have been identified which includes such changes as performance optimisation, password reset, API's and query criteria standardisation. Shipper engagement is planned for Q2 2020 to further refine the in-scope requirements, with delivery of the Gemini System Enhancements planned to go live in March 2021.

564. Within 2019/20, we submitted our RIIO-T2 proposal for Gemini. We have been planning and mobilising a project team to consider the requirements for the future of the capacity and balancing services and system; how and what we can deliver within the RIIO-T2 framework. This work will continue throughout 2020/21.

XVII. Operational Review

565. The 2019/20 winter was the 12th warmest October to March in the last 60 years.

	2019/20	**2018/19**	*Comments*
The System Average Price (SAP)	29.6p/th Ranging from (18 p/th to 43 p/th)	57.9p/th Ranging from (34.4 p/th to 78.6 p/th)	*The reduced price range was due to the availability of global supplies. In 2019/20, the reduction in price was predominantly driven by an increase in LNG supplies.*
Total consumption	84 bcm	81.7bcm	*This increase was largely driven by increased demand from LDZ Offtakes and Moffat export.*
Highest Daily Demand Day	362.6 mcm (21st January 2020)	402.7 mcm (23rd January 2020)	*This was 40 mcm lower than last year's maximum.*
Lowest Daily Demand Day	119.6 mcm (29th August 2019)	129.6 mcm (2nd September 2018)	*This was 10 mcm lower than last year's minimum.*
Coldest National Composite Variable (CWV)	2.89 (1st December 2019)		

Table 10: Operational review statistics

566. In 2019/20, we have seen a continuation of the more diverse supply of gas into the NTS, closer to the centres of demand than in recent years.

567. On 5 December 2019, the NTS received the largest amount of LNG ever imported into the system, with a total input of 135.4mcm. Consequently, there was a reduction in usage from traditional assets in Scotland and the centre of the network, with a larger focus on compression placed closer to the LNG terminals. LNG terminal flows have increased, with the number of LNG cargoes received increasing from 102 in 2018/19 to 189 in 2019/20.

568. In 2019/20, all significant offtake pressure customer obligations were delivered. There were 361 maintenance operations were completed successfully during the year.

Operational challenges

569. Non-diversified supplies as observed during winter 2019/20 (see figure below), require a larger transit distance for gas from point of supply to point of demand and need more network intervention e.g. compression. With LNG supplies in the South East particularly close to high demand centres these challenges are eased.

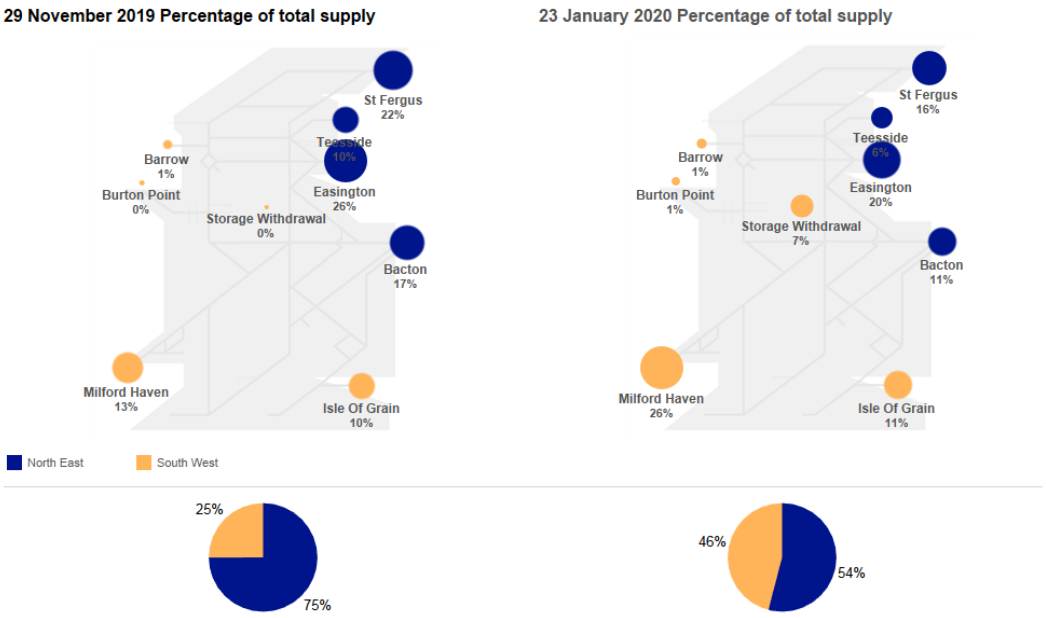


Figure 45: Different supply profile on two days during winter 2019/20

570. During the winter, there were 126 GS(M)R supplier gas quality excursions, which were resolved using the relevant processes.

571. There was an unplanned system event at one NTS offtake resulting in a loss of flow to the offtake. All efforts were made to return the flow in a timely manner, whilst ensuring the safe operation of the NTS.

Gas Demand and Supply

572. The chart below displays the gas demand for the past 12 months by the individual demand components.

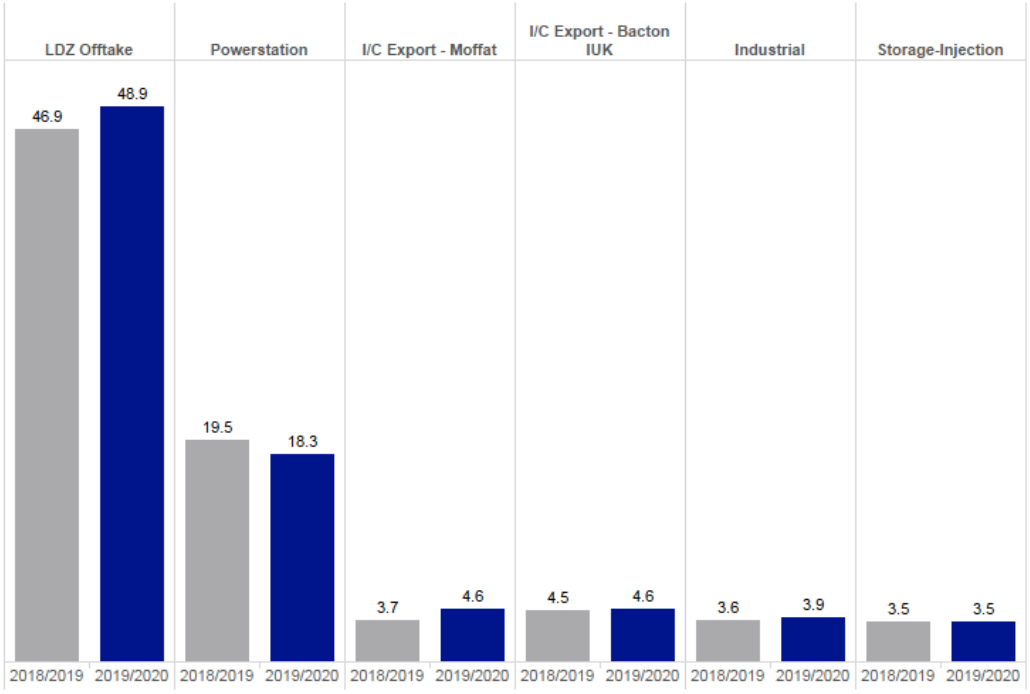


Figure 46: Gas demand in 2019/20 vs 2018/19 by demand components

573. LDZ demand was higher in 2019/20 at 48.9 bcm compared to 46.9 bcm in 2018/19; averaging 188 mcm/d in winter 2019/20 compared to 181 mcm/d in 2018/19.

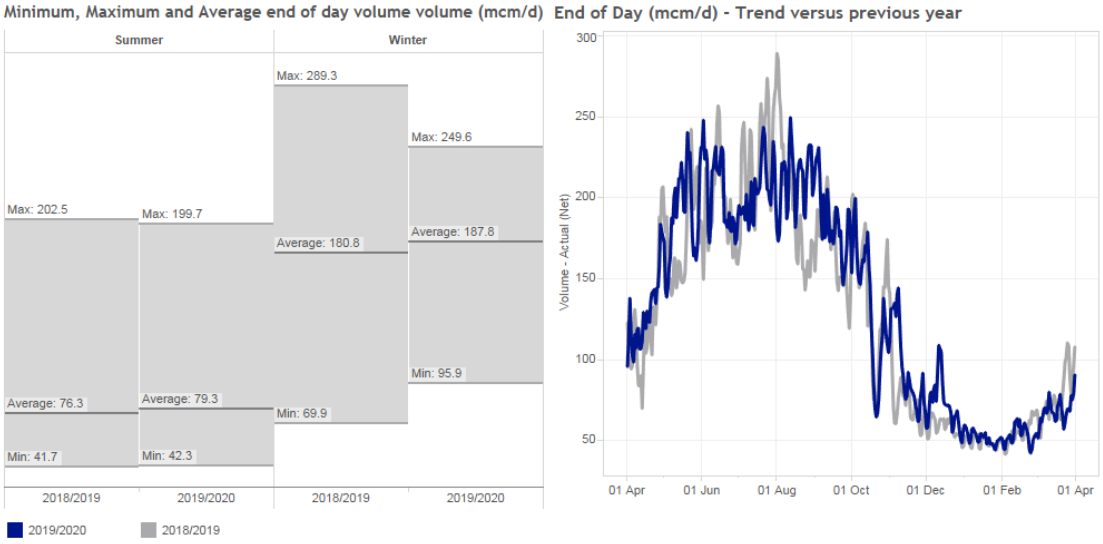


Figure 47: LDZ demand average daily volume, range and trend previous years

Weather

574. The Composite Weather Variable (CWV) is a single measure of daily weather and is a function of actual temperature, wind speed, effective temperature and seasonal normal effective temperature. The CWV highlights a slightly colder winter than last year, which correlates with LDZ demand levels. There is a narrower range of CWV in winter, when compared to the previous year, this is in line with the narrower range of LDZ demand.

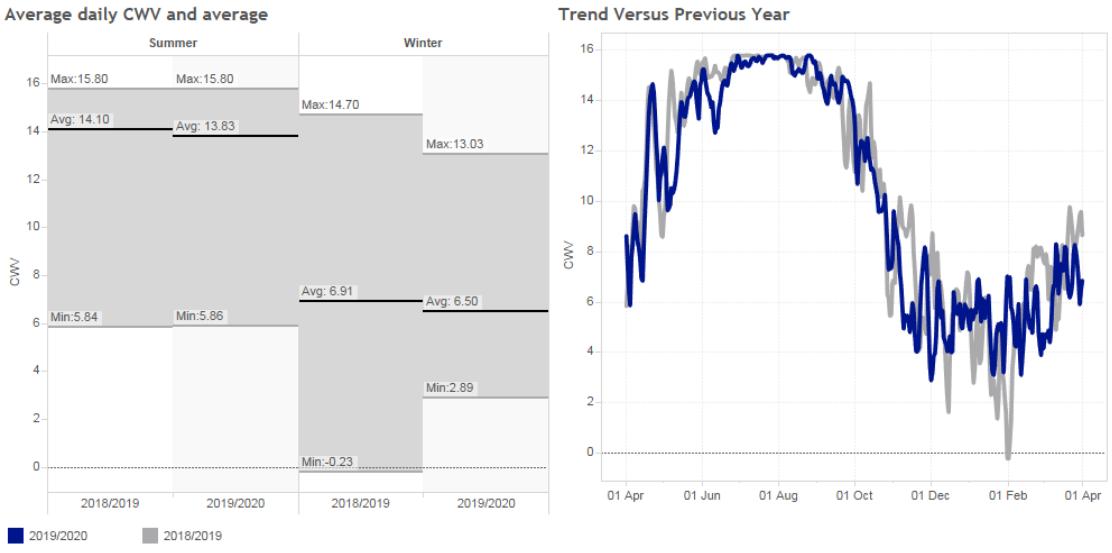


Figure 48: National Composite Weather variable data

Demand for Power Generation

575. The chart below shows the gas demand for power generation this year, compared to the previous year. In the summer, the average demand was almost equal with a difference of -0.6 mcm, but had a decreased minimum and maximum demand when compared to the previous year. This pattern was also evident in the winter with average demand smaller than the previous year with a difference of 8mcm.

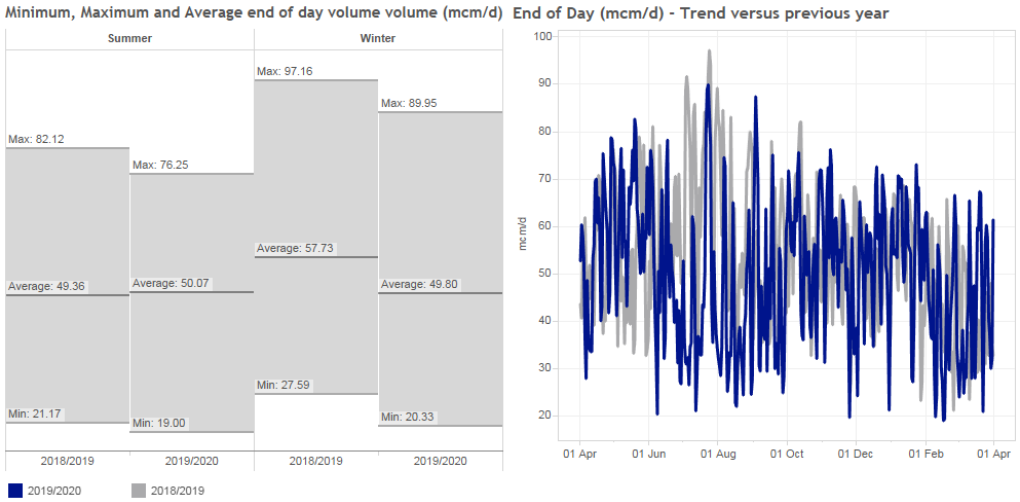


Figure 49: Demand for power generation

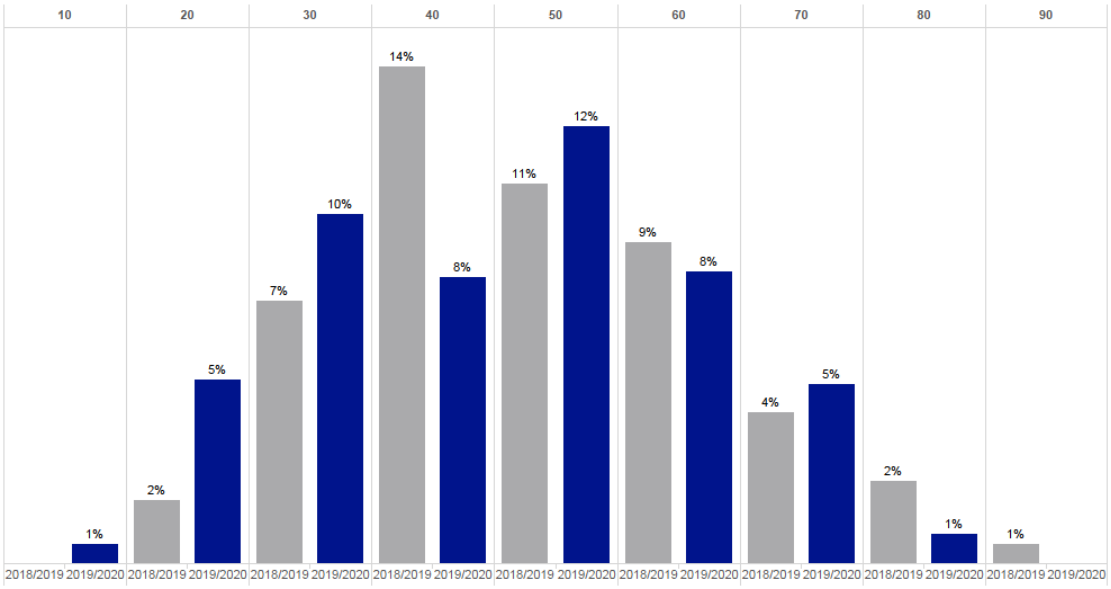


Figure 50: The distribution of daily power station demand shows the percentage of days of power station demand in the year 2019/20 and 2019/18. The x-axis shows the demand range (value of 40 = 31-40). In 2019/20, demand of 41-50mcm was the peak occurrence on 12% of days, while in 2019/18, demand of 31-40mcm was the peak occurrence on 14% of days.

Import/Export Flows at IUK

576. Figure 51 shows the import/export flows at IUK for this winter 2019/20 in comparison to last year. There was a 66% reduction in imports and an increase in exports in the UK.

577. In Winter 2019/20, there were physical reverse flows for BBL. The first physical reverse flow of 9.4 mcm was seen on 27 September 2019.

578. The requirement for supplies at Bacton ASEP to provide for the South East and South West demand centres was reduced due to the significantly higher flows experienced at Isle of Grain.

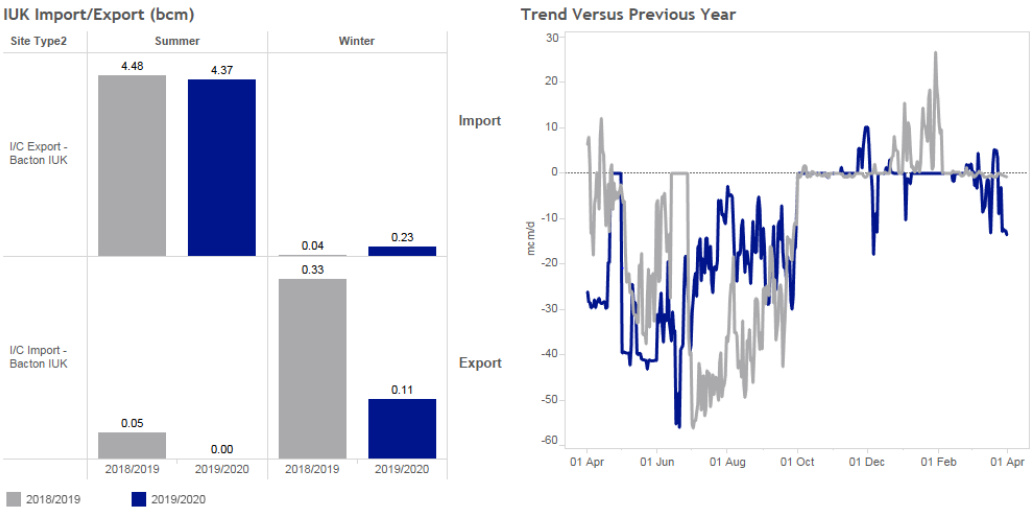


Figure 51: IUK import/export volumes for 2019/20 vs 2018/19

Supply Breakdown

579. Compared to the previous year the largest elements of the supply profile, UKCS and Norway have seen a decrease. There has been an increase in supply from LNG to offset this.

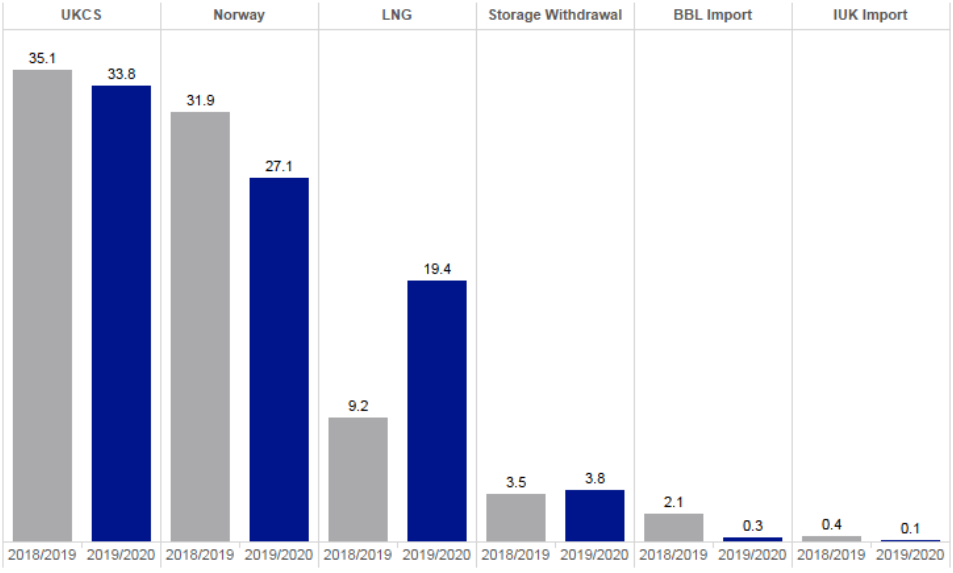


Figure 52: Gas supply breakdown 2018/19 vs 2019/20

580. The chart below shows the gas supplies by geographic location, illustrating that most gas continues to be supplied through Easington, St Fergus and Bacton, however the locational profile has changed to some extent. When compared to the previous year, there has been an increase in the volume of LNG supply entering the NTS in the West at Milford Haven.

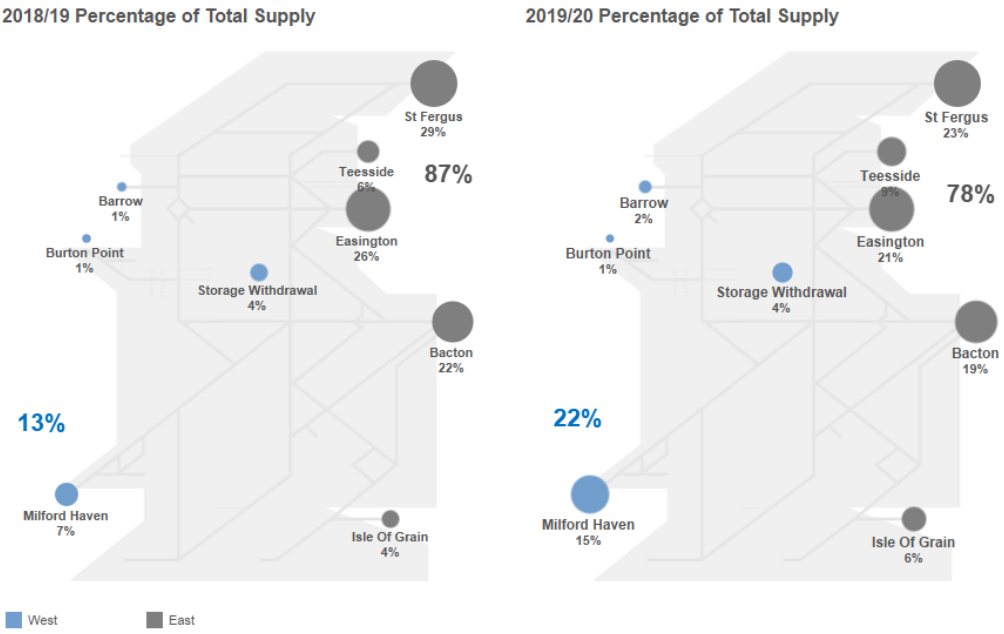


Figure 53: Supply profile by location for winter 2018/19 vs 2019/20

Compressor Utilisation

581. Overall compressor running hours have decreased significantly in 2019/20.

582. As a result of the changes in volume of supply by location, the regional profile of compressor running hours has changed, with a decrease in East/West and Scotland.

583. With an increase in LNG supply in 2019/20, and a reduction of supply from St Fergus and other parts of the network, this has led to a reduction in overall compressor running hours.

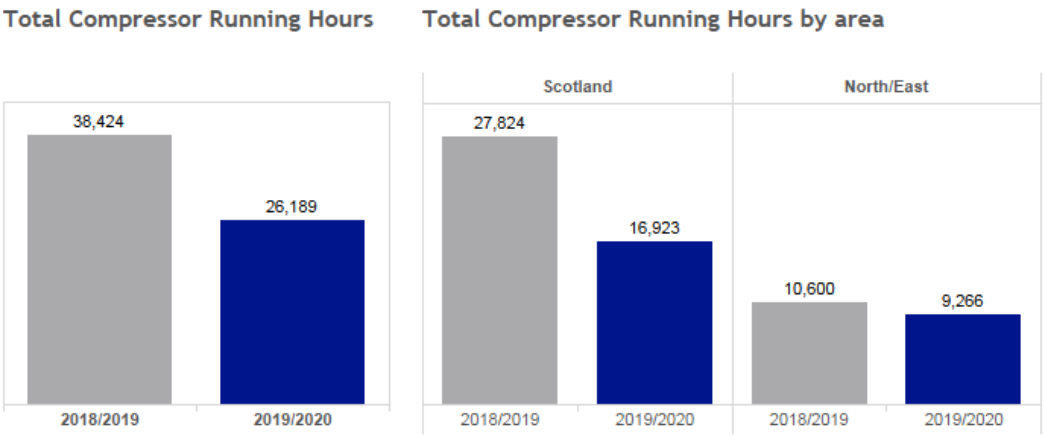


Figure 54: Compressor running hours 2018/19 vs 2019/20

Commercial Prices

584. Commercially, average gas prices were lower, both in the winter 2019/20 and summer 2019/20, than the previous year.

585. A number of factors can drive the change in price, one of which is the availability of global supplies. In 2019/20, the reduction in price was predominantly driven by an increase in LNG supplies.

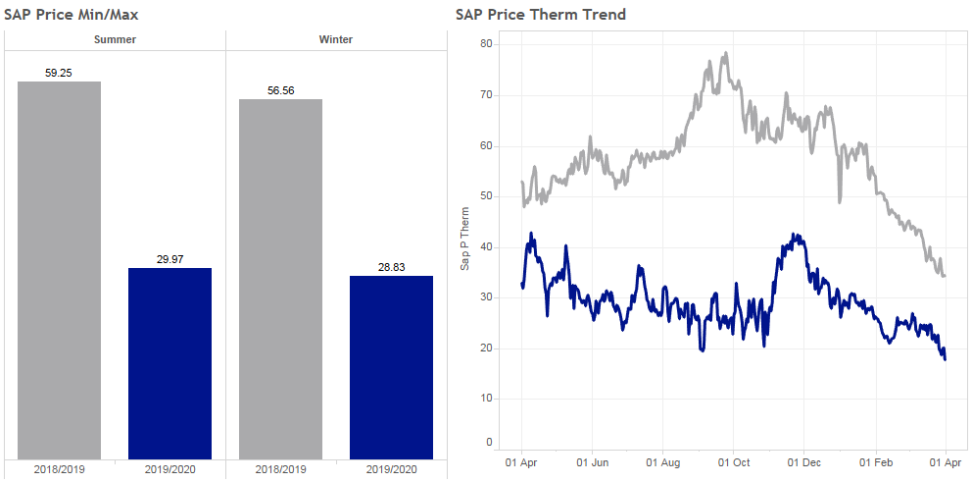


Figure 55: Daily SAP 2018/19 vs 2019/20

Comparison of NTS linepack swing

586. Within day profiling remains an ongoing issue for system operability, due to the design of the NTS and associated contractual rules, both of which have been designed for flat supply and demand profiles. It can therefore be challenging to meet customer requirements, in particular maintaining required pressures on days of large linepack swing.

587. When comparing the daily linepack swings recorded in 2019/20 versus 2018/19, the average linepack swings have increased slightly, with Winter 2019/20 producing the highest average swing recorded. As linepack swings have increased, the average frequency of residual balancing actions have also increased in 2019/20 compared to the previous year.

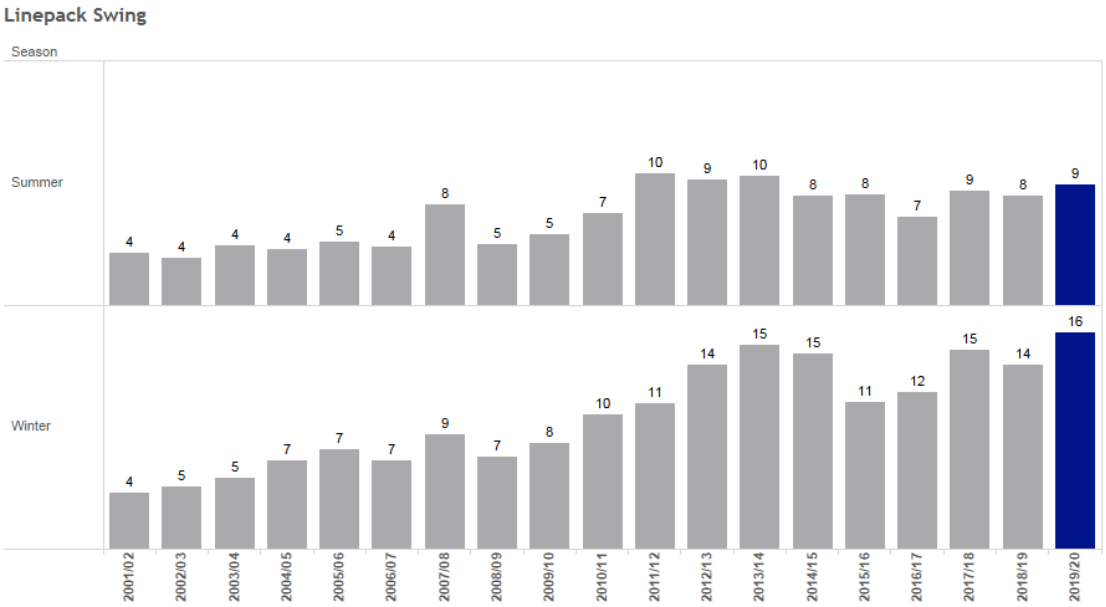
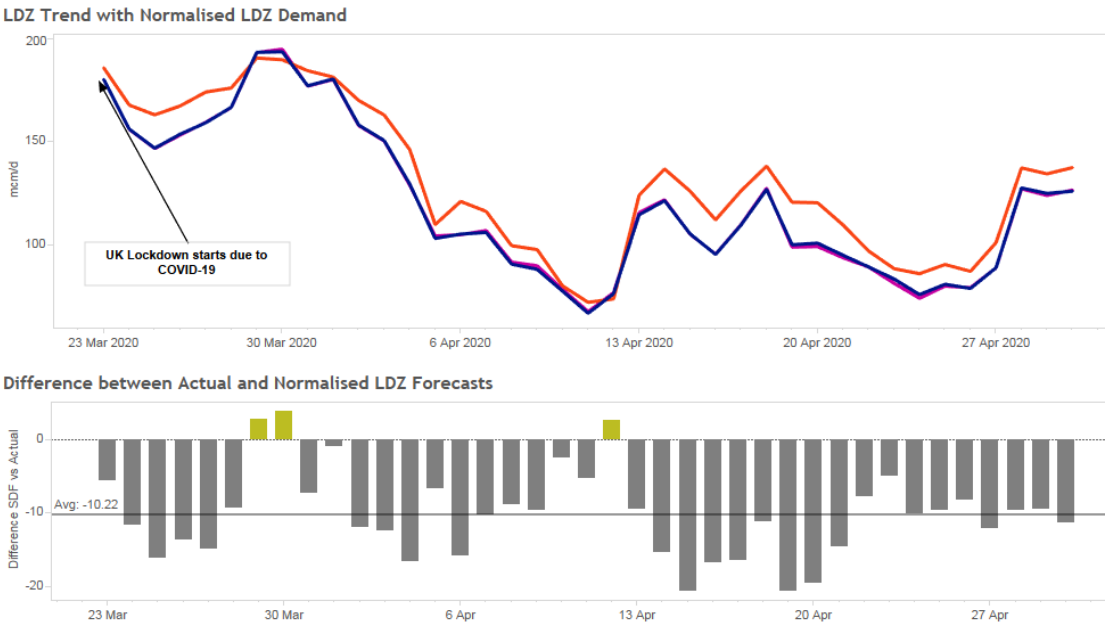


Figure 56: Chart showing average daily linepack swing since 2001/02

Impact of COVID-19 on Demand

588. To understand the impact the controls and restrictions associated with COVID-19 have on national demand, we have analysed our recent historic demand values and adjusted them based on our reasonable assumptions. On the same basis, we have forecast gas demand using both our normal forecasting models and those adjusted to include impacts related to COVID-19.

589. We are focusing on the LDZ components of demand, as controls for COVID-19 have a greater impact on domestic and embedded industrial components.



LDZ Actuals
LDZ Demand Forecast - Revised forecast incorporating changes in behavior in response to COVID-19
LDZ Normalised Demand Forecast - Forecast using only CWV and Rainfall to calculate the LDZ demand. This will NOT include changes in behavior in response to COVID-19

Figure 57: Chart showing LDZ demand and LDZ forecasts.

590. LDZ demand after the UK lockdown was on average 10mcm lower than the normalised forecast. The difference between these two is attributable to a reduction in demand from industrial facilities, coupled with a larger proportion of domestic properties inhabited.

Appendix I – Totex Tables

Totex
National Grid Gas Transmission
2019/20

2.4 Published Totex

Actual/Forecast Expenditure (£m, 2019/20 Prices)

		Actual	Actual	Actual	Actual	RIIO-T1 Forecast				
		2014	2015	2016	2017	2018	2019	2020	2021	Total
	Load Related Capex	4.0	1.6	1.5	1.9	2.8	2.5	8.3	1.6	24.2
TO	Asset Replacement Capex	64.9	62.0	83.6	105.8	133.7	116.1	66.4	78.3	710.9
	Other Capex	34.6	38.3	31.6	16.4	47.5	52.4	33.6	41.5	295.9
	Non Operational capex	14.2	13.4	15.0	24.2	19.3	22.5	23.7	16.5	148.8
	Total Capex	**117.7**	**115.4**	**131.8**	**148.3**	**203.3**	**193.4**	**131.9**	**138.0**	**1,179.8**
	Opex									
	Faults	9.9	6.9	3.5	4.7	5.2	8.0	6.8	5.7	50.8
	Planned Inspections and Maintenance	27.7	29.8	26.8	30.0	28.1	27.0	31.0	26.1	226.5
	Other direct costs	1.2	7.2	5.6	5.5	6.1	7.0	7.1	5.4	45.2
	Closely Associated Indirect Costs	24.6	21.6	26.6	32.8	34.2	47.8	24.6	33.5	245.7
	Business Support	25.9	27.9	31.7	34.1	39.3	40.9	43.1	37.4	280.4
	Adjustment for IAS 19 pension accrual	- 0.7	0.3	- 0.2	- 0.8	1.0	- 10.4	0.8	-	- 10.0
	Total Controllable Opex	**88.6**	**93.7**	**94.1**	**106.2**	**113.9**	**120.4**	**113.4**	**108.2**	**838.5**
	UNCERTAIN EXPENDITURE									
	Load Related Capex	-	-	-	-	-	-	-	-	-
	Asset Replacement Capex	-	5.2	3.3	33.7	57.7	42.8	27.2	11.4	181.3
	Other Capex	41.2	26.8	16.3	4.4	24.0	28.0	28.3	10.4	179.3
	Total Uncertain Capex	**41.2**	**32.0**	**19.6**	**38.1**	**81.7**	**70.8**	**55.5**	**21.8**	**360.6**
	Controllable Opex	6.9	4.9	6.9	8.7	11.2	9.0	8.1	7.1	62.8
TO	**TOTEX**	**254.4**	**246.0**	**252.3**	**301.3**	**410.1**	**393.5**	**309.0**	**275.1**	**2,441.7**
SO	**Non Operational capex**	23.9	36.8	48.2	36.1	28.0	33.5	37.6	27.8	271.8
	Direct costs	31.6	36.7	38.2	36.5	37.1	36.9	35.5	32.0	284.4
	Closely Associated Indirect Costs	9.3	11.4	10.0	11.4	9.5	5.7	7.3	8.3	73.0
	Business Support	15.6	14.4	16.2	17.4	16.2	20.3	20.7	28.6	149.4
	Adjustment for IAS 19 pension accrual	- 0.4	0.2	- 0.2	- 0.6	0.6	0.3	0.5	-	0.4
	Controllable Opex	**56.2**	**62.7**	**64.2**	**64.7**	**63.4**	**63.2**	**64.0**	**68.9**	**507.2**
SO	**TOTEX**	**80.0**	**99.4**	**112.4**	**100.8**	**91.4**	**96.8**	**101.6**	**96.7**	**779.1**

Total Allowances (£m, 2019/20 Prices)

		RIIO-T1 Allowances								
		2014	2015	2016	2017	2018	2019	2020	2021	Total
	Load Related Capex	20.4	8.3	1.7	1.4	8.0	6.8	0.3	-	46.9
TO	Asset Replacement Capex	117.0	136.8	125.5	120.4	141.2	113.1	70.5	68.9	893.5
	Other Capex	36.2	24.5	14.5	17.0	43.1	44.0	27.6	8.7	215.5
	Non Operational capex	13.9	13.0	8.9	8.3	7.5	5.6	8.6	7.9	73.8
	Total Capex	**187.5**	**182.6**	**150.6**	**147.1**	**199.8**	**169.6**	**107.1**	**85.5**	**1,229.7**
	Faults	8.7	8.8	8.9	8.9	9.0	9.0	9.1	9.2	71.6
	Planned Inspections and Maintenance	30.6	30.8	31.8	31.7	32.2	32.4	33.5	33.0	256.0
	Other direct costs	11.8	10.1	15.3	27.9	34.9	33.3	24.9	19.7	177.8
	Closely Associated Indirect Costs	20.5	21.3	22.2	22.0	22.3	22.2	22.3	22.6	175.4
	Business Support	20.0	19.5	20.0	20.3	20.2	20.5	20.9	21.2	162.7
	Adjustment for IAS 19 pension accrual									
	Total Controllable Opex	**91.6**	**90.6**	**98.2**	**110.8**	**118.6**	**117.5**	**110.8**	**105.7**	**843.5**
	UNCERTAIN EXPENDITURE									
	Load Related Capex	-	-	-	-	-	-	-	-	-
	Asset Replacement Capex	-	-	-	-	-	-	-	-	-
	Other Capex	- 5.2	- 1.8	1.4	- 3.5	- 6.1	- 15.0	- 8.2	9.5	- 28.9
	Total Uncertain Capex	**- 5.2**	**- 1.8**	**1.4**	**- 3.5**	**- 6.1**	**- 15.0**	**- 8.2**	**9.5**	**- 28.9**
	Controllable Opex	**5.4**	**3.7**	**2.2**	**2.6**	**6.5**	**6.6**	**4.1**	**1.3**	**32.3**
TO	**TOTEX**	**279.3**	**275.1**	**252.3**	**256.9**	**318.7**	**278.7**	**213.8**	**201.9**	**2,076.6**
SO	**Non Operational capex**	**72.1**	**43.6**	**36.9**	**37.6**	**37.1**	**43.3**	**43.3**	**36.1**	**350.0**
	Direct costs	59.4	62.3	68.3	70.1	64.1	67.8	69.0	68.1	529.3
	Business Support	-	-	-	-	-	-	-	-	-
	Adjustment for IAS 19 pension accrual									
	Controllable Opex	**59.4**	**62.3**	**68.3**	**70.1**	**64.1**	**67.8**	**69.0**	**68.1**	**529.3**
SO	**TOTEX**	**131.5**	**105.9**	**105.2**	**107.7**	**101.3**	**111.1**	**112.3**	**104.2**	**879.2**

Variance Actual/Forecast v Allowances

		Variance to Allowance								
		2014	2015	2016	2017	2018	2019	2020	2021	Total
	Load Related Capex	16.4	6.6	0.1	- 0.4	5.2	4.3	- 8.0	- 1.6	22.7
TO	Asset Replacement Capex	52.1	74.8	41.9	14.5	7.4	- 2.9	4.1	- 9.4	182.6
	Other Capex	1.6	- 13.8	- 17.2	0.6	- 4.4	- 8.3	- 5.9	- 32.9	- 80.3
	Non Operational capex	- 0.3	- 0.4	- 6.1	- 15.9	- 11.8	- 16.8	- 15.1	- 8.6	- 75.1
	Total Capex	**69.8**	**67.2**	**18.8**	**- 1.2**	**- 3.6**	**- 23.8**	**- 24.9**	**- 52.5**	**49.9**
	Faults	- 1.2	1.9	5.4	4.2	3.8	1.0	2.3	3.5	20.8
	Planned Inspections and Maintenance	2.8	1.1	5.0	1.7	4.1	5.4	2.5	6.9	29.4
	Other direct costs	10.6	2.9	9.7	22.4	28.8	26.3	17.8	14.2	132.7
	Closely Associated Indirect Costs	- 4.0	- 0.2	- 4.5	- 10.8	- 11.9	- 25.6	- 2.3	- 11.0	- 70.3
	Business Support	- 5.9	- 8.5	- 11.7	- 13.7	- 19.0	- 20.4	- 22.2	- 16.3	- 117.7
	Adjustment for IAS 19 pension accrual	0.7	- 0.3	0.2	0.8	- 1.0	10.4	- 0.8	-	10.0
	Total Controllable Opex	**3.0**	**- 3.1**	**4.1**	**4.6**	**4.6**	**- 2.9**	**- 2.7**	**- 2.6**	**5.0**
	UNCERTAIN EXPENDITURE									
	Load Related Capex	-	-	-	-	-	-	-	-	-
	Asset Replacement Capex	-	- 5.2	- 3.3	- 33.7	- 57.7	- 42.8	- 27.2	- 11.4	- 181.3
	Other Capex	- 46.4	- 28.6	- 14.9	- 7.9	- 30.1	- 43.0	- 36.5	- 0.9	- 208.2
	Total Uncertain Capex	**- 46.4**	**- 33.7**	**- 18.2**	**- 41.6**	**- 87.8**	**- 85.8**	**- 63.7**	**- 12.3**	**- 389.5**
	Controllable Opex	- 1.5	- 1.2	- 4.7	- 6.1	- 4.7	- 2.4	- 4.0	- 5.8	- 30.4
TO	**TOTEX**	**24.9**	**29.1**	**- 0.0**	**- 44.3**	**- 91.5**	**- 114.8**	**- 95.2**	**- 73.2**	**- 365.1**
SO	**Non Operational capex**	48.2	6.8	- 11.2	1.4	9.2	9.7	5.7	8.3	78.2
	Direct costs	27.8	25.7	30.1	33.6	27.1	31.0	33.6	36.1	244.9
	Business Support	- 15.6	- 14.4	- 16.2	- 17.4	- 16.2	- 20.3	- 20.7	- 28.6	- 149.4
	Adjustment for IAS 19 pension accrual	0.4	- 0.2	0.2	0.6	- 0.6	- 0.3	- 0.5	-	- 0.4
	Controllable Opex	3.2	- 0.3	4.1	5.5	0.7	4.6	5.1	- 0.8	22.0
SO	**TOTEX**	**51.4**	**6.5**	**- 7.1**	**6.9**	**9.9**	**14.3**	**10.8**	**7.5**	**100.2**

Appendix II – Published Outputs

Totex
National Grid Gas Transmission
2019/20

2.5 Published Outputs

1. Stakeholder Satisfaction

	2014	2015	2016	2017	2018	2019	2020	2021
NGGT Customer survey - baseline	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9
NGGT Customer survey - score	7.2	7.6	7.6	8.0	7.6	7.8	8.0	-
Stakeholder survey - baseline	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4
Stakeholder survey - score	7.8	7.9	8.0	8.0	8.0	8.1	8.4	-

2. Incremental Capacity

	2014	2015	2016	2017	2018	2019	2020	2021
Signals for incremental capacity (GWh/day)								
Entry								
Exit								
PARCA Termination Value (£m)	0.0	0.0	0.0	(0.0)	(0.1)	0.0	0.0	0.0

3. Gas Constraints

	2020
Constraint management revenues - Entry	3.3
Constraint management revenues - Exit	1.0
Constraint management costs - Entry	0.7
Constraint management costs - Exit	0.0

Legal disclaimer

This document contains certain statements that are neither reported financial results nor other historical information. These statements are forward-looking statements within the meaning of Section 27A of the Securities Act of 1933, as amended, and Section 21E of the Securities Exchange Act of 1934, as amended.

These statements include information with respect to National Grid plc's financial condition, its results of operations and businesses, strategy, plans and objectives. Words such as 'anticipates', 'expects', 'should', 'intends', 'plans', 'believes', 'outlook', 'seeks', 'estimates', 'targets', 'may', 'will', 'continue', 'project' and similar expressions, as well as statements in the future tense, identify forward-looking statements.

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