national gas transmission

Annual Network Capability Assessment Report (ANCAR)

June 2024

Welcome

How to use this document

We have published the ANCAR Report 2023 as an interactive document.

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Words in green and underlined have links to other pages in this document, or are URLs.

Welcome to the latest issue of the Annual Network Capability Assessment Report (ANCAR).

Your feedback is so important to us ⊕

About this publication

The National Transmission System (NTS) is essential in providing consumers with secure access to energy, both gas and electricity. It connects the critical components of supply, storage, and demand to keep homes warm, keep businesses running, keep exports flowing, and through flexible gas-fired generation, keep the lights on when renewables are unavailable.

Our Network Capability process enables us to calculate and demonstrate the physical capability of the NTS and assess whether this meets our customer requirements and associated obligations across GB for the foreseeable future.

This assessment is carried out against a range of future supply and demand scenarios using a range of inputs and data including the Future Energy Scenarios (FES) outputs produced by the Electricity System Operator (ESO). The output of this assessment helps inform and evaluate potential changes to physical assets through our Network Development Process to ensure continued safe and economic operation of the NTS in meeting our obligations and customers' needs.

As outlined in our Gas Ten Year Statement in November 2023, this ANCAR uses FES 2023 outputs from all four FES scenarios: Leading the Way, Consumer Transformation, System Transformation and Falling Short, for consistency with previous ANCAR publications. Most of the flame charts are unchanged from Gas Ten Year Statement, however some of the capability lines have been updated to reflect our latest analysis and assumptions.

Whilst the FES provide us with detailed insight and analysis, there are a number of uncertainties around the data it contains and how relevant it still is for our forward view in National Gas Transmission. Due to these uncertainties, we may use different sets of data in our other publications or documents. For example, for the RIIO-GT3 business plan, we expect to focus on the Falling Short FES scenario as it is our opinion that the Falling Short scenario is the most relevant data set for this document, and demonstrates what we should plan against to ensure continued network security.

Following the Energy Act 2023, the National Energy System Operator (NESO) will be formed and will be engaging in the area of network capability for the gas network. NGT is looking forward to working closely with NESO on their future publications as well as continuing to publish our view on system capability requirements through other publications and our business plans.

The main findings of this year's ANCAR are:

- **The range of physical capability currently available on the network is generally consistent with the network requirements, demonstrated by the supply and demand scenarios we have utilised from FES as well as the sensitives we have applied.**
- **Investment in improving network resilience is crucial to ensure we can maintain safe and efficient operation of the network and meet our customer requirements and associated obligations across GB for the foreseeable future.**
- **As is consistent with previous ANCAR publications, additional capability investment is needed for the South Wales zone to ensure the network can accommodate increasing supplies of imported gas. The Western Gas Network upgrade and the new compressor unit at Wormington both contribute towards increasing resilience in this zone.**
- **Expected increases in LNG imports and interconnector exports in the South East have led to a demonstrable requirement for an increase in capability for the region. We have therefore switched our focus in terms of the region's entry capability from Bacton to Isle of Grain, as this is the more likely source of a constraint.**

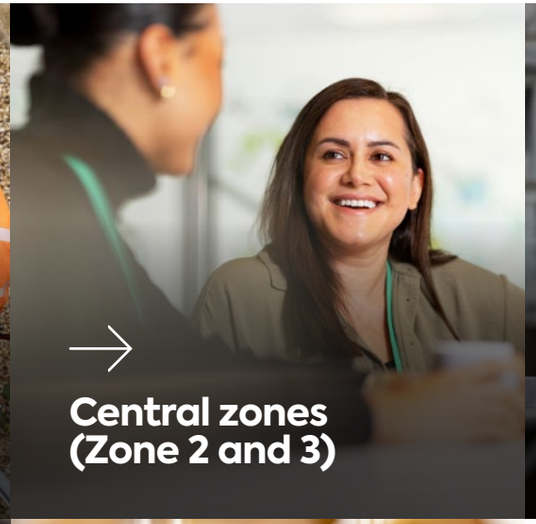
Our RIIO-GT3 business plan submission is currently being developed and will be submitted later this year. As such, specific network development proposals will not be explored as part of this ANCAR document. Any proposed developments will be highlighted in our RIIO-GT3 business plan, supported by the most appropriate and up to date forecasting and modelling available.

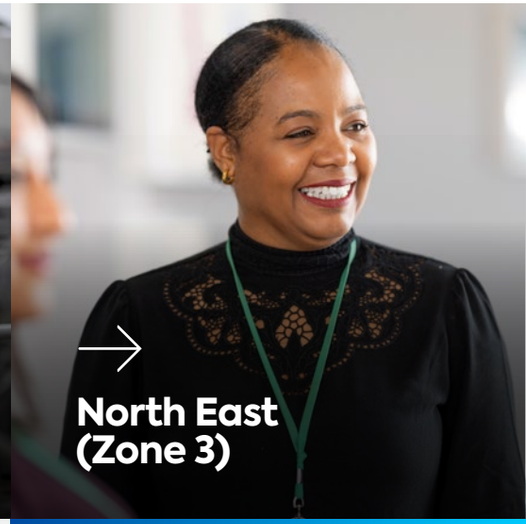
Resilience

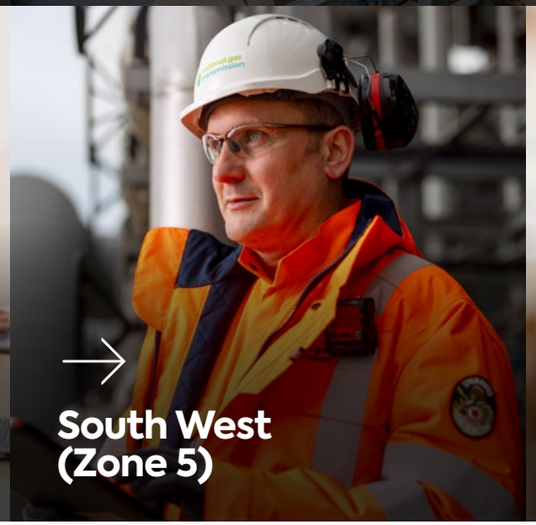
In response to your feedback, we have recently been focusing our analysis developments on assessing and demonstrating network resilience and compressor availability.

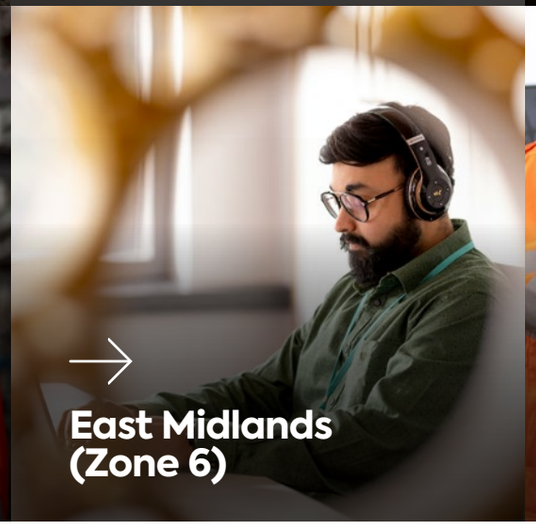
The flame charts historically shown in this report have reflected an asset base that is 100% reliable and available. Last year the concept of resilience was introduced, and this report now includes flame charts featuring resilience lines. For more details on what these lines mean and how they are calculated, please refer to ANCAR 2023.

Collaboration with you, our stakeholders, will remain a key focus to help us evolve and improve the information we provide. Ultimately, the documents we publish are for you, so please let us know what elements of this publication have been most useful, and what you'd like to see incorporated into future publications. If you'd like to get in touch, please send us an email at Box.OperationalLiaison@nationalgas.com









Appendix

Glossary

Network capability and resilience

The capability lines are based on the current network, including any future asset investments, for which we received funding in the RIIO-2 regulatory period.

As well as delivering entry and exit capability within the zone they are located, compressors are also essential for moving gas through a zone to relieve pressure increases at entry points, satisfy demand and raise pressure at exit points across the whole wider network. We continuously review our investment and maintenance plans to ensure the compressor fleet is resilient and delivers value to consumers. We seek to optimise operation of the system using rules, tools and assets to minimise and mitigate possible constraints where it is economic to do so.

We must ensure that we can maintain security of supply, as per Standard Special Condition A9: Pipe-Line System Security Standards which outlines our 1-in-20 obligation. Failing to meet our obligations has serious consequences for consumers and the integrity of the network.

Over the next ten years it is proposed that our compressor fleet's operational units will reduce, mainly due to the Medium Combustion Plant Directive (MCPD) emissions legislation. Despite this reduction in units, we will maintain our intact network capability but it does remove some of the system's resilience and therefore could reduce the level of certainty that the network capability required can be achieved on a given day.

There may also be opportunities to disconnect or decommission certain compressor units, where this does not compromise the required network capability or overall network resilience, the compressors can be decommissioned and not replaced. The units that are still required to provide resilience to the main operating units at compressor sites will be retained. A decision on whether these are maintained, derogated, or replaced will be made as part of our Asset Management Planning process which will inform our RIIO-GT3 business plan submission.

The high resilience lines assume that National Gas receives funding to maintain the level of resilience we expect to have at the end of the RIIO-2 period (2026). This will be a key part of our RIIO-GT3 business plan submission in terms of the level of resilience required across the network and how this interacts with the government's and Ofgem's view of an onshore infrastructure standard, as highlighted in the Energy Security Plan that was published in March 2023.

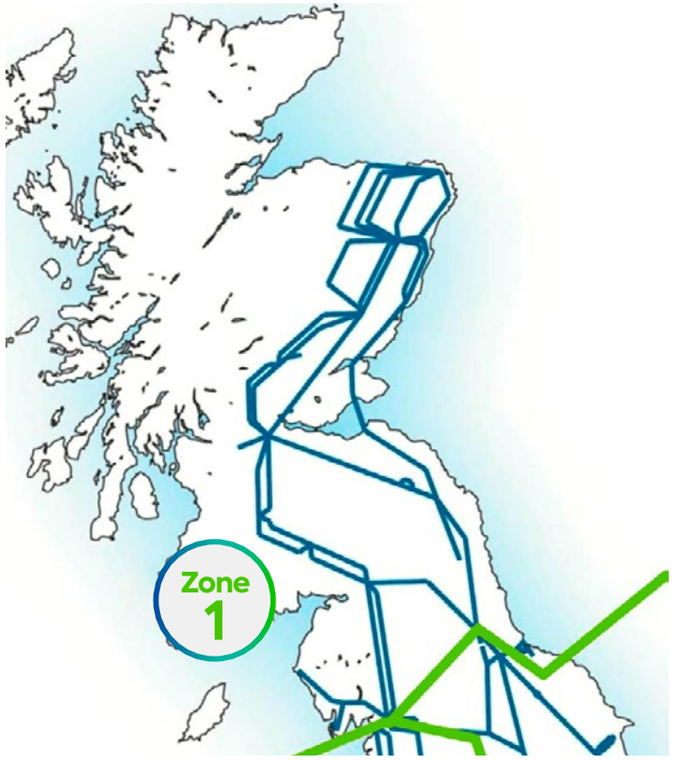
Out to 2033, the analysis and flame chart visualisations continue to support the need for planned asset investments, for which we received funding in the RIIO-2 regulatory period. The range of physical capability is consistent with the requirements demonstrated by the supply and demand scenarios from FES with the assets we expect to be available on the network.

As supplies from the UK Continental Shelf (UKCS) decline from their peak levels, we may have less reliance on some of the compressor units in Scotland and the North. We will therefore continue to consider decommissioning those that were previously required to meet sustained higher St Fergus entry flows. It's important to note that other compressors in this area are still critical to maintain exit pressures for both distribution network offtakes and industrial customers connected to the NTS. There may also be a future requirement to reverse compression to increase flow capability from South to North in order to maintain these pressures.

Scotland and The North (Zone 1)

Scotland and The North (Zone 1)

Zone 1



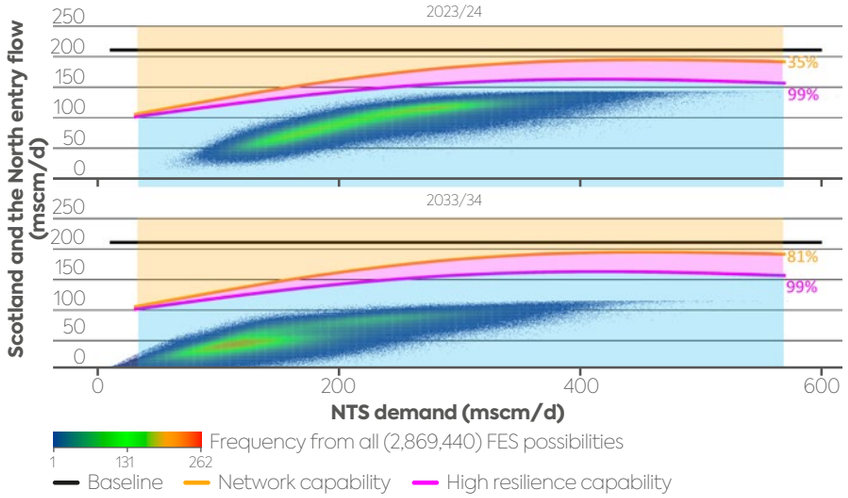
Entry

Figure 1 shows that both the intact and high resilience lines are above future expected entry flows. This indicates that Scotland and The North's entry capability is sufficient to meet current and future requirements.

There is a reduction in zone entry flows as UKCS supplies are forecast to decline. This is reflected in the 2034 chart by the lowering of the flame's position and a greater concentration of flow frequency towards the lower demand levels as national demand decreases.

We will continue to review our future compression strategy in Scotland and the North as we develop our RIIO-GT3 business plan and potentially reassess the high resilience and intact capability lines as our plans develop.

Figure 1
Scotland and the North entry capability



Scotland and The North (Zone 1)

Exit

Figure 2 shows our Scottish exit capability against NTS demand.

Scotland security of supply

With the network having limited capability to transport gas from South to North, the decline in entry flows will make it difficult to meet our exit commitments in Scotland. To assess the required capability, we annually review supplies from the St Fergus terminal against demand in Scotland. This is because we have no compression capability to move the supplies from Teesside, the North East and the North West towards the areas of high demand in Scotland.

For 2033/34, Figure 3 shows that we expect the maximum flow through the St Fergus terminal to reduce compared to today's flows and there are now some plausible circumstances with very low or zero flows from the terminal. A number of them are beyond our current levels of exit capability and would lead to scenarios where the demand cannot be met on the system without intervention. We are reviewing options as part of our RIIO-GT3 business plan, where we may put forward recommendations to mitigate constraints or failure to supply risk.

Figure 2
Scotland and The North exit capability against NTS demand for 2023/24 and 2033/34

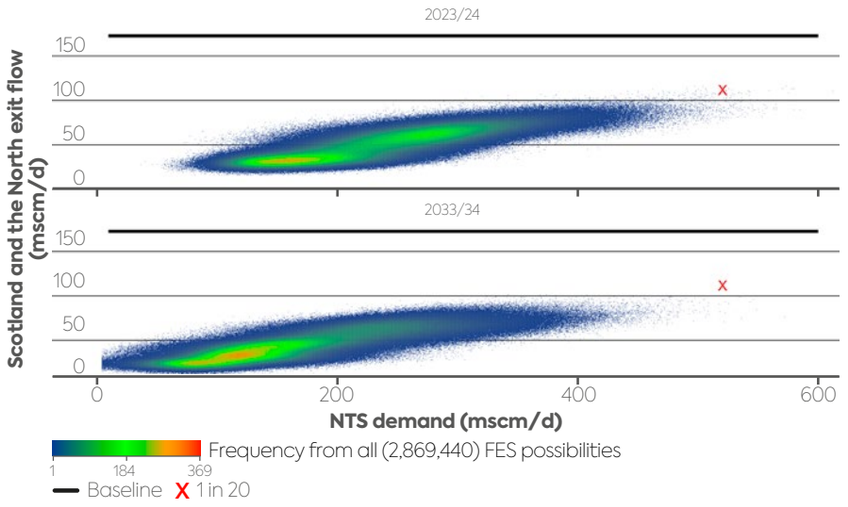
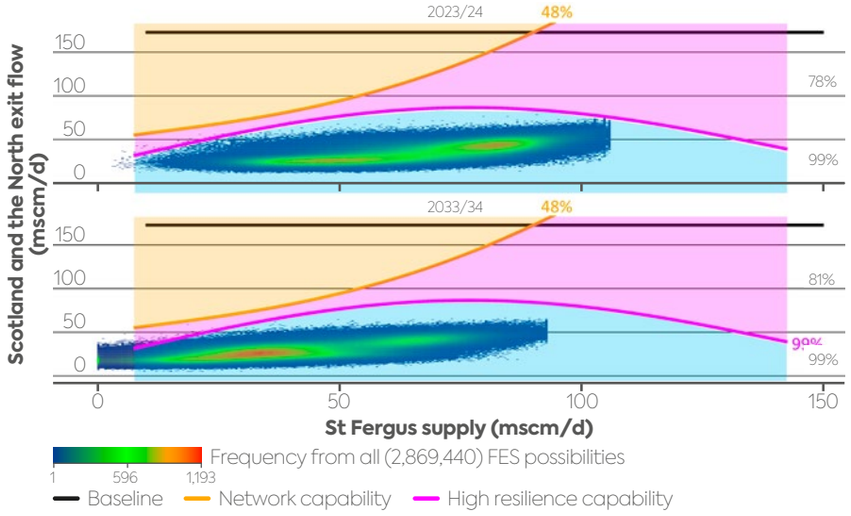


Figure 3
Scotland and the North's supply and demand



Scotland and The North (Zone 1)

Compressor Station Availability and Constraint Days

Figure 4 shows the zonal and station availability for Zone 1 entry, both now and at the end of RIIO-2. The current availability of all stations in the zone is 35%, with that number increasing to 81% by the end of RIIO-2. Our current intact figure of 35% is lower than we would expect for the region and is largely due to station outages at Aberdeen which have now been resolved.

The current intact availability for Zone 1 is quite low, due primarily to the low availability at Aberdeen and Wooler compressor stations. The increase in availability by the end of RIIO-2 is due to planned asset health work across the compressor stations, with the greatest increase being at the Aberdeen compressor station.

Figure 5 shows the zonal and station availability for Zone 1 exit, now and at the end of RIIO-2. The current intact availability for exit is 48% and we expect this to remain unchanged by the end of RIIO-2.

Please note: we calculate the exit capability for this zone differently, as Wooler compressor station and Kirriemuir Unit E are both unsuitable for supporting exit flows. This is due to the fact that Wooler compressor station primarily directs gas out of Zone 1 and Unit E at Kirriemuir is not designed to operate with low St Fergus flows. We have therefore removed them from our availability calculations in Figure 5.

Figure 4
Scotland and The North station availabilities for Entry

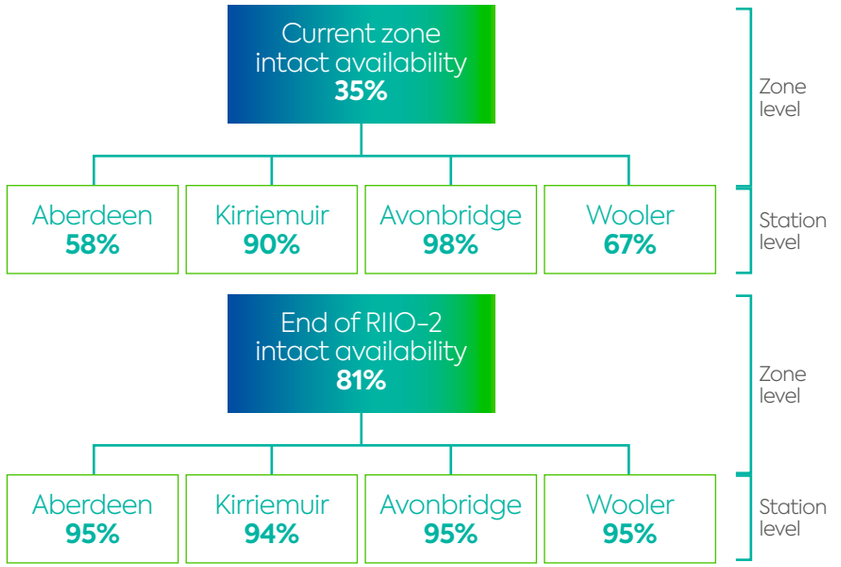
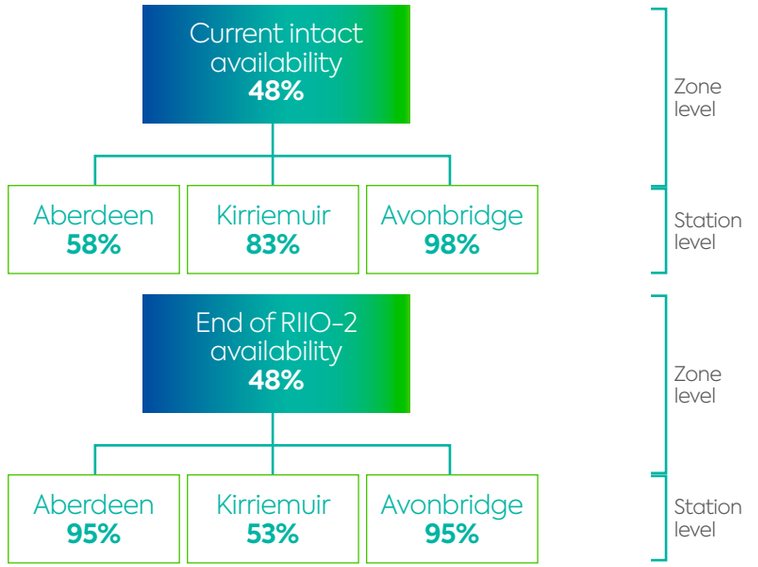


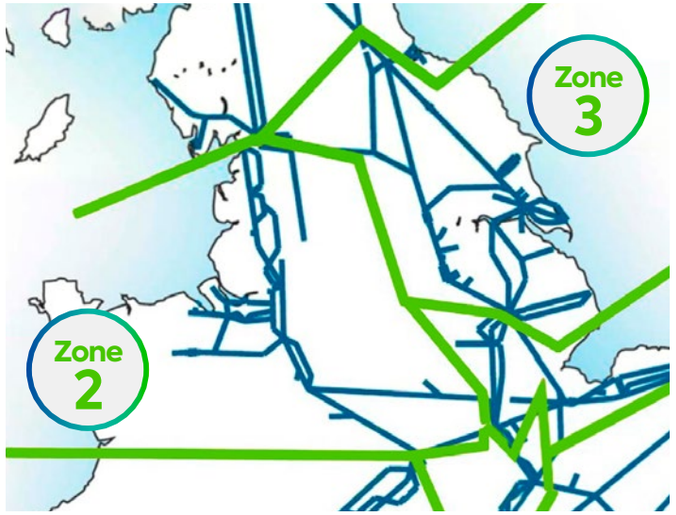
Figure 5
Scotland and The North station availabilities for Exit



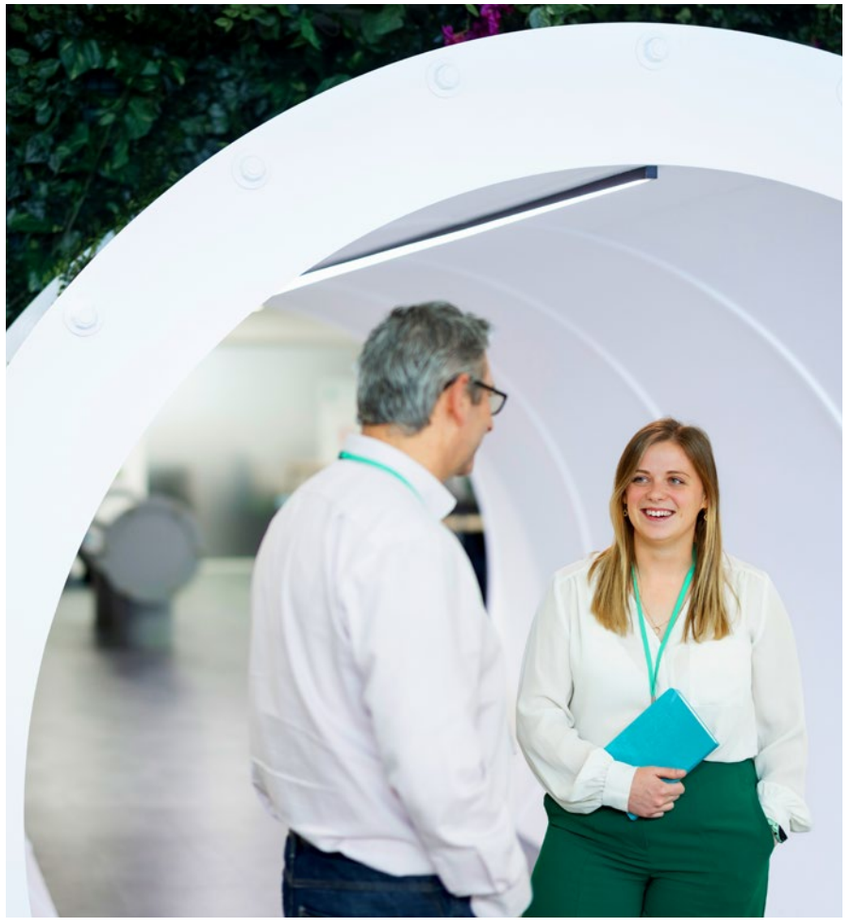
Central Zones (Zone 2 and 3)

Central Zones (Zone 2 and 3)

Zone 2 and 3



The North East and the North West (Zones 2 and 3) are grouped together in this additional section of the report to reflect the way they operate within the NTS. Relative to other zones, the expected exit and entry flows in these zones is small, however they are considered transit zones and are required for interzonal flow. Compression in this region is required to support entry flows in Scotland and The North, as well as exit flows in the zones to the south. In this section, we primarily explore how these Central zones impact Zone 1.



Central Zones (Zone 2 and 3)

Central Entry

Figure 6 uses the same entry capability graph as figure 1, but with a new high resilience line that represents the effect that Central compressor resilience has on Scottish and North entry capability. We have done this to illustrate how Central compression supports interzonal flows and demonstrate what losing this compression looks like for Scottish entry capability. We can see here that whilst partial loss of central compression has a minor effect on the entry capability of Zone 1, both lines are above the flame. We therefore don't expect to see any constraints.

Figure 7 includes a combined high resilience line that illustrates the effect that both Scottish and Central compression has on entry capability. The new high resilience line is much lower than both the Scottish and Central high resilience lines, further illustrating the impact that compression in these zones has on Scottish entry capability – i.e. loss of compression in both zones would have a greater impact than loss of compression in an individual zone. The high resilience line is, however, above the flame showing that we have a good level of resilience – we therefore do not expect entry constraints in Zone 1 if there is a loss of compression in these zones. We will be looking to maintain this level of resilience in RIIO-GT3.

Figure 6
Scotland and the North entry capability with Central compression capability

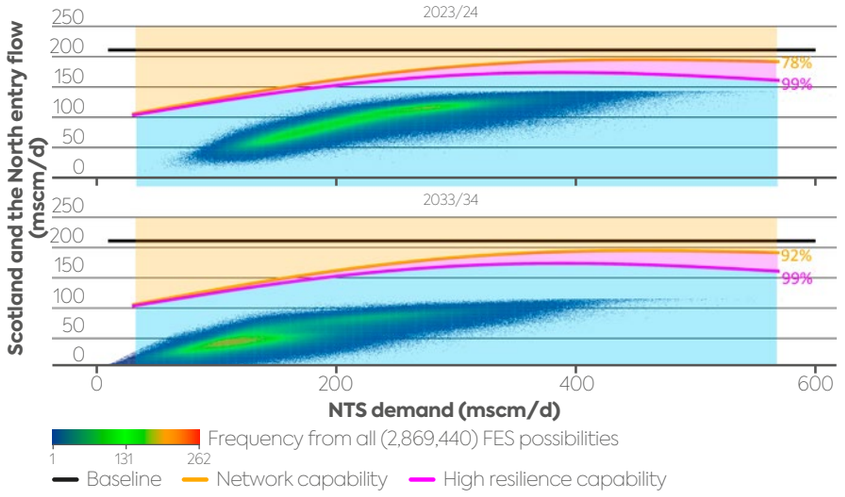
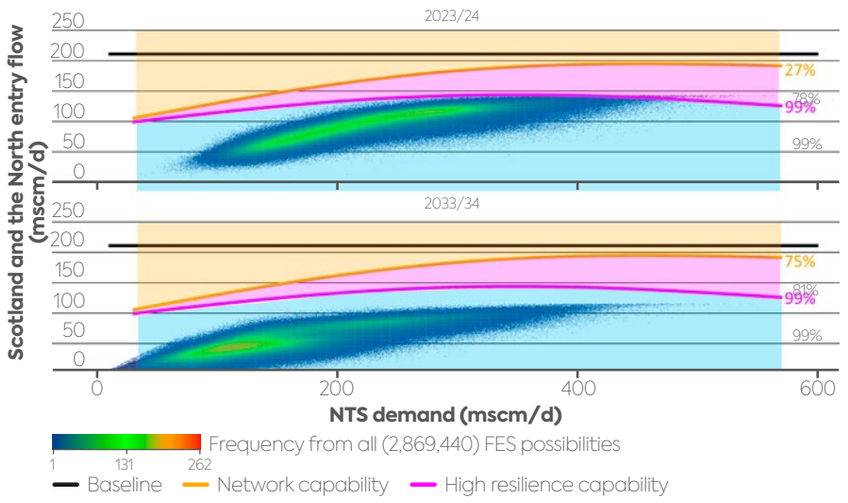


Figure 7
Scotland and the North entry capability with combined Scottish and Central Compression resilience considered

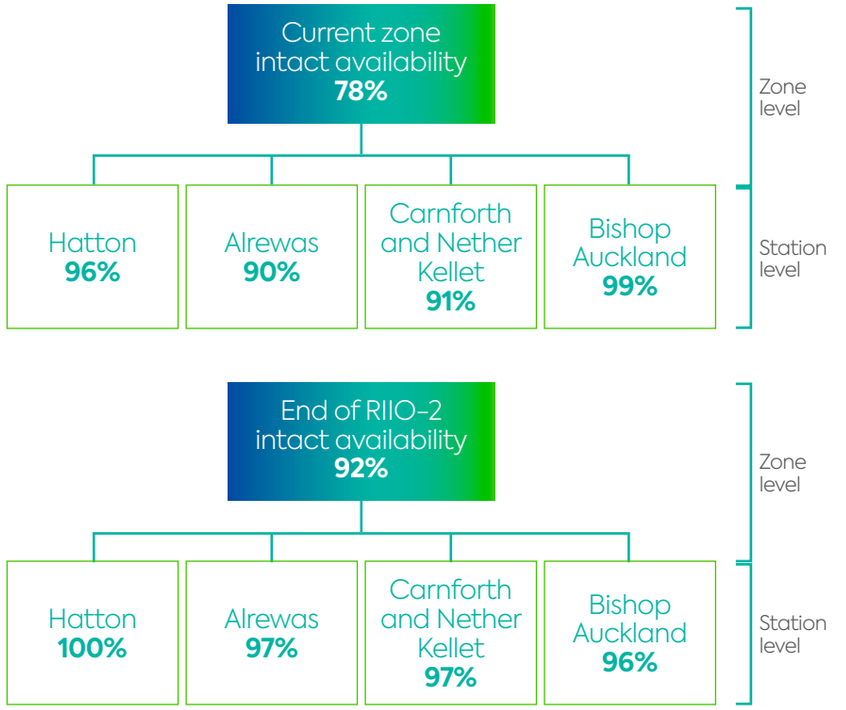


Central Zones (Zone 2 and 3)

Central (Zone 2 and 3) Compressor Availability

Figure 8 shows the availability of compressors used to support the Central zones. We combine the zones when examining availability as they are strongly linked to each other, with compressor conditions affecting both regions. We currently expect high compressor site availability in this zone with a high zonal availability as well. We expect this availability percentage to improve by the end of RIIO-2, primarily due to improvements at Alrewas, the Carnforth and Nether Kellet compressor stations.

Figure 8
Central zones compressor availabilities – current and end of RIIO-2



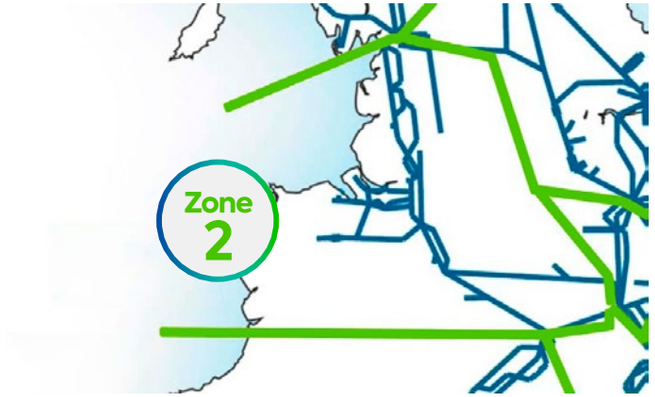
North West (Zone 2)

Entry

Exit

North West (Zone 2)

Zone 2

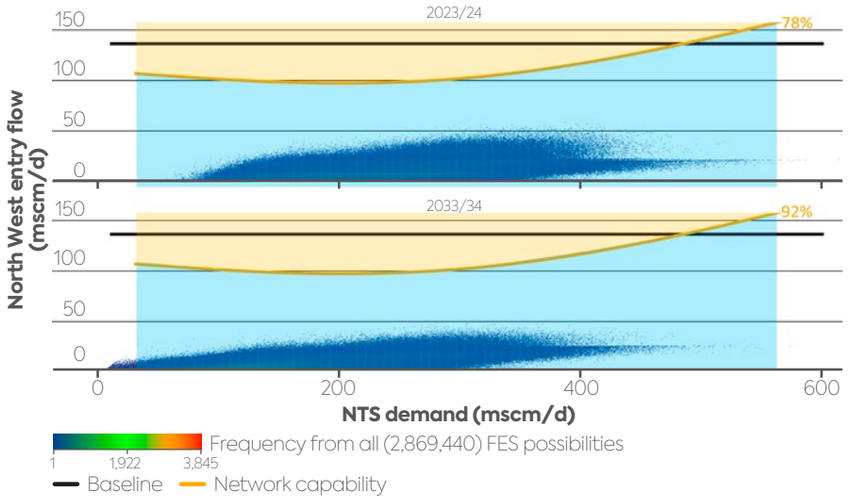


Entry

Figure 9 indicates that the North West entry capability is sufficient to meet the entry requirements both now and in the next ten years as there is minimal change in the range of entry flows between the decades. There is no high resilience line on this chart because the intact network capability is always available due to lack of reliance on compressors for entry. Therefore, no constraints are expected in this zone.

However, for this zone, the flame chart only shows a part of the capability requirement, as the North West is a transit zone for moving gas from North to South. There is an interzonal flow requirement which is not reflected in the entry capability charts, which currently only display only entry point flows within the zone and not pipeline flows from other zones. Consequently, the better way of assessing the capability required is by combining this zone with other central zones and assessing the impact of asset resilience in adjacent zones, as explored in section 3.

Figure 9
North West entry capability for 2023/24 and 2033/34



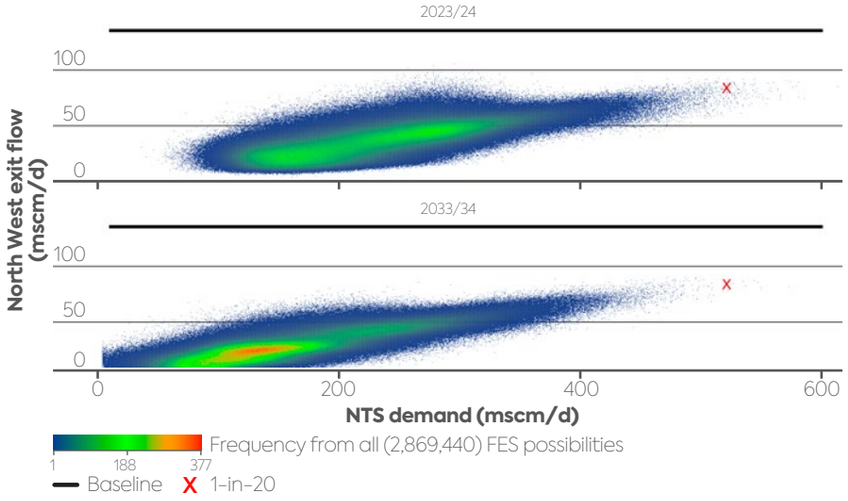
North West (Zone 2)

Exit

The North West network has sufficient capability to meet the exit requirements required both now and in the next ten years. The North West is a transit zone and as such is not expected to be the first area of the network to fail under typical circumstances, therefore zonal resilience is not considered. The range of the 2033/2034 flow patterns is similar to the 2023/2024 flow patterns, although the range of potential flows at any given NTS demand level has reduced.

There is a more pronounced concentration of flow frequencies towards the lower NTS demand levels and fewer flows at the top end, although zonal demands have only slightly reduced.

Figure 10
North West exit capability for 2023/24 and 2033/34



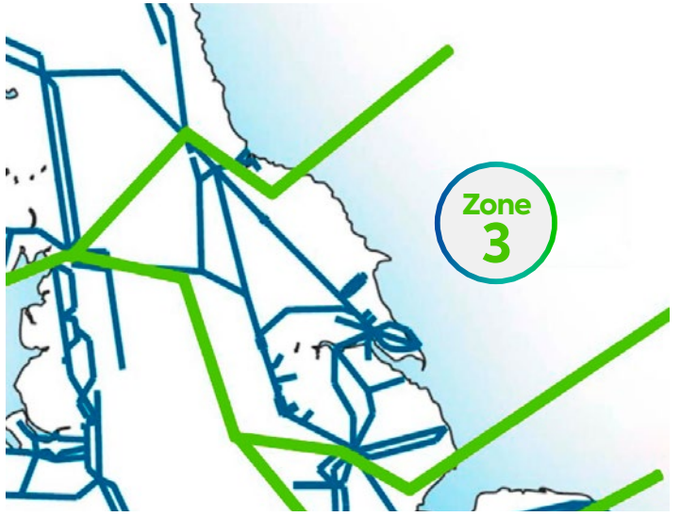
North East (Zone 3)

Entry

Exit

North East (Zone 3)

Zone 3



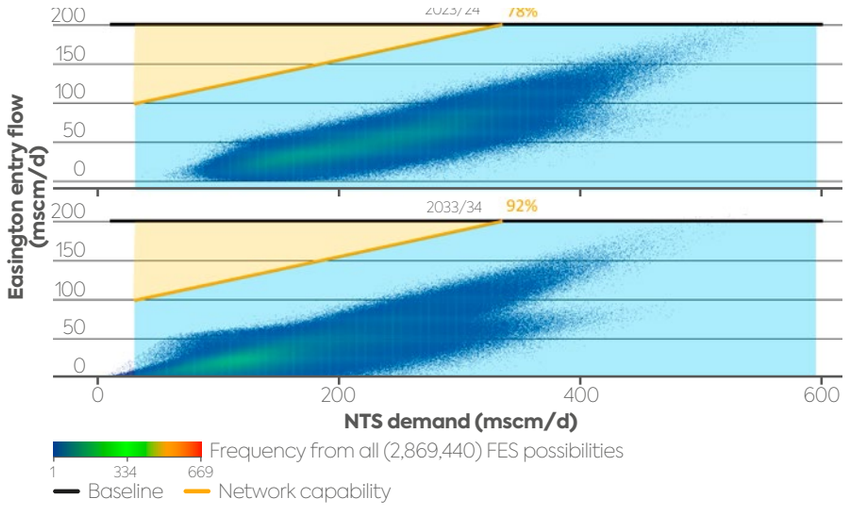
Entry

Figure 11 indicates that the North East entry capability is sufficient to meet the entry requirements both now and in the next ten years. There is a slightly more pronounced concentration of flow frequencies towards the lower NTS demand levels in 2034 and fewer flows at the extreme top end of NTS demand levels. The demand changes are believed to be due to expected reductions in gas demand.

The entry capability line for this region is above the expected flows in all the scenarios and therefore no constraints are expected. There is no high resilience capability line on this chart because compressors are not relied upon for entry capability in this zone.

However, for this zone, the flame chart only shows a part of the capability requirement as the North East is a transit zone for moving gas from north to south. There is an interzonal flow requirement which is not reflected in the entry capability charts, which currently only display only entry point flows within the zone and not pipeline flows from other zones. Consequently, the better way of assessing the capability required is by combining this zone with other central zones and assessing the impact of asset resilience in adjacent zones, as explored in section 3.

Figure 11
North East entry capability for 2023/24 and 2033/34

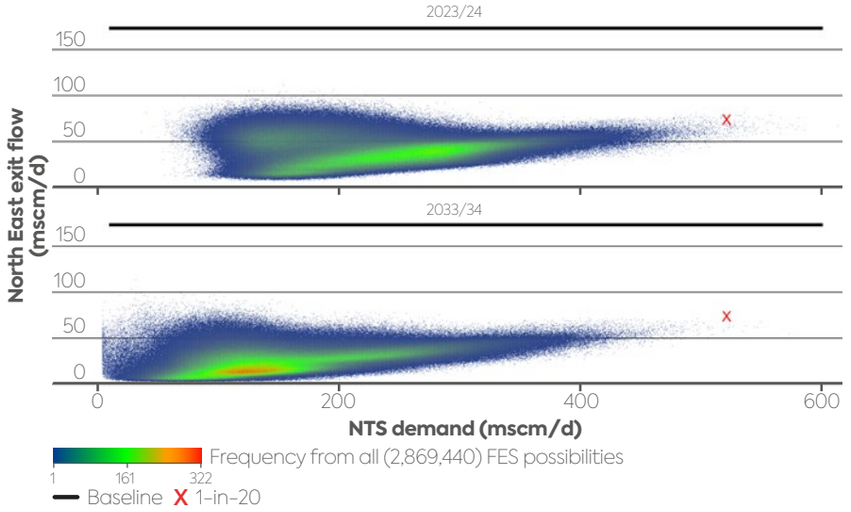


North East (Zone 3)

Exit

The North East regions network has sufficient capability to meet the exit requirements required both now and in the next ten years. The North East is a transit zone and as such is not expected to be the first area of the network to fail under typical circumstances, therefore zonal resilience is not considered. The range of the 2033/2034 flow pattern is similar to the 2023/2024 flow pattern, although the range of potential flows at any given NTS demand level has reduced. There is a much more pronounced concentration of flow frequencies towards the lower NTS demand levels and fewer flows at the top end of NTS demand levels, whilst zonal demands remain only slightly reduced.

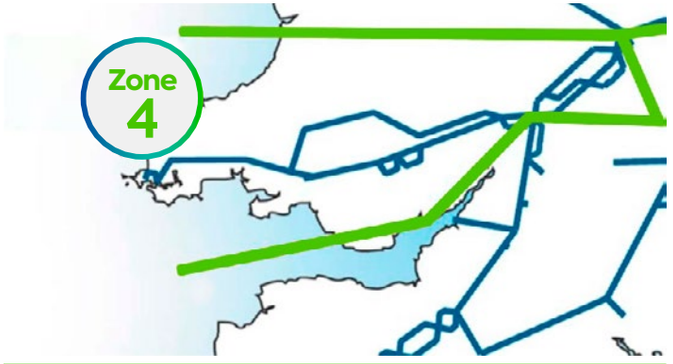
Figure 12
North East exit capability for 2023/24 and 2033/34



South Wales (Zone 4)

South Wales (Zone 4)

Zone 4



Entry

The entry capabilities for South Wales shown in Figures 13 and 14 indicate scenarios where supply is above intact and high resilience capability both now and in the next ten years. This is consistent with our previous ANCAR publications and shows a strong indication for an increased capability requirement. Within this zone, the use of short-term physical and commercial actions (constraint management contracts and locational sells on the open market) has historically been used to manage flows above physical capability.

In 2034, based on the supply scenarios, there are more periods where supply is above capability due to a greater reliance on imports of LNG to offset the declining UKCS supplies, which will increase flows through this zone. Given the increase in flows from LNG imports the Western Gas Network Project (WGNP), upgrades are required to mitigate constraint risk and facilitate higher flows, especially at lower NTS demand levels (shown in figure 14).

Availability of compressors will be improved by control system upgrades at Felindre, commissioning of Unit A at Felindre, as well as asset health works. This is based on the current planned RIIO-2 investments, including the WGNP.

We remain concerned that the entry point at Milford Haven, which is set to grow in significance to the GB market over future years, is reliant on a single pipeline in South Wales. Whilst our regime of maintenance and line inspections has ensured its continued operation to date, the impact of an issue on the pipeline would be significant.

As shown in Figure 14, while the WGNP increases capability, there remains scenarios which would not be met by the planned intact and high resilience network capability. We will continue to monitor flows and review the need for further investment as part of RIIO-GT3 planning.

Figure 13
South Wales entry capability for 2023/24

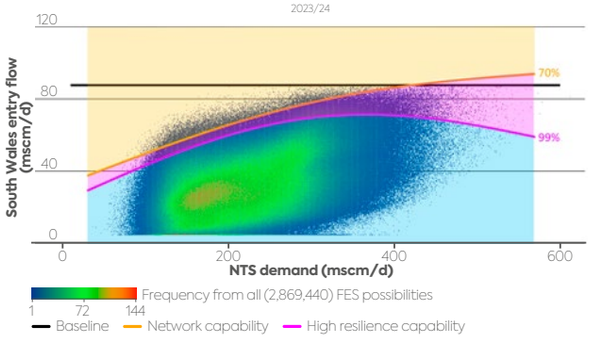
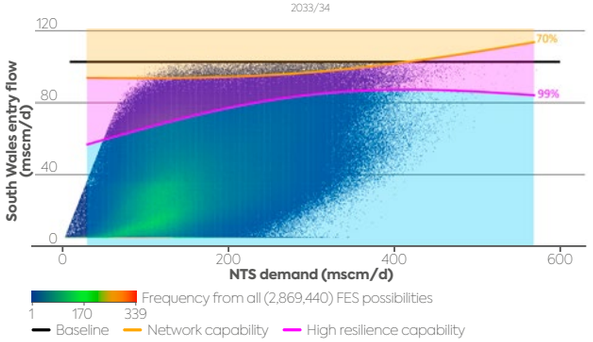


Figure 14
South Wales entry capability for 2033/34 after Western Gas Network project upgrades

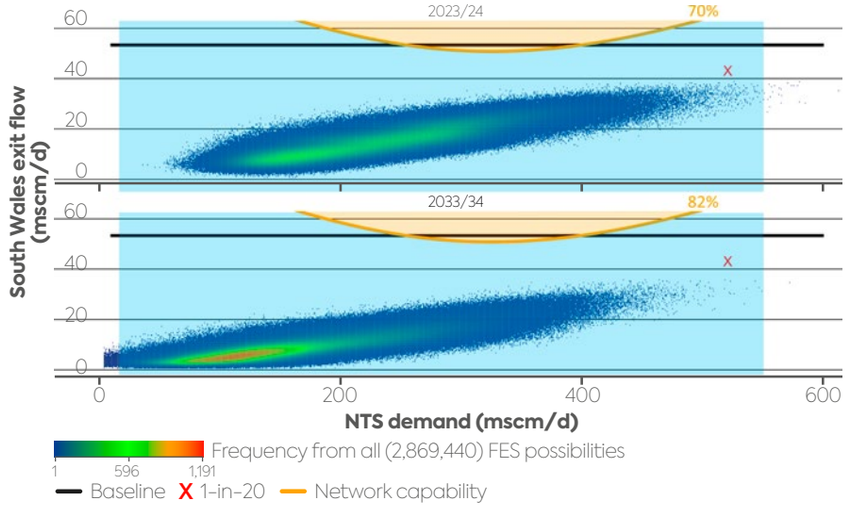


South Wales (Zone 4)

Exit

The South Wales network has sufficient capability to meet the exit requirements now and in the next ten years. The range of the 2034 flow patterns is broadly similar to the 2024 flow pattern, and whilst zonal demands are only slightly reduced, there is a more pronounced concentration of flow frequencies towards the lower NTS demand levels, with fewer flows at the extreme top end of NTS demand levels. These demand changes are believed to be due to expected reductions in gas demand.

Figure 15
South Wales exit capability for 2023/24 and 2033/34

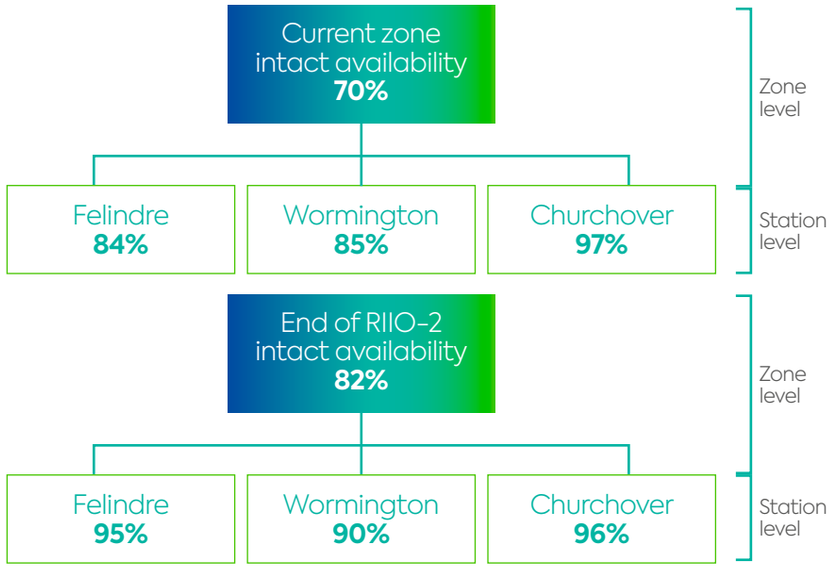


South Wales (Zone 4)

Compressor availability

Figure 16 shows the availability data for Zone 4. Current availability sits at 70%, but this is expected to increase to 82% by the end of RIIO-2 due to an increase in station availability at Wormington and Felindre following asset health works.

Figure 16
South Wales (Zone 4) compressor availability



South West (Zone 5)

South West (Zone 5)

Zone 5

Entry

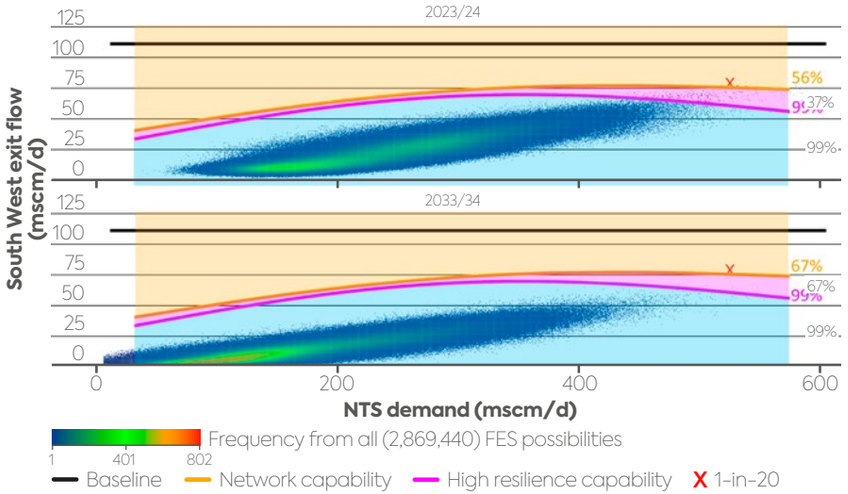
Excluding storage (which contributes less than 5% to meeting local winter demand), there are no entry sites in the South West zone. Therefore, there is no entry capability heatmap.

Exit

The 2034 flow pattern is broadly similar to the 2024 flow pattern, although the range of potential flows at any demand level has reduced slightly. There is a more pronounced concentration of flow frequencies towards the lower NTS demand levels and fewer flows at the extreme top end of NTS demand levels, whilst zonal demands remain only slightly reduced. The demand changes are believed to be due to the expected reduction in gas demand as a result of net zero strategies taking effect.

Due to the significant effect power station demand has on this region, we believe it is critically important to retain the current level of intact capability in this zone. The high resilience and intact lines being below the 1 in 20 demand point represents a risk to the network being able to meet the 1 in 20 demand obligation. Investment during RIIO-2 also goes some way to mitigating this risk and we are assessing what other work is needed through our RIIO-GT3 business planning process.

Figure 17
South West exit capability for 2023/24 and 2033/34

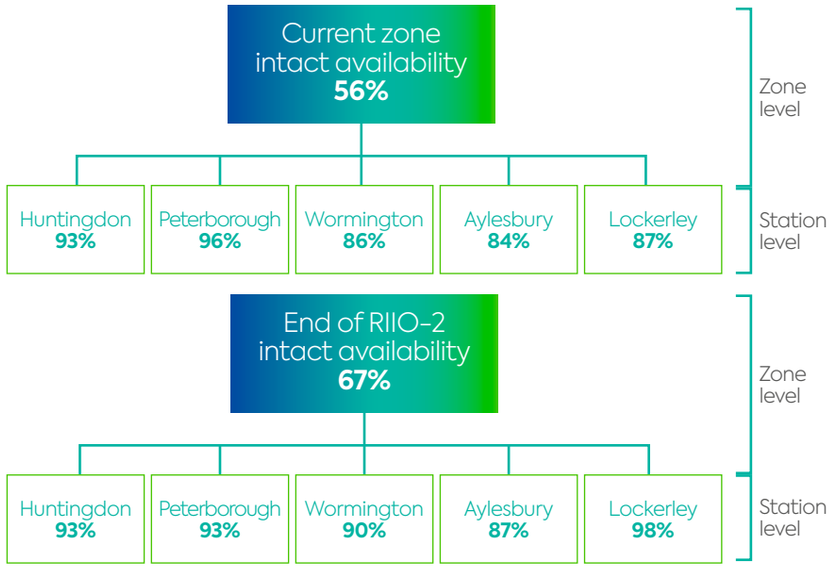


South West (Zone 5)

Compressor availability and constraint days

Figure 18 shows the compressor availability for Zone 5. The current intact availability for the zone is 56%, with this number increasing to 67% by the end of RIIO-2. This is due to planned asset health works, which will deliver improvements to the compressor stations. As a result, the availability of all compressor stations in the zone will increase.

Figure 18
South West compressor availability – current and at the end of RIIO-2



East Midlands (Zone 6)

Entry

Exit

Compressor availability and constraint days

East Midlands (Zone 6)

Zone 6

Bacton is considered an exit point for the East Midlands because the gas it exports via the interconnectors is mainly supplied by moving gas through the East Midlands via the King's Lynn compressor station. Bacton is also considered an entry point for the South East (Zone 7) because most of the gas coming through the terminal proceeds to meet demand in the South East.

Entry

There are no entry sites in the East Midlands zone, so no entry capability flame charts or heatmaps have been produced.

East Midlands (Zone 6)

Exit

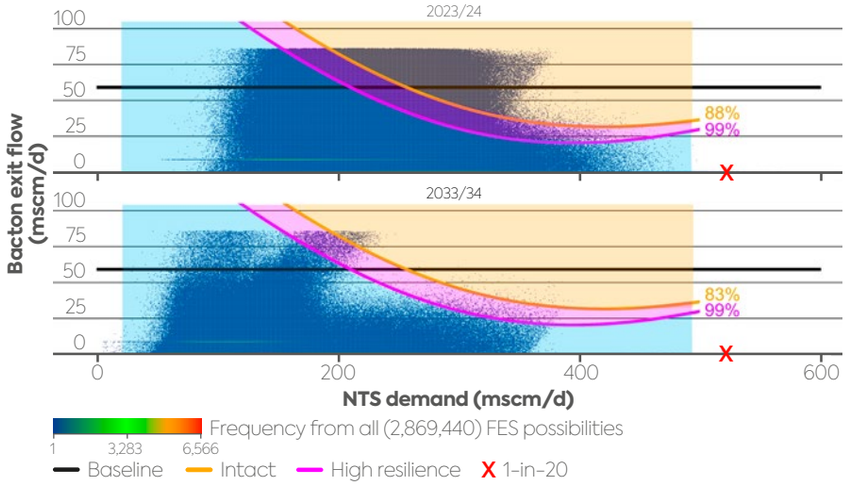
The shape of the flames in figure 19 differs from others in this publication. This is due to it being a graph of Bacton Interconnector exit flows rather than LDZ flows like other zones exit graphs. Interconnectors behave differently than other demand sites. One example of this difference of behaviour is the abrupt reduction in higher exit flows at higher NTS demands, seen clearest in the 2033/34 graph. This is caused by the transition of interconnector flows from exit to entry, meaning that interconnector exit demand disappears from the chart.

Figure 19's capability lines show exit capability while assuming minimal Isle of Grain and Bacton entry flows, as this is a 'worst case' supply scenario. Both the intact and high resilience capability lines show that the East Midlands network generally has sufficient capability to meet the 1-in-20 exit requirements, both now and in the next ten years. There are many flow points above the intact capability line in 2023/24, which indicates a high risk of constraint. It is worth noting, however, that we would not expect these high export flow scenarios to occur at the same time as minimal Isle of Grain and Bacton supply inputs at higher NTS demand levels.

The 2034 flow pattern has a similar shape to the 2024 flow pattern, although the range of potential flows above a demand level of 200mcm/d has reduced dramatically, with a more pronounced concentration of flow frequencies towards the lower NTS demand levels. This significant change in flame profiles reflects the high level of interconnector exports to Continental Europe. However, FES currently predicts that the overall interconnector exit demand requirements will reduce considerably as new LNG terminals open in Continental Europe, reducing their reliance on imports from GB. Maximum export flow rates are expected to remain similar to today. However, in future years, high export scenarios are predicted to occur less frequently at higher NTS demand levels when capability is lower. We believe further work is required to assess interconnector demand forecasting, as this has seen a significant change in recent years and future flows are uncertain.

The lines show that the highest level of exit capability in the East Midlands is at lower NTS demands when Bacton export requirements are at their highest. The chart shows that there will still be the need for Bacton to be able to support baseline exit capacity in 2033/34. Potential future increases in LNG imports (Milford Haven and Isle of Grain terminals) could enable higher exit flows to be supported via Bacton.

Figure 19
East Midlands exit capability for 2023/24 and 2033/34

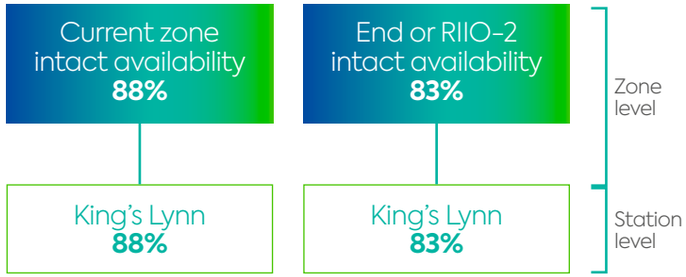


East Midlands (Zone 6)

Compressor availability and expected constraint days

Figure 20 shows the compressor availability for Zone 6. Only Kings Lynn is considered for this zone, as this is the only compressor required to meet exit demand at Bacton Interconnectors. The rest of the zone does not need compression to meet exit requirements. Availability this year has been higher than we would expect on average and therefore there appears to be a slight decrease in availability at Kings Lynn predicted from now until the end of RIIO-2.

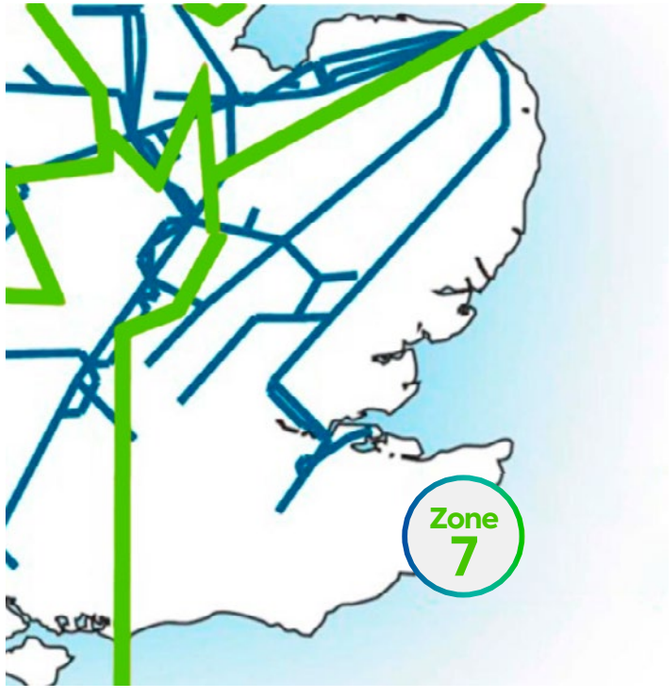
Figure 20
East Midlands compressor availability



South East (Zone 7)

South East (Zone 7)

Zone 7



Entry

Bacton and Isle of Grain are considered entry points for the South East, as the gas from these facilities is largely used to support the high demand centres in the zone.

The above figures show Isle of Grain entry flows against NTS demands, which is a departure from previous years' entry charts where we have depicted Bacton flows. This change has been made to reflect the increasing LNG imports at Isle of Grain, which now pose more of an entry risk than at Bacton, as cases of Bacton exporting rather than importing gas via interconnector are becoming much more commonplace.

It is worth noting that the capability lines reflect Isle of Grain capability at two specific Bacton flows (-40 and 60 mcm), not all of the points of the flames are relevant for these lines as these flames represent all potential Isle of Grain flows across all potential Bacton flows (and not just at Bacton flows of -40 and 60).

Figure 21
South East entry capability with 40mcm of exports at Bacton for 2023/24 and 2033/34

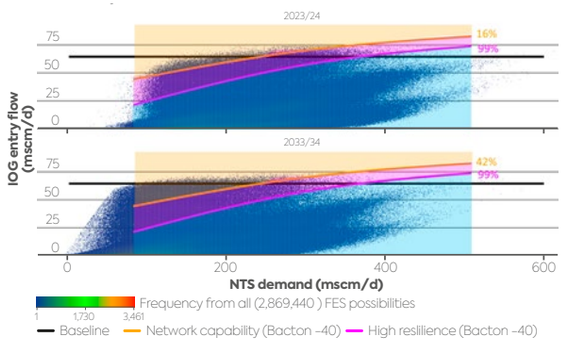
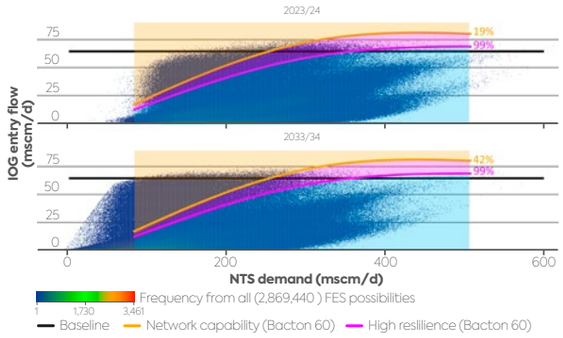


Figure 22
South East entry capability with 60mcm of supply at Bacton for 2023/24 and 2033/34



South East (Zone 7)

Figures 23 and 24 explore scenarios where some Bacton flows are filtered out i.e. for figure 23, only Bacton flows above 60mcm are showing on the flame. This is to filter out scenarios where the capability is actually higher than is relevant for that point. This goes some way to showing a clearer picture of the capability requirement, however there are many other factors which affect South East capability on the day such as South East demand, which can have a significant impact on Isle of Grain capability at lower demands. We are working toward further defining the capability requirements and assessing whether additional investment is required through our RIIO-GT3 business planning process.

In general, the flame charts show that capability is broadly sufficient to meet the entry requirements of the zone in 2024, with our high resilience capability indicating a risk of constraint in the short term when there is lower NTS demand. Looking at the 2034 charts, we can see that the risk of constraint grows considerably for both Intact and High Resilience capability lines, with risk at low NTS demand being particularly significant due to the increase in expected Isle of Grain flows at lower demands. This indicates that further reinforcement is required in this zone to ensure this risk is mitigated. This reinforcement is being further defined as part of our RIIO-GT3 business plan submission.

Figure 23
South East entry capability with 60mcm of supply at Bacton for 2023/24 and 2033/34 with Bacton flows only included when above 60mcm

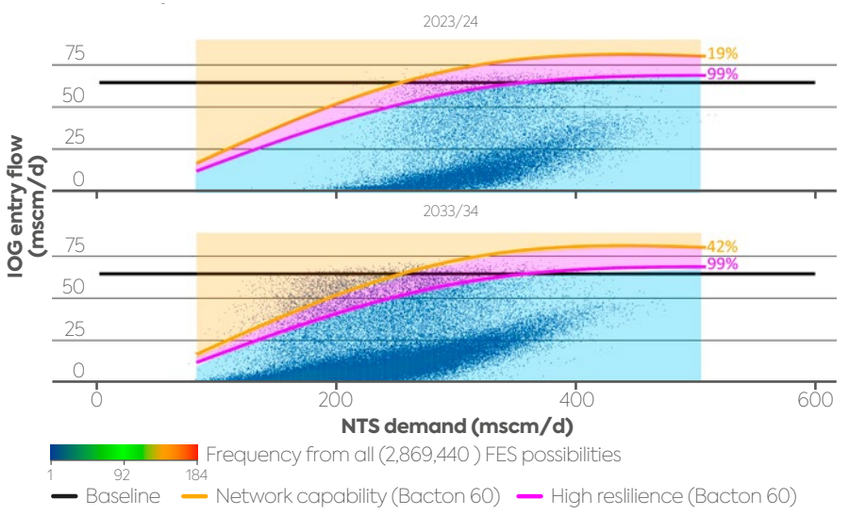
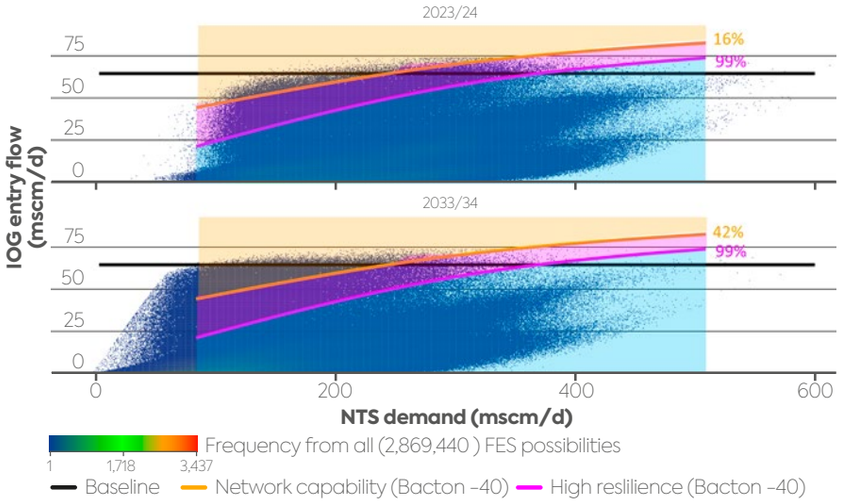


Figure 24
South East entry capability with 60mcm of supply at Bacton for 2023/24 and 2033/34 with Bacton flows only included above 40mcm



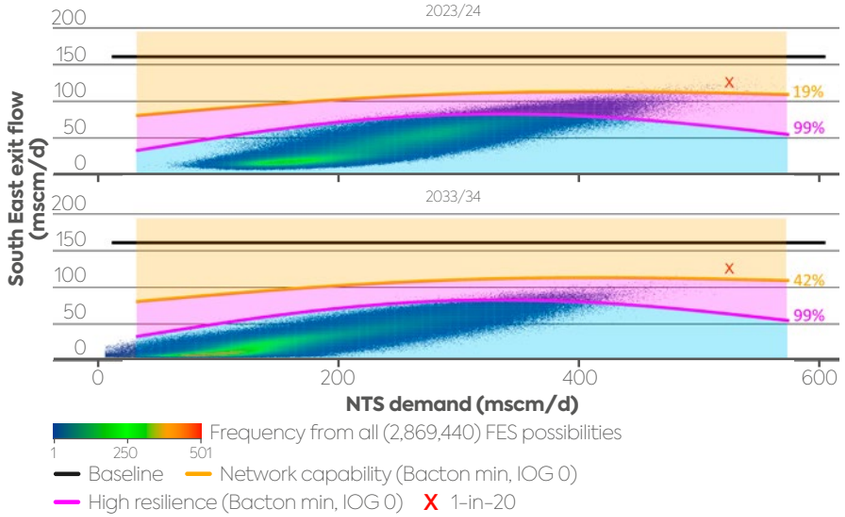
South East (Zone 7)

Exit

Figure 25 indicates that the South East network does not have sufficient intact capability (when there are minimum feasible Isle of Grain and Bacton flows) to meet the exit requirements both now and in the next ten years, evidenced by the 1 in 20 demand level being above the intact line. However, during a 1 in 20 demand situation we would expect some level of Isle of Grain flows onto the network, or supplies at Bacton to be higher than minimum. As part of our RIIO-GT3 business plan process we will assess what investment may be needed to achieve acceptable resilience levels.

The 2034 flow pattern is similar to the 2024 flow pattern, although the range of potential flows has reduced slightly. There is a more pronounced concentration of flow frequencies towards the lower NTS demand levels and fewer flows at the extreme top end of NTS demand levels, whilst zonal demands remain only slightly reduced.

Figure 25
South East exit capability for 2023/24 and 2033/34

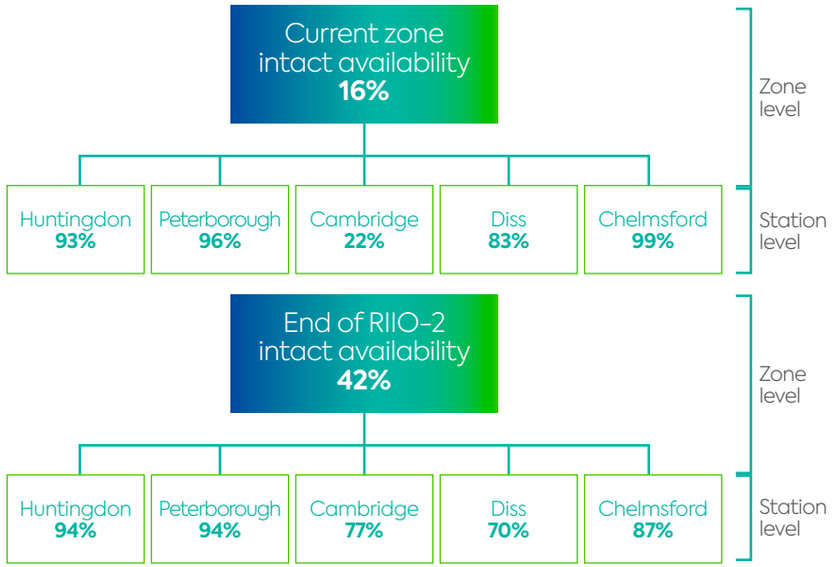


South East (Zone 7)

Compressor Availability

Figure 26 shows that our current intact availability for the South East is very low, primarily due to the low availability of the Cambridge compressor station. By the end of RIIO-2 the availability improves slightly, although it is still comparatively low when compared to other zones. The South East is therefore an area of priority for investment in order to have sufficient levels of capability and resilience and meet our obligations.

Figure 26
South East compressor availability – current and end of RIIO-2



Appendix

Appendix

Intact and High Resilience Capability

Intact Capability, also referred to as Network Capability, is the highest capability a zone can deliver. It is based on the assumption that all compressor stations and other assets in the zone have their full capability available. As this may require more than one compressor unit at each station, it may not be possible to achieve intact capability if one or more compressor units are not available for any reason.

High Resilience Capability is the compressor reliability we calculate a zone should always be able to deliver, given current and predicted levels of availability. It is calculated so that the likelihood of unavailable compressors preventing high resilience capability is below 1%. In order to achieve an availability of 99%, the capability has to be assessed with only a subset of compressors available, e.g. 99% of the time at least 2 out of 4 compressors will be available. As these scenarios have less compression available, the high resilience capability is unlikely to deliver the same flows as intact capability.

High resilience capability can often be achieved by running multiple combinations of compressor stations, which reduces the impact of varying unit-level availability.

FES flow scenarios shown in the flame charts which lie above the high resilience capability line have the potential to not be met should the necessary assets not be sufficiently available. This would result in constraint days in an entry zone or potential for failure to supply customers with gas in an exit zone. The number of constraint days predicted can therefore be used as a metric to assess network resilience. FES flow scenarios which are above the intact line cannot be met with the current assets, regardless of their availability. The number of FES flow scenarios between the two lines which may not be met is dependent on compressor unit availability.

Calculating Zone Availability

Station-level availabilities were used to calculate high resilience capability, and the likelihood of achieving intact capability in each zone. The availability of the station is based on the availability of the units required to achieve the full capability of the station. The unit availability for the current year is based on actual historic performance, and the end of RIIO-2 values are based on the reliability, availability, and maintainability (RAM) study findings and the planned investments during RIIO-2.

The combinations of stations required to deliver intact capability or high resilience capability are used to calculate zone-level availabilities. The calculations are shown in figures 25 and 26.

Figure 27
Calculation of zone 'Intact' availability

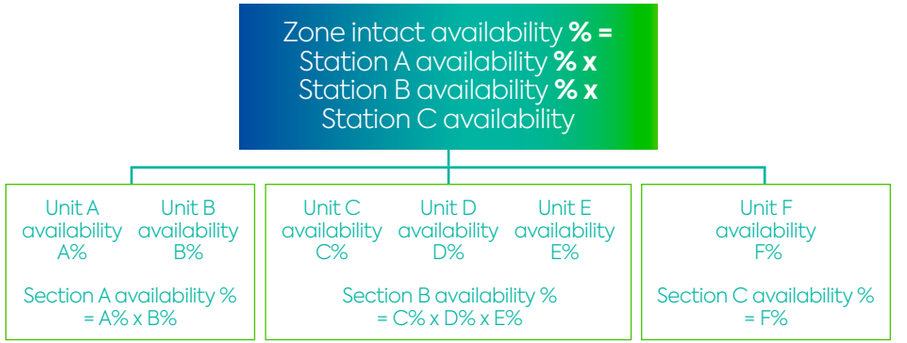
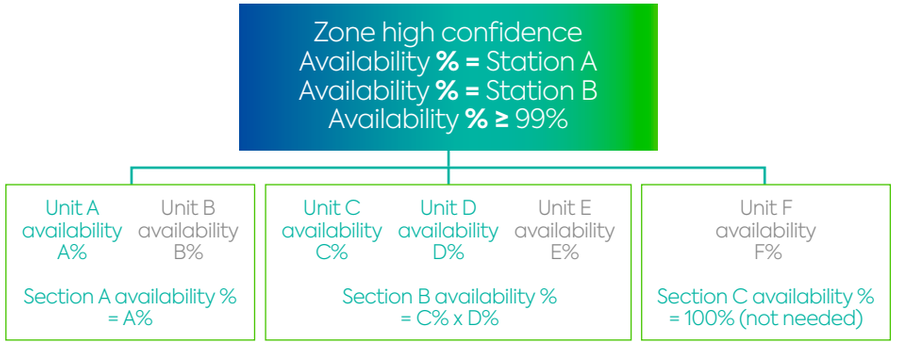


Figure 28
Calculation of 'high confidence' availability



Appendix

Calculating Zone Resilience

To measure the impact of availability on network resilience, we modelled the FES flow scenarios in each zone and analysed the likelihood that the network would be able to meet those scenarios. Constraint days in an entry zone are the number of days in a year that we expect the network will not be able to meet flow scenarios without commercial actions. The more resilient the network, the lower the number of constraint days. In the case of an exit zone, a constraint day represents a failure to meet exit pressures without commercial actions.

We calculated the highest entry and exit flows that the intact capability network and high resilience capability network can meet across increasing levels of demand for each zone and included them on flame charts:

- Intact capability is represented by the orange line – it is higher because it represents the most capable network operating scenario, i.e. our maximum capability.
- High resilience capability is represented by the pink line – it is lower because it reflects the actual availability of compressor units in the zone.

An example for entry flows in South Wales is shown in figure 29.

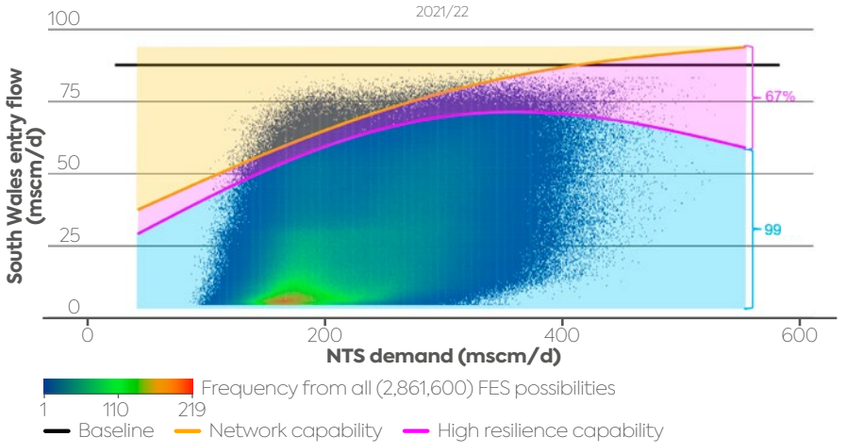
What this means – understanding our intact and high resilience lines

The network cannot deliver any of the flow scenarios above intact capability (the orange line). The network has a 99% likelihood of delivering all scenarios under the high resilience line (the pink line). The actual capability on any given day will be between the two lines depending on asset availability.

The likelihood of achieving intact capability is used to estimate the average number of flow scenarios that will not be met. This number is then converted into days.

- The total number of FES flow scenarios under the high resilience capability line (points in the blue area on the chart) represent scenarios that have a greater than 99% likelihood of being met given current availability/reliability of compressor units and other assets.
- The total number of FES scenarios under the intact capability line, but also above the high capability line (the pink area), has a 67% likelihood of being met in the above example, since this is the compounded zonal availability based on unit-level values.
- Flows above the intact capability line (the orange line) cannot be met.

Figure 29
Operating strategy example for South Wales entry



Glossary

Glossary

1-in-20 obligation
This is the highest level of gas demand that we should expect to experience only once in every 20 years. We are obliged to plan and develop the network to meet the 1-in-20 level.

Asset
Any physical part of the network, includes such things as compressors, pipelines, flow valves and regulators.

Commercial actions
Actions taken to balance the NTS, such as buying and selling gas either nationally or locally.

Compressor
Compressors are used to move gas around the transmission network through high pressure pipelines. There are currently 71 compressors at 24 sites across the country. These compressors move the gas from entry points to exit points on the gas network. They are predominantly gas-driven turbines that are in the process of being replaced with electric units.

Constraint
A constraint is where the pressure or flow required to meet customer needs cannot be met by the physical capability of the network. On entry flame charts the potential of this is represented by a dot above the capability line.

Flame chart
These charts are a visualisation of the range of potential flows into and out of the zones across the network and the physical capability we assess to be available.

Heatmaps
As per flame charts with the addition of a 3rd dimension which is concentration of flows.

High resilience
Reflects levels of compressor capability which can be met 99% of the time.

Intact capability
All compressors are available and reliable.

Interconnector
Two pipelines connecting GB and the EU. The Interconnector (UK) Limited is a bi-directional gas pipeline connecting Bacton in the UK and Zeebrugge in Belgium. BBL is a bi-directional gas pipeline connecting Bacton in the UK and Balgzand in the Netherlands.

LNG
Liquid natural gas that has been converted to liquid form for ease of storage or transport. It is formed by chilling gas to -161°C so that it occupies 600 times less space than in its gaseous form.

National Transmission System (NTS)
A high pressure gas transportation system consisting of compressor stations, pipelines, multi-junction sites and offtakes. Pipelines transport gas from terminals to offtakes. The system is designed to operate at pressures up to 94 barg.

Physical capability
The maximum amount of gas that the network can physically flow at specific locations without going outside any of its pressure obligations, or equipment's safe operational tolerances.

Reliability, availability, and maintainability (RAM)
The RAM model is the output from a study undertaken to assess asset reliability, availability and maintainability.

Resilience
Resilience is the ability of the network to recover from unforeseen conditions such as asset failure. If, at a compressor site, there is a back-up unit, the site resilience is much higher.

RIIO-2 Business Plan/Business Plan
RIIO (Revenue = Incentives + Innovation + Outputs) is a price control mechanism that is set by Ofgem. The RIIO-2 period is 2021 to 2026.

T3 plan
The planning process for RIIO-3 (Revenue = Incentives + Innovation + Outputs) which covers the period 2026 to 2031.

Uncertainty Mechanism (UM)
These allow price control arrangements to respond to change. They protect both end consumers and licencees from unforecastable risk or changes in circumstances.

Unit-level values/availability
The unit availability for the current year is based on actual historic performance, and the end of RIIO-2 values are based on the RAM study findings and the planned investments during RIIO-2.

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