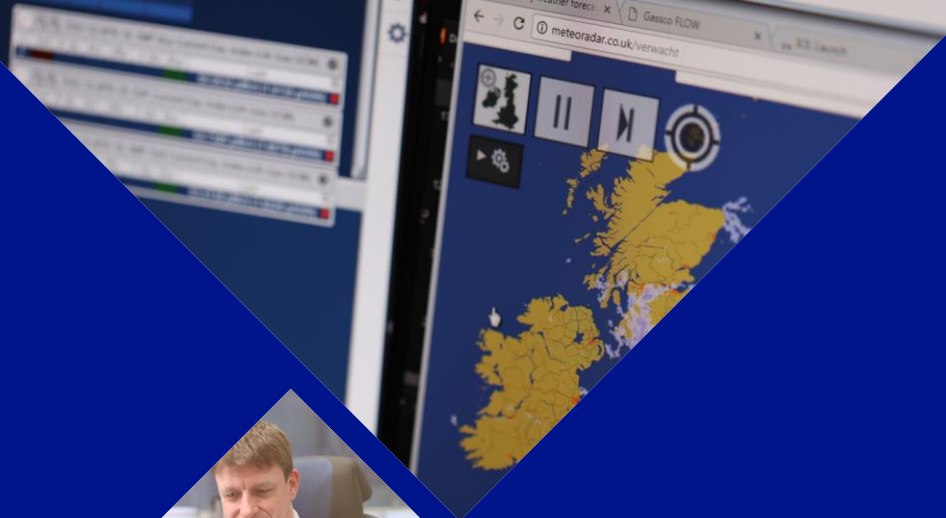


Gas System
Operator

GFOP within-day behaviour study

Gas supply stakeholder
insight summary

nationalgrid



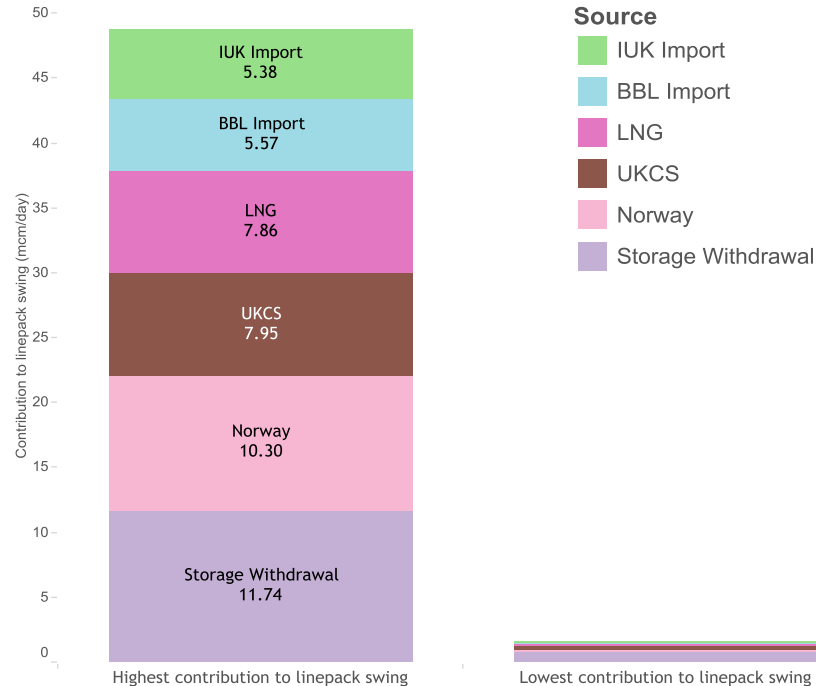
How gas is brought onto the network at an entry point is influenced by many factors. Therefore, a supply source's potential contribution to linepack swing can vary significantly.

How the contributions from each source align determines the level of supply driven linepack swing we see within-day.

We have been engaging with stakeholders to better understand the factors that influence how gas is brought onto the network.

This document summarises the insights we gathered for each supply source.

Contribution to linepack swing by supply source



Data: highest 14 linepack swing days in 2017/18, where linepack swing ranged from 21mcm/day to 41mcm/day

National Grid Contribution to swing calculation:

For demand – if demand is greater than the flat 1/24th average demand rate, it is having a negative contribution to linepack (causing it to decline)

For supply – if supply is less than the flat average supply rate, it is having a negative contribution to linepack (causing it to decline)

Storage withdrawal

Factors that influence how gas is brought onto the network

- Later nominations as the risk assessment between exposure to cash-out prices and cost of balancing ones portfolio becomes clearer later in the gas day.
- Expected nomination behaviour of customers. Anticipating how customer needs may change influences flow/no flow decision.
- The ability of the site and its compressors, and whether it has third-party access or not. This impacts how flow requests are managed.
- Carry out small maintenance during the day and begin to flow once complete.
- For freeflow withdrawal:
 - Locational pressure of the transmission system. The difference in storage and network pressures affect withdrawal rate.
- For electrical compressor driven withdrawal:
 - triad periods and electricity prices as this impacts operational costs

Potential drivers of change to within-day flow behaviour:

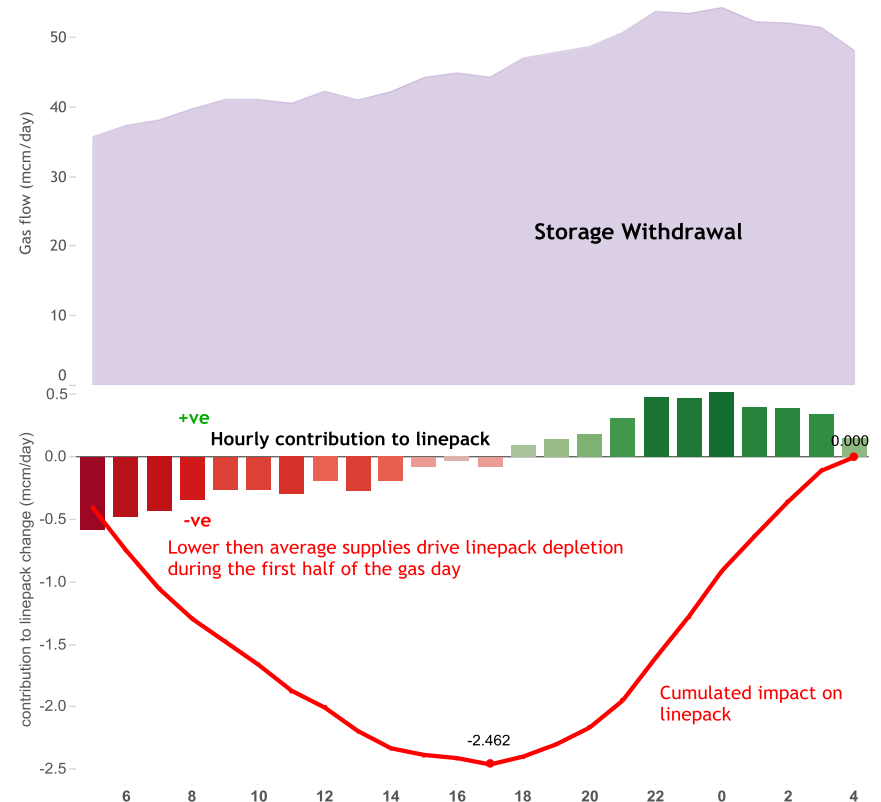
- Regime changes could alter how shippers balance their portfolios. This could impact storage demands as their fast lead times are adept for portfolio balancing.
- Changing electricity price behaviour could drive further compressor optimisation.

National Grid Contribution to swing calculation:

For demand – if demand is greater than the flat 1/24th average demand rate, it is having a negative contribution to linepack (causing it to decline)

For supply – if supply is less than the flat average supply rate, it is having a negative contribution to linepack (causing it to decline)

Behaviour for 14 highest linepack swing days in 2017/18



Liquefied Natural Gas (LNG)

Factors that influence how gas is brought onto the network

- Number of commercial customers operating at a site.
- Supply losses within a gas day. The ability to ramp up at short notice makes LNG adept at making up supply shortfalls.
- Terminal maintenance tends to happen during the day. LNG terminals will then ramp up to meet nominated gas flows.
- locational optimisation, which is driven by a number of factors including:
 - Level of inventory and when the next carriage is forecasted to arrive
 - future gas prices

Potential drivers of change to within-day flow behaviour:

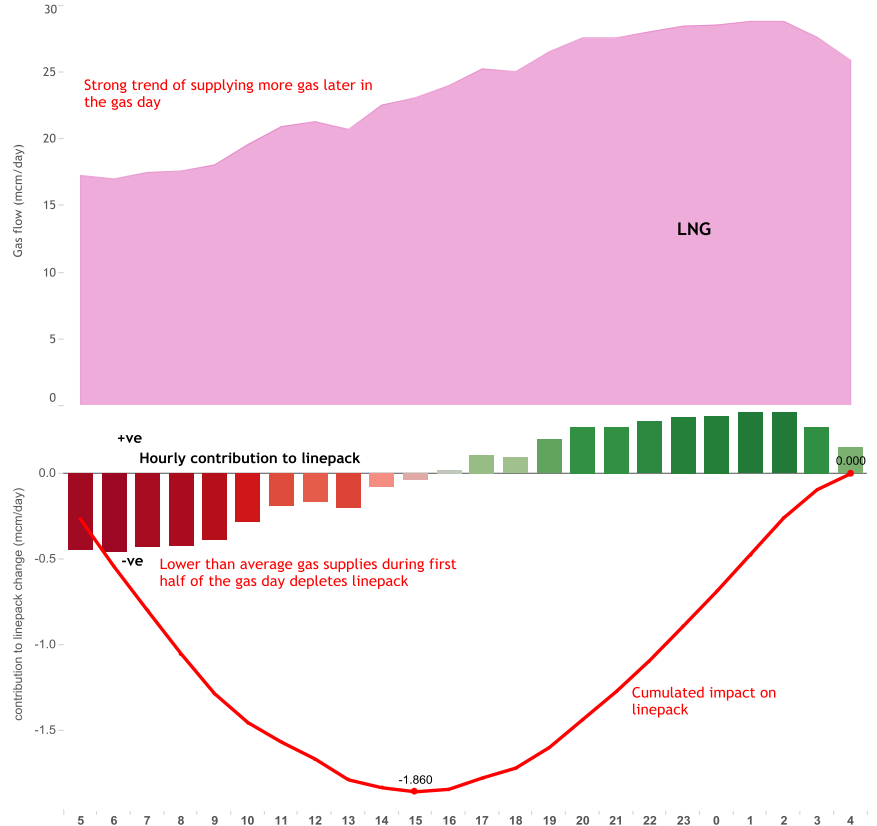
- Number of commercial customers with access at LNG sites could increase in the future.
- LNG will become more globally linked, with more carriages available. This could impact locational decision-making of when to bring, and then flow gas.

National Grid Contribution to swing calculation:

For demand – if demand is greater than the flat 1/24th average demand rate, it is having a negative contribution to linepack (causing it to decline)

For supply – if supply is less than the flat average supply rate, it is having a negative contribution to linepack (causing it to decline)

Behaviour for 14 highest linepack swing days in 2017/18



Interconnector imports

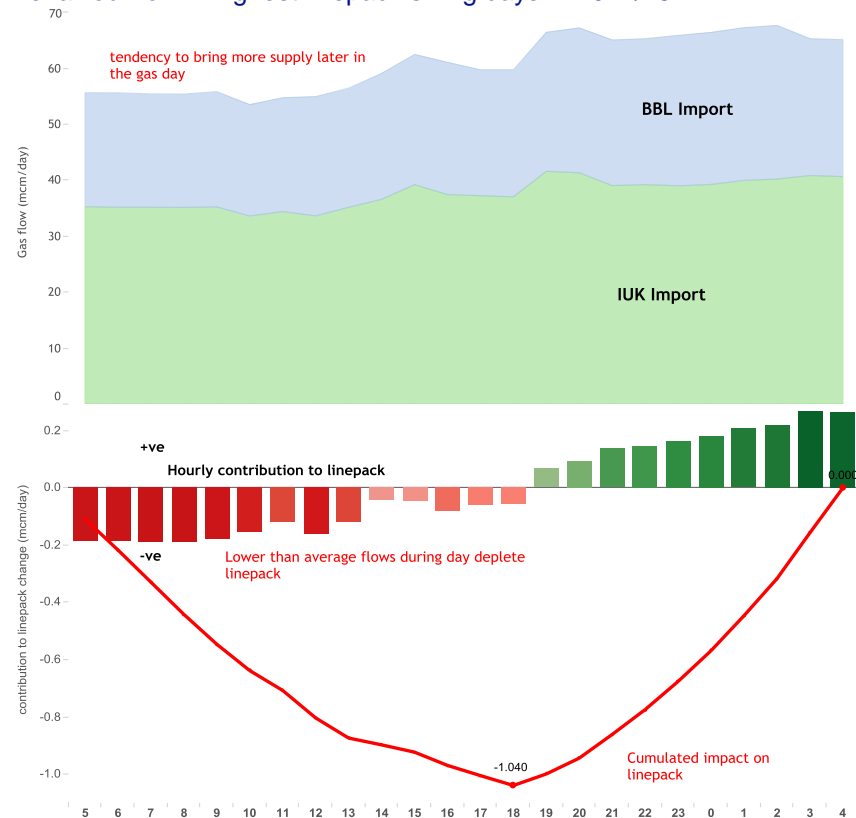
Factors that influence how gas is brought onto the network

- Continental Europe and UK gas spot price. This can be influenced by many factors including:
 - supply losses
 - Transmission System Operator actions across UK and Europe
 - exchange rates
- Transportation charges and operational costs. Given the usage of electrical compressors, flow is batched to avoid peak electricity prices if possible.

Potential drivers for change in within-day flow behaviour:

- Decreasing number of long-term contracts. This could lead to more customers, in turn leading to more price spread optimisation and thus more flow volatility.
- The closure of Rough has contributed further to interconnectors becoming 'seasonal transporters'. This could change in the future.
- Changes to market regimes could affect how within-day gas-flow is optimised.

Behaviour for 14 highest linepack swing days in 2017/18



National Grid Contribution to swing calculation:

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Norway Continental Shelf

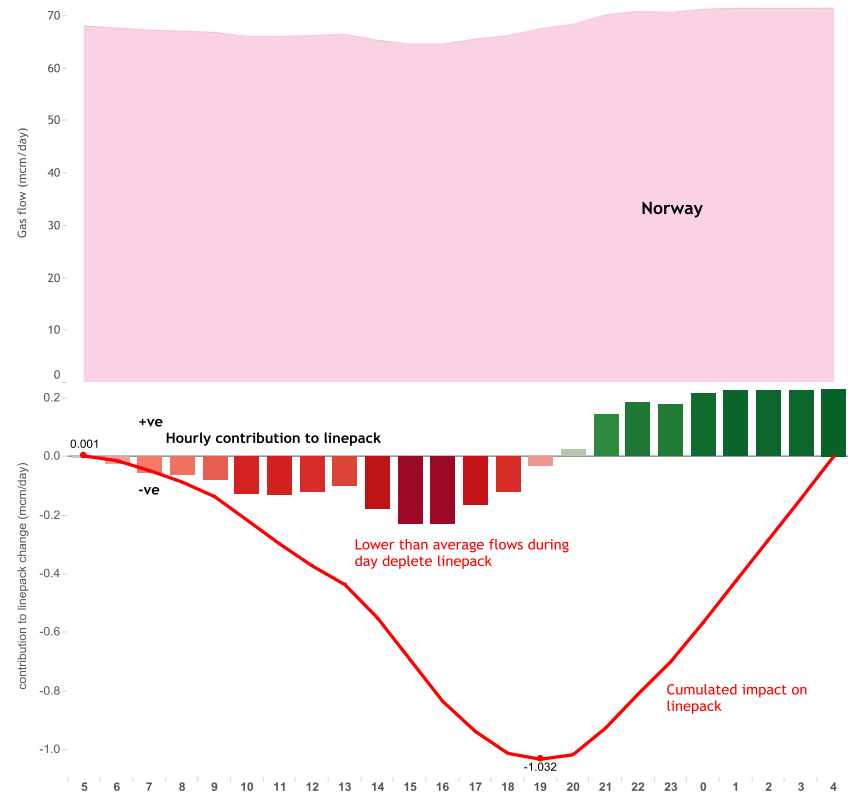
Factors that influence how gas is brought onto the network

- Upstream failures impact downstream flows.
- Some sub-terminals are single customer, others have multiple customers. This could lead to differences in behaviour.
- Gas spot prices between Continental Europe and the UK.

Potential drivers for change in within-day flow behaviour:

- Aging infrastructure could lead to higher frequency of supply losses

Behaviour for 14 highest linepack swing days in 2017/18



National Grid Contribution to swing calculation:

For demand – if demand is greater than the flat 1/24th average demand rate, it is having a negative contribution to linepack (causing it to decline)

For supply – if supply is less than the flat average supply rate, it is having a negative contribution to linepack (causing it to decline)

UK Continental Shelf

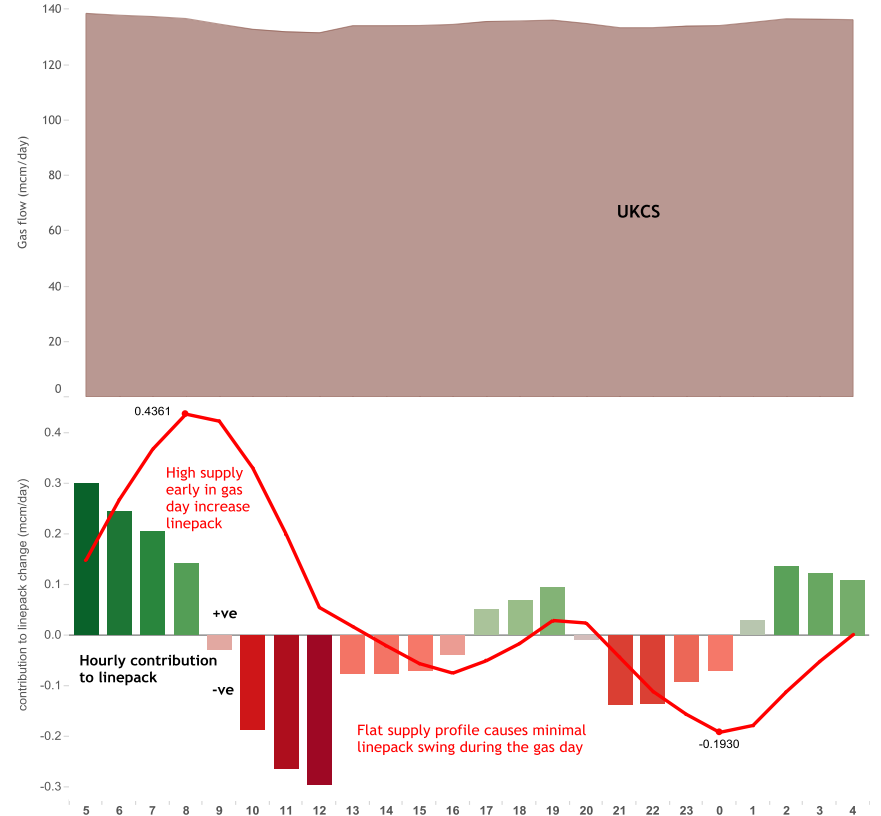
Factors that influence how gas is brought onto the network

- Upstream failures have a strong impact downstream on within-day flows.
- Some sub-terminals are single customer, others have multiple customers. This would lead to differences in behaviour

Potential drivers for change in within-day flow behaviour:

- Ageing infrastructure could lead to higher frequency of supply losses

Behaviour for 14 highest linepack swing days in 2017/18



National Grid Contribution to swing calculation:

For demand – if demand is greater than the flat 1/24th average demand rate, it is having a negative contribution to linepack (causing it to decline)

For supply – if supply is less than the flat average supply rate, it is having a negative contribution to linepack (causing it to decline)

Throughout this study, we want you to continue to collaborate with us. This will help us outline the future within-day needs of the network and determine potential options that meet these needs.

Support our next instalment:

We are now working to predict how within-day flow behaviour could change in the future. This will be strongly influenced by the insights we have gathered so far.

To improve our predictions:

- I. **is there any potential drivers for change in within-day flow behaviour that we have not captured?**
- II. **which factors do you believe will most strongly impact how gas is brought on and off the network in the future?**

Please email your responses to **box.gfop@nationalgrid.com**.

Upcoming release dates and instalment outputs

February 14th

Summary of how within-day flows have changed, and factors influencing behaviour

February 28th

Predict how within-day gas flows could change by 2025

March 28th

Assessment of our physical network's capability to meet future within-day customer needs.

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