Gas System Operator

GFOP within-day behaviour study

Instalment 2 - Predicting future within-day customer needs
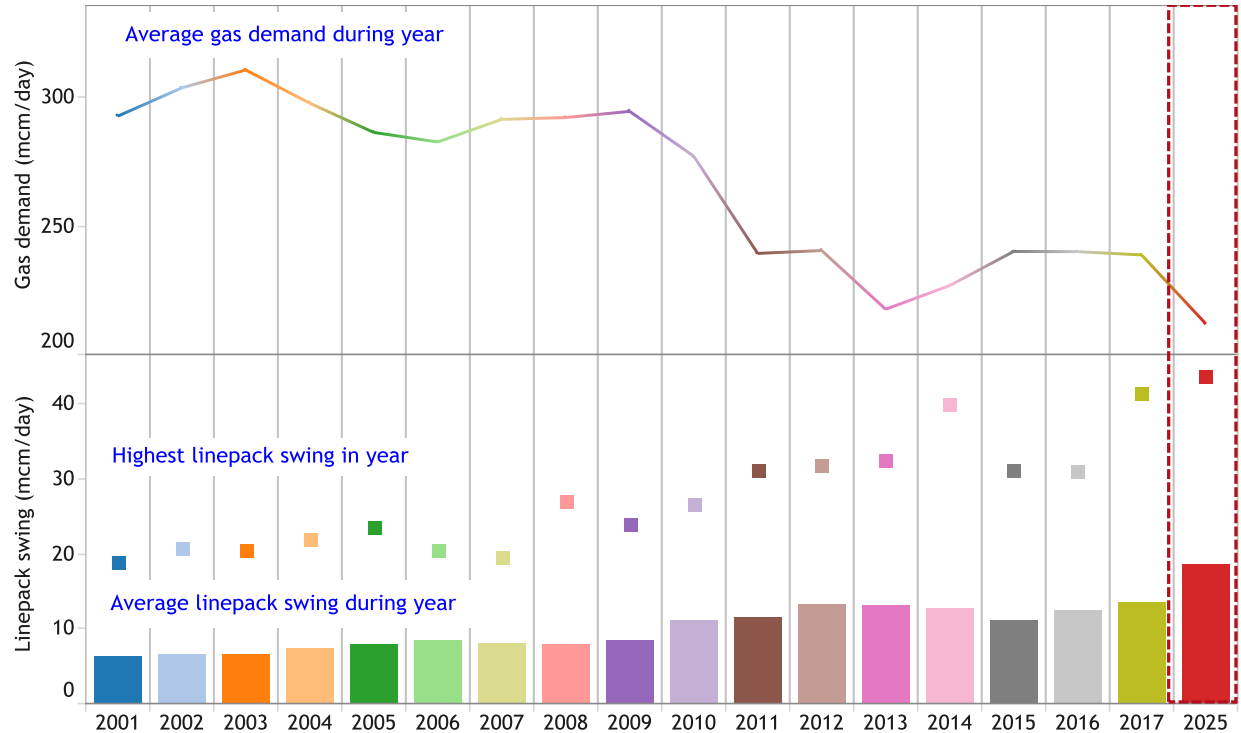
nationalgrid

Despite reducing gas demand, the amount of linepack swing we manage has increased. We anticipate that this trend will continue.

Using your insights, we have forecast daily linepack swing in 2025.

We project that the frequency of large linepack swing days will increase, especially in the summer.

Average gas demand during year

Highest linepack swing in year

Average linepack swing during year

Gas demand (mcm/day)

Linepack swing (mcm/day)

2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2025

Linepack swing: highest linepack level – lowest linepack level within a gas day
Data does not include: Ireland exports, storage injection, IUK exports and Industrials

Anticipated increases in both the frequency and magnitude of hourly supply-demand imbalances is driven by several factors.

Drivers for increase in supply-driven linepack swing:

- Reductions in UK Continental Shelf (UKCS)[1] supply is replaced by sources whose within-day delivery rates are typically less constant (interconnectors and LNG).

- Further refinements in interconnector and storage compressor fuel usage and gas spot price spread optimisation could lead to more within-day volatility in delivery rates.

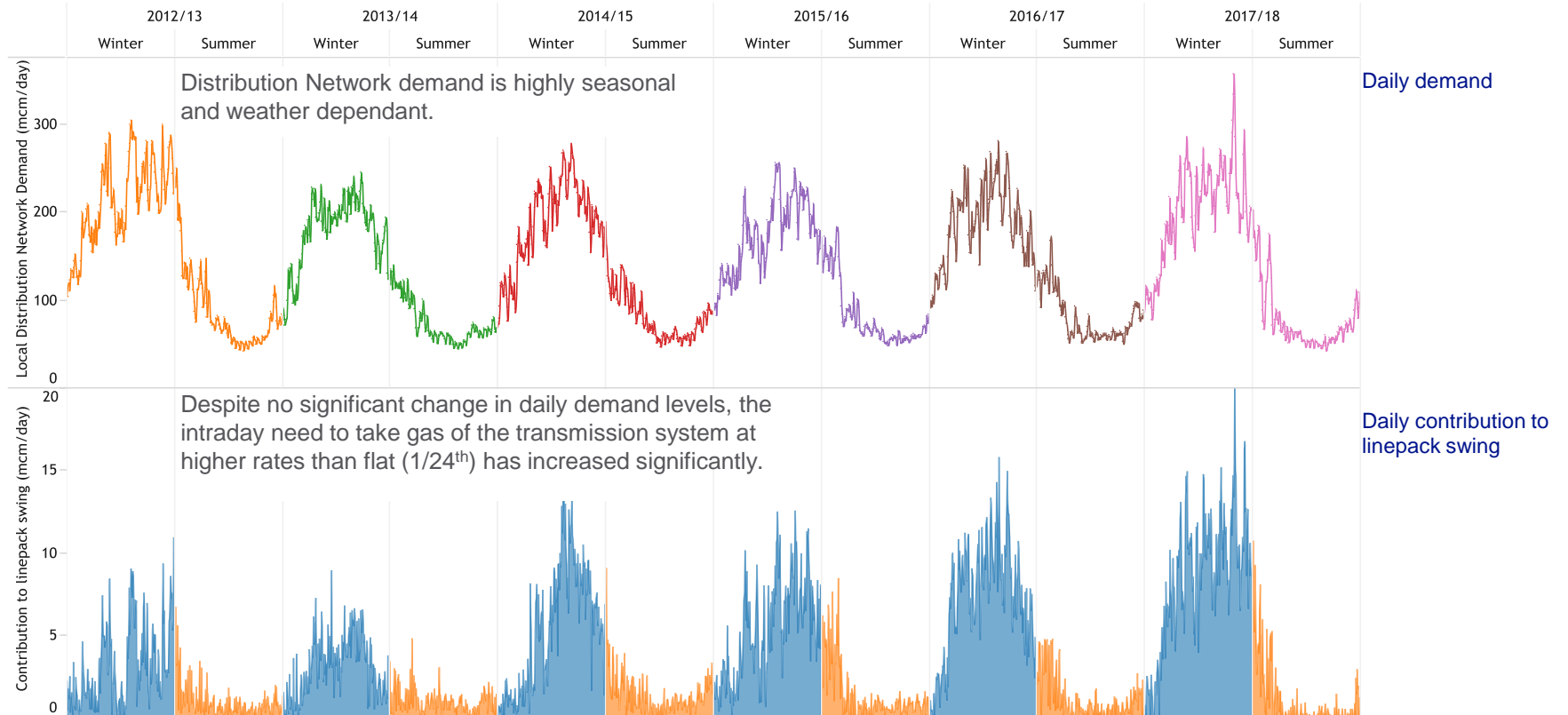## Drivers for increase in demand-driven linepack swing:

- Increased proliferation of renewables could lead to more frequent increases and decreases in gas-fired generation within-day demand rates.

- Increases in small-scale gas-fired power stations connected to Distribution Networks could lead to increased intraday needs for gas above flat rate (1/24th).

Average linepack swing by month (mcm/day)

National Grid [1] *Future Energy Scenarios (FES)*

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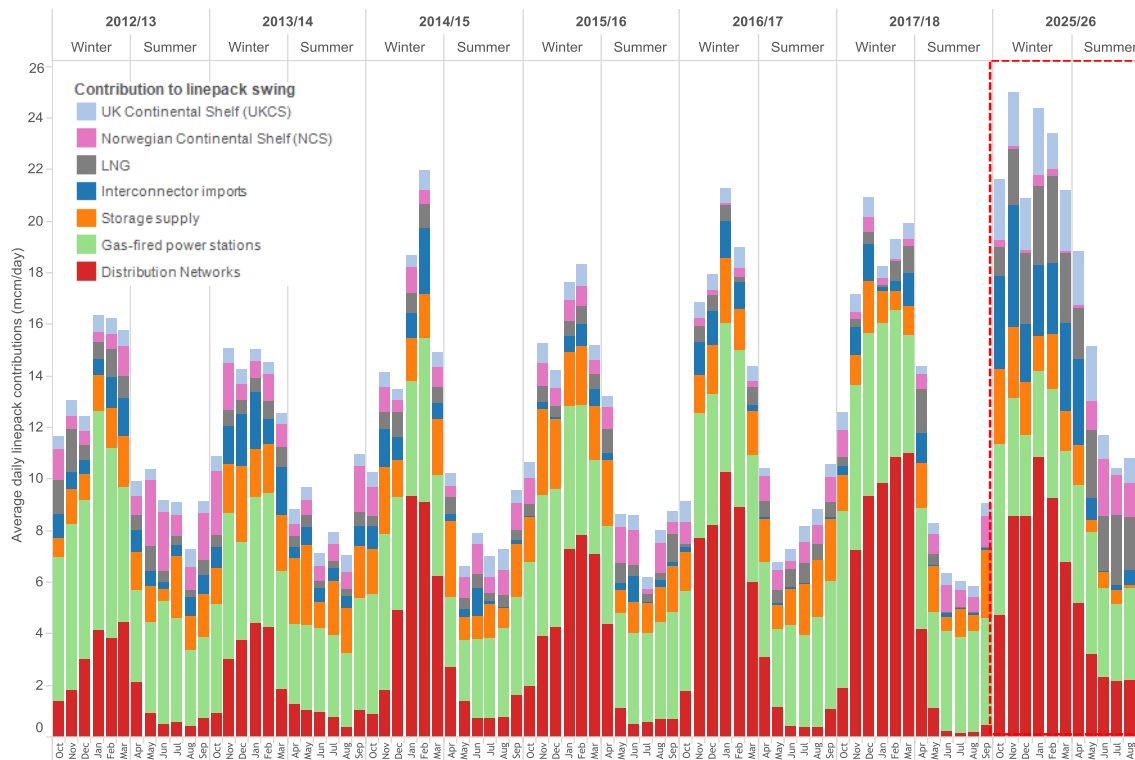
As Distribution Network's own inherent storage facilities have declined, reliance on National Transmission System linepack to meet within-day demands has increased significantly.

Daily Distribution Network demand and contribution to linepack swing

Distribution Network demand is highly seasonal and weather dependant.

Daily demand

Despite no significant change in daily demand levels, the intraday need to take gas of the transmission system at higher rates than flat (1/24th) has increased significantly.
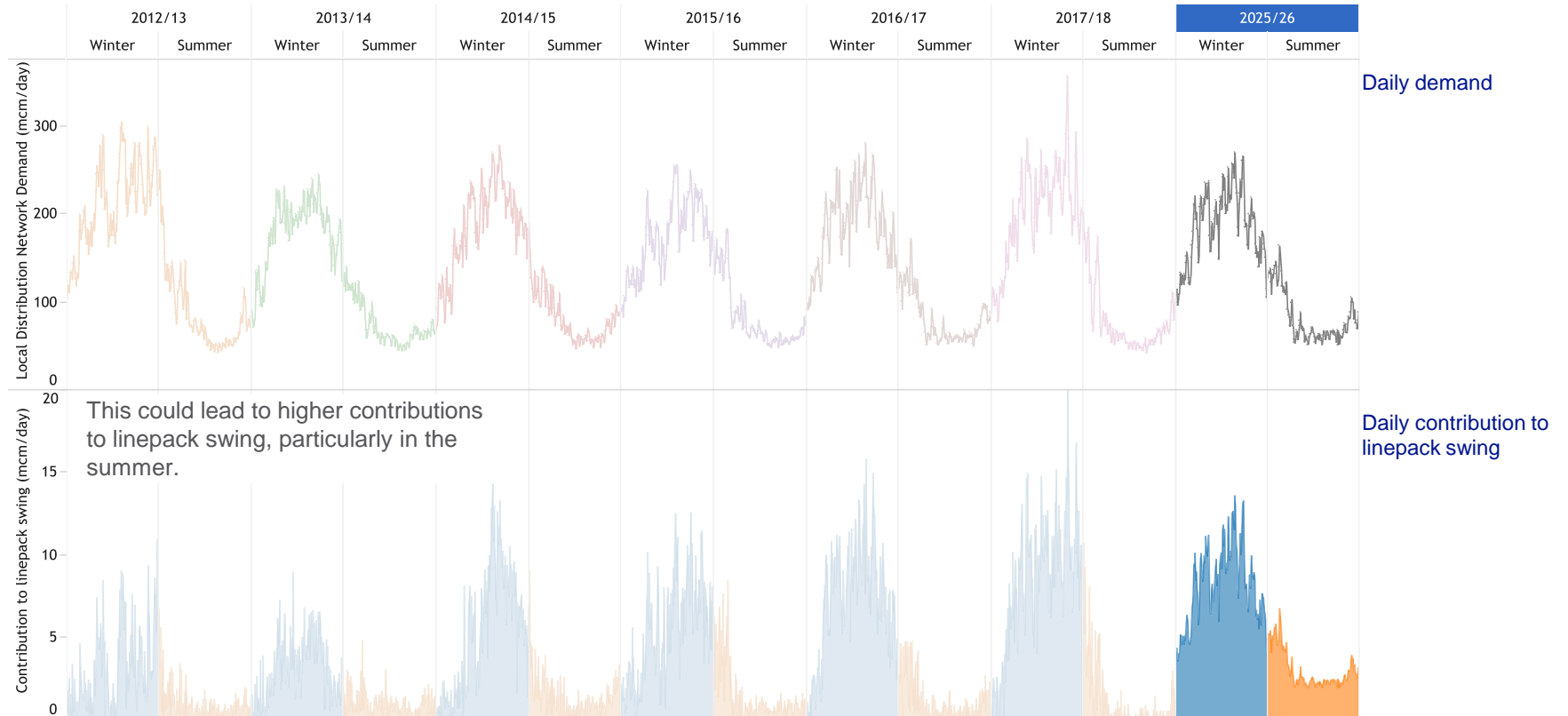
Daily contribution to linepack swing

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)

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Demand – Distribution Networks

FORECAST: Increases in small-scale gas-fired power stations connected to Distribution Networks could lead to increased intraday needs for gas above flat rate (1/24th).

Daily Distribution Network demand and contribution to linepack swing

This could lead to higher contributions to linepack swing, particularly in the summer.

Daily demand

Daily contribution to linepack swing

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)

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Changes in the power generation mix has increased day-to-day variability and within-day volatility in gas-fired generation demand.

Daily gas-fired power station demand and contribution to linepack swing

Reducing coal-fired generation has increased demand.
Increased renewable generation has led to demand becoming more variable day-to-day and more seasonal.

Daily demand

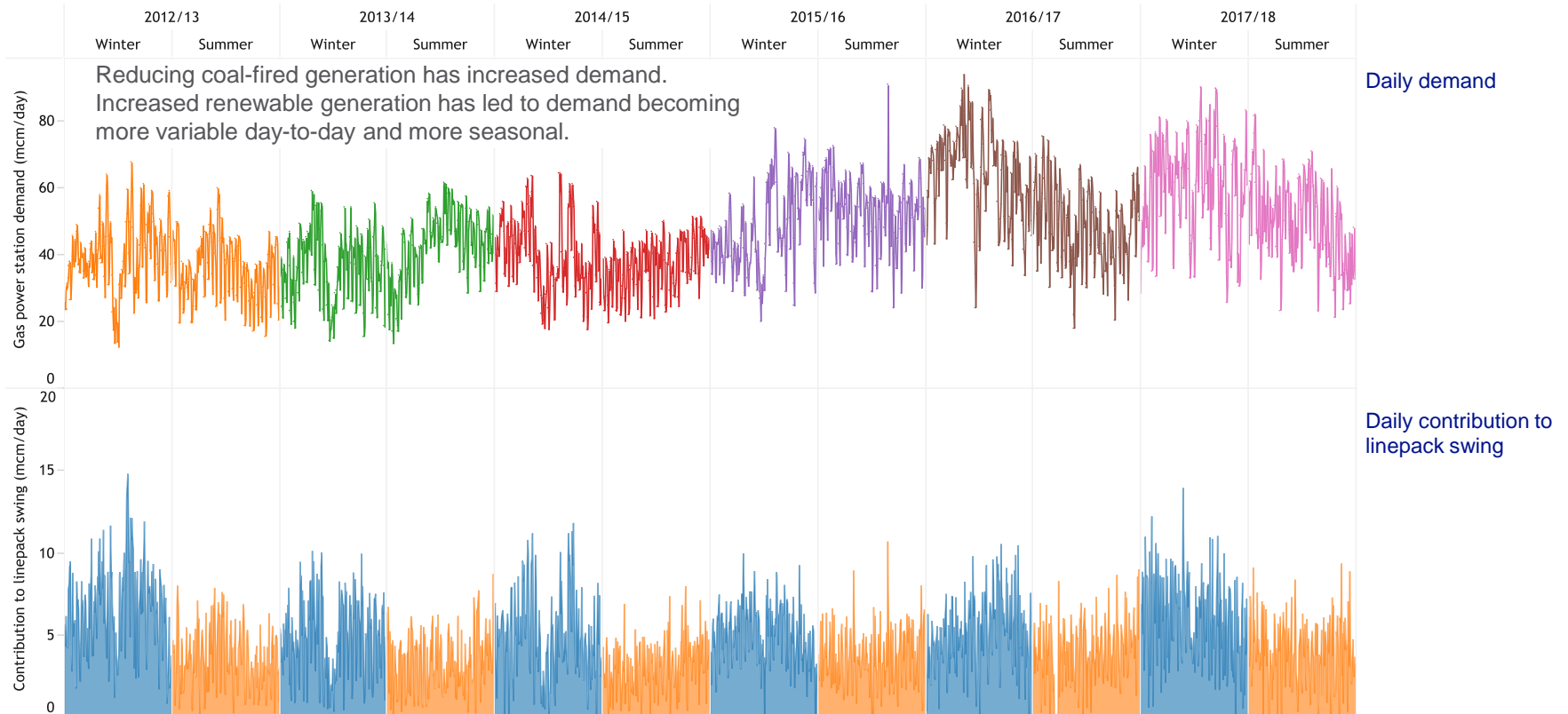Daily contribution to linepack swing

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

FORECAST: Gas-fired power stations responding to more volatile within-day electricity price signals could increase linepack swing, especially in the summer when demand levels are lower.

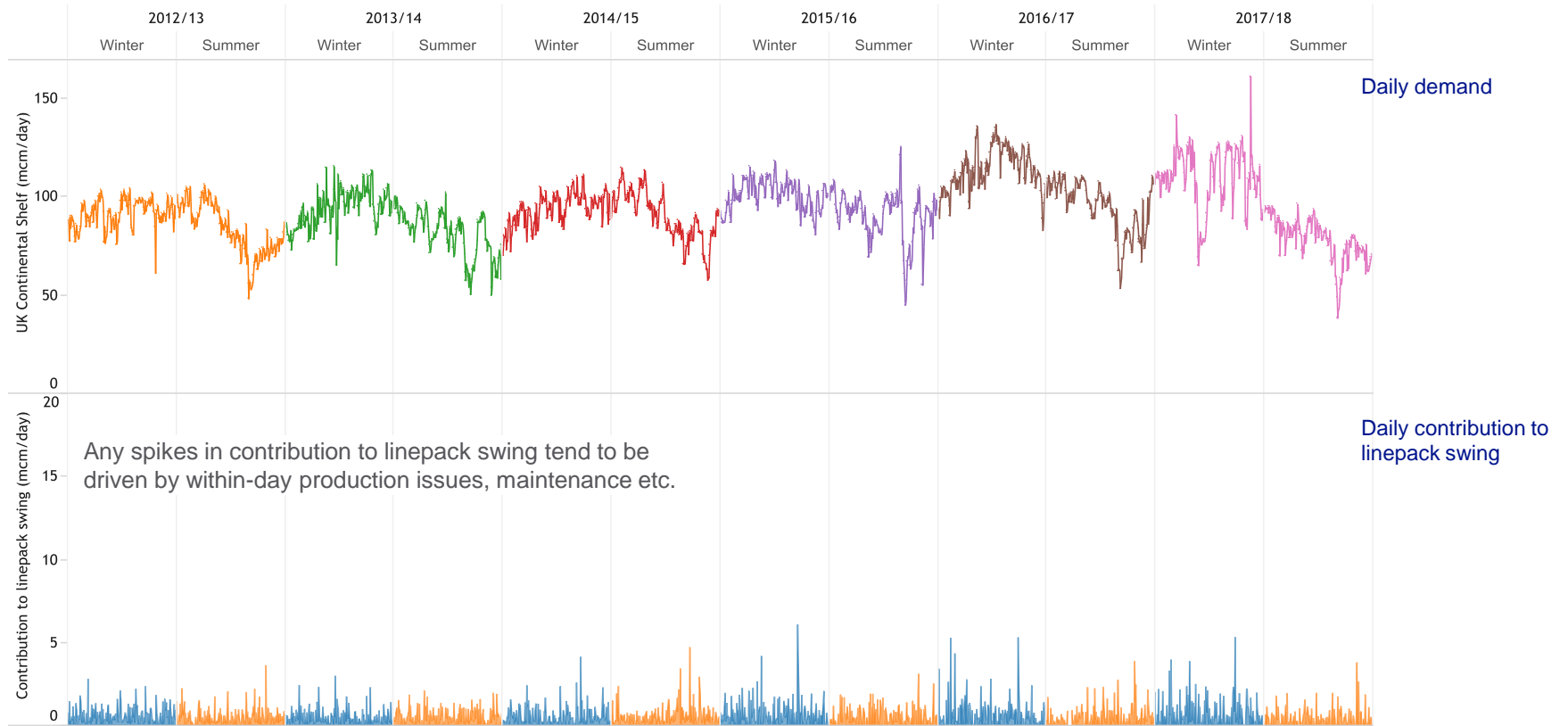Daily gas-fired power station demand and contribution to linepack swing

Increased proliferation of renewables lead to day-to-day gas-fired power station demand becoming significantly more variable.

Daily demand

The inconsistent nature of renewable generation could lead to more frequent short-notice increases and decreases in gas-fired generation demand.

This could increase contribution to linepack swing, especially at lower daily demand rates.

Daily contribution to linepack swing

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)

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UKCS supply within-day is typically constant in delivery rate. This results in minimal contribution to linepack swing.

Daily UKCS supply and contribution to linepack swing

Daily demand

Any spikes in contribution to linepack swing tend to be driven by within-day production issues, maintenance etc.
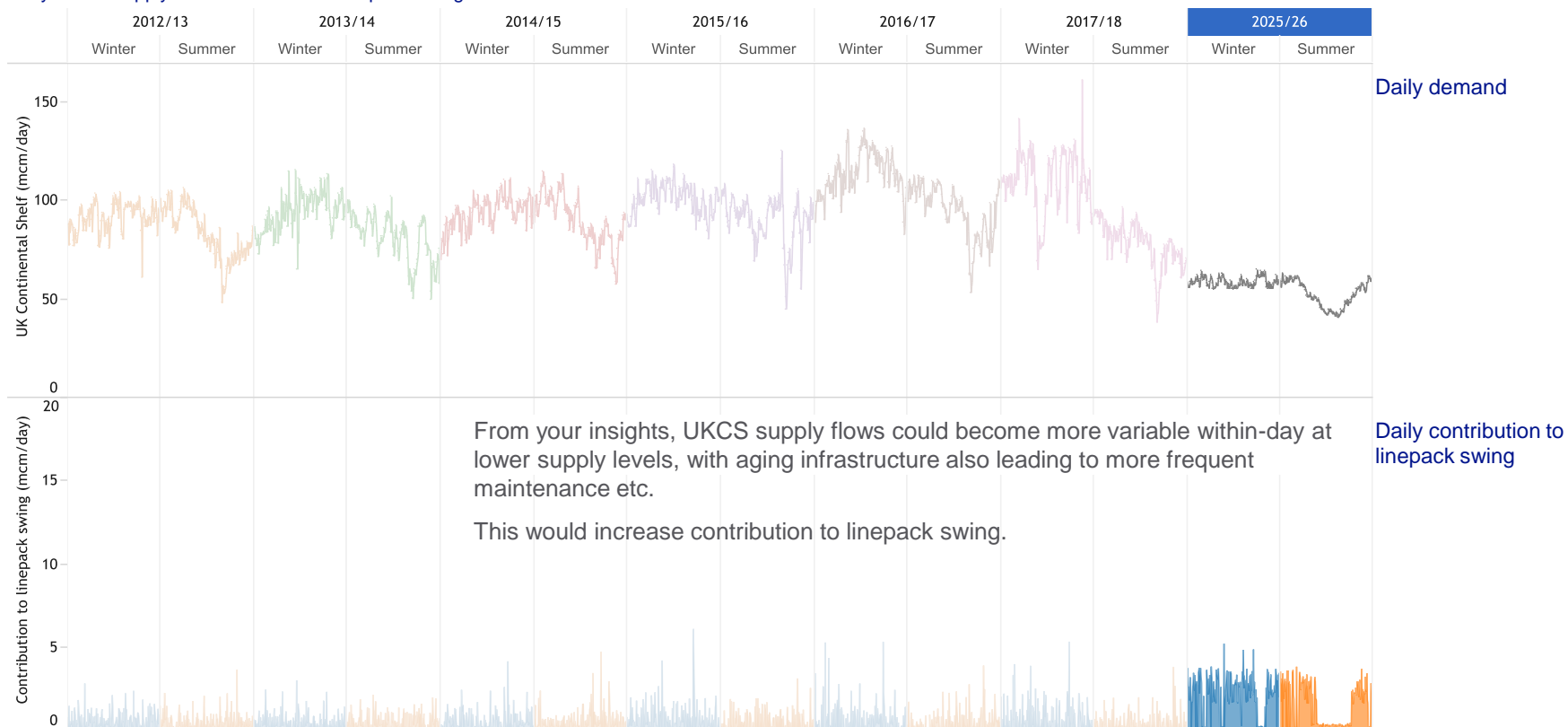
Daily contribution to linepack swing

National Grid Contribution to swing calculation:
For supply – if supply is less than the flat average supply rate, it is having a negative contribution to linepack (causing it to decline)

FORECAST: UKCS is expected to decline in the future[1]. This will increase supply-driven linepack swing as alternative sources are typically less constant in delivery rate.

Daily UKCS supply and contribution to linepack swing

2012/13		2013/14		2014/15		2015/16		2016/17		2017/18		2025/26	
Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer

Daily demand

Daily contribution to linepack swing

From your insights, UKCS supply flows could become more variable within-day at lower supply levels, with aging infrastructure also leading to more frequent maintenance etc.

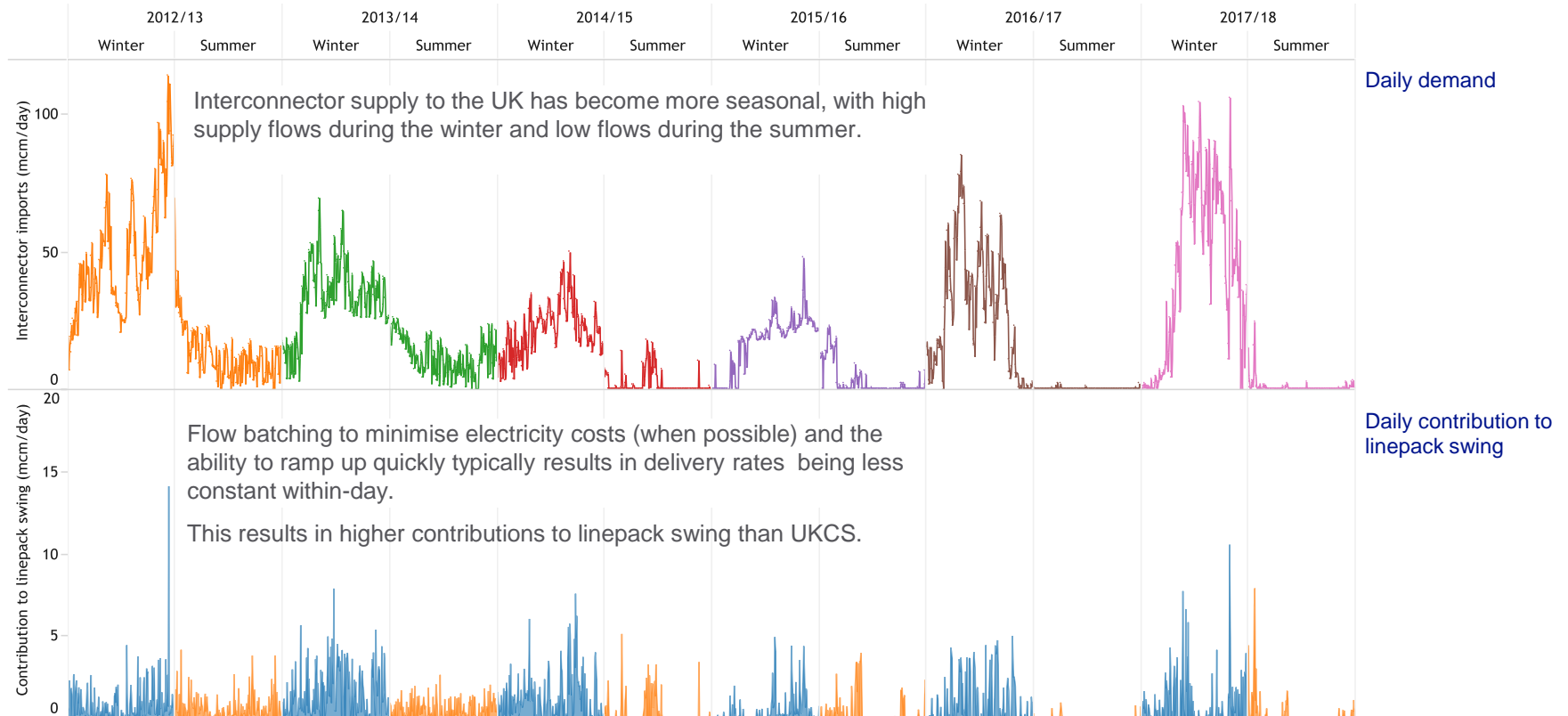This would increase contribution to linepack swing.

National Grid Contribution to swing calculation:
For supply – if supply is less than the flat average supply rate, it is having a negative contribution to linepack (causing it to decline)
[1] *Future Energy Scenarios (FES)*

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Europe-UK spot price spreads and compressor fuel usage optimisation typically lead to variability in how interconnectors bring gas onto the network within-day.

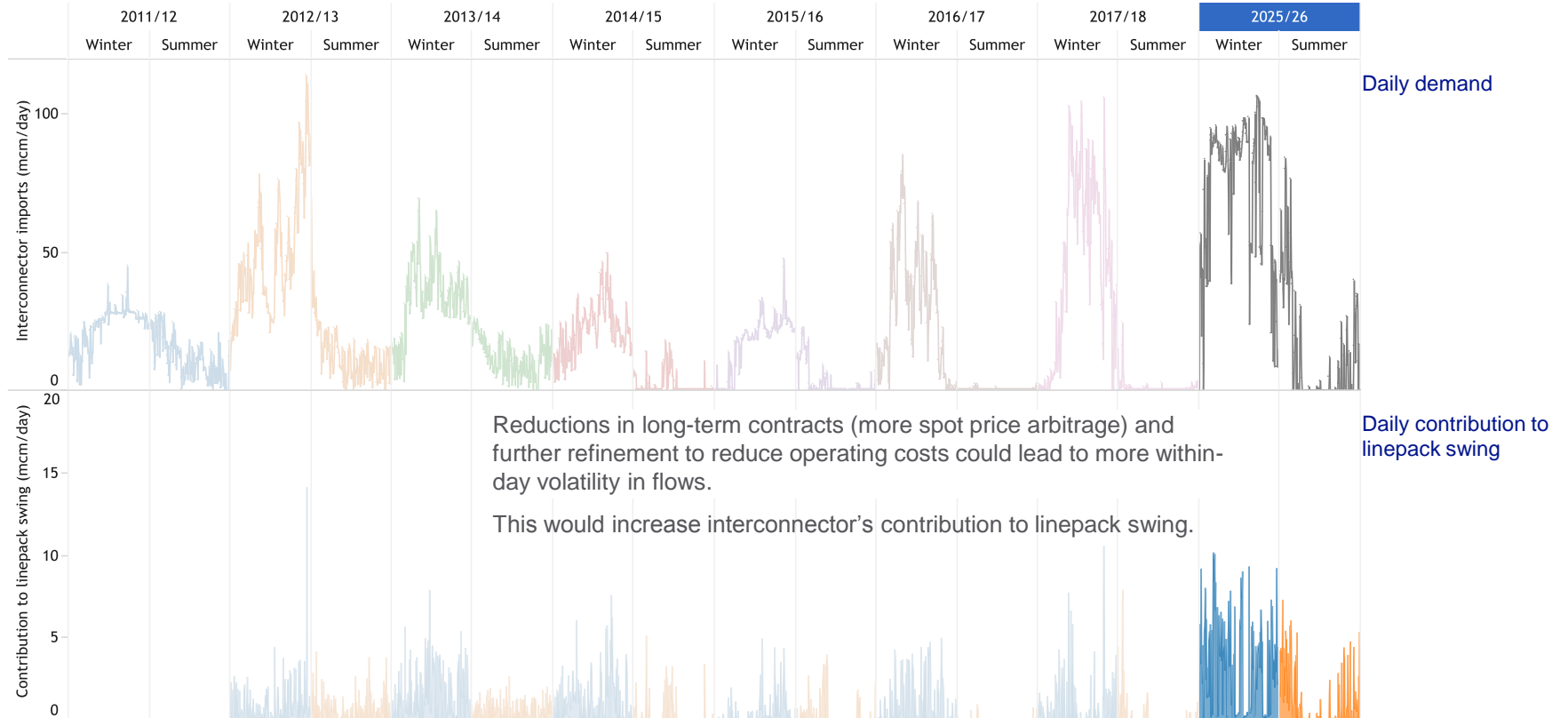Daily interconnector supply and contribution to linepack swing

Interconnector supply to the UK has become more seasonal, with high supply flows during the winter and low flows during the summer.

Flow batching to minimise electricity costs (when possible) and the ability to ramp up quickly typically results in delivery rates being less constant within-day.

This results in higher contributions to linepack swing than UKCS.

Daily demand

Daily contribution to linepack swing

National Grid Contribution to swing calculation:
For supply – if supply is less than the flat average supply rate, it is having a negative contribution to linepack (causing it to decline)

FORECAST: With interconnector imports expected to increase[1],the daily levels of supply-driven linepack swing that need to be accommodated (especially in winter) will increase.

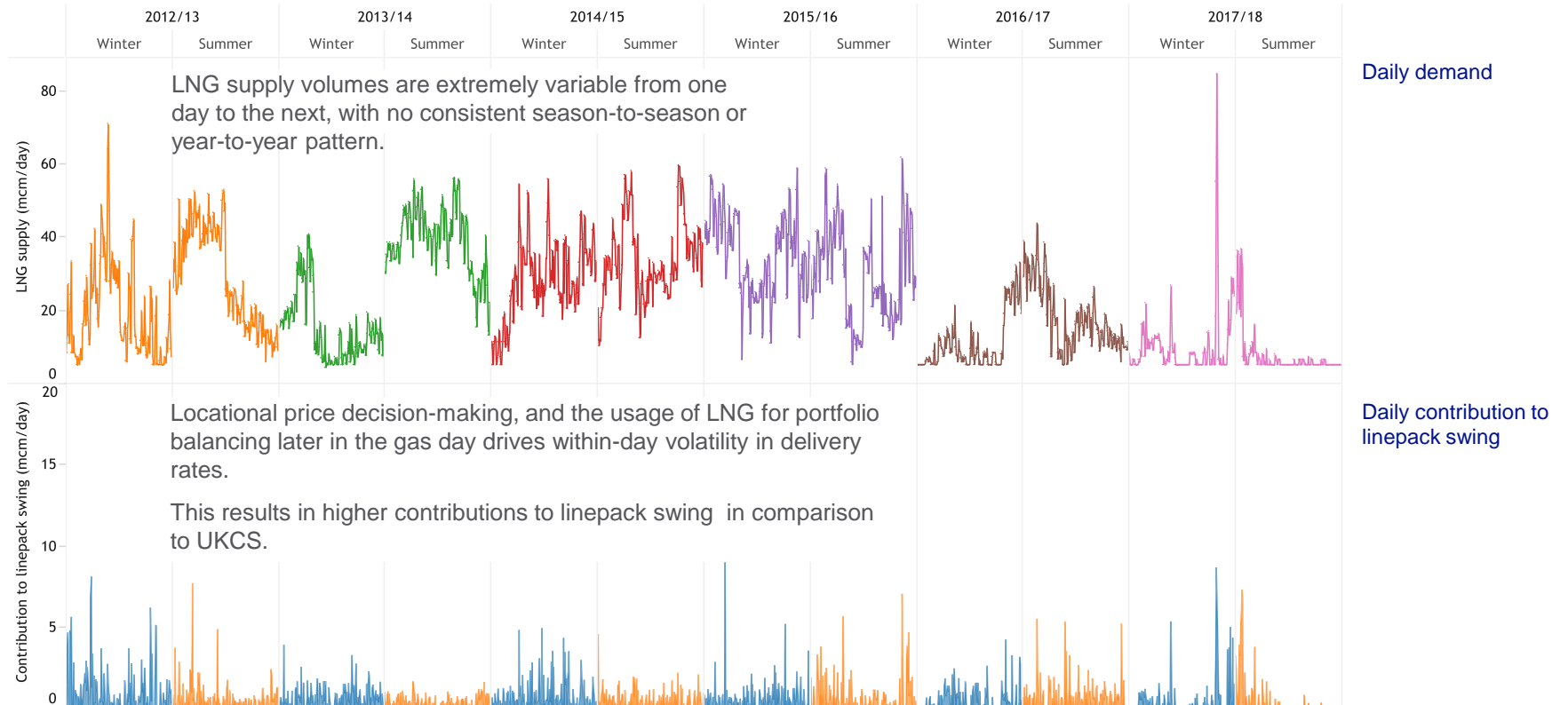Daily interconnector supply and contribution to linepack swing

Daily demand

Daily contribution to linepack swing

Reductions in long-term contracts (more spot price arbitrage) and further refinement to reduce operating costs could lead to more within-day volatility in flows.

This would increase interconnector's contribution to linepack swing.

National Grid Contribution to swing calculation:
For supply – if supply is less than the flat average supply rate, it is having a negative contribution to linepack (causing it to decline)
[1]*Future Energy Scenarios*

Like interconnectors, LNG delivery rates are typically less constant than UKCS.

Daily LNG supply and daily contribution to linepack swing

LNG supply volumes are extremely variable from one day to the next, with no consistent season-to-season or year-to-year pattern.

Locational price decision-making, and the usage of LNG for portfolio balancing later in the gas day drives within-day volatility in delivery rates.

This results in higher contributions to linepack swing in comparison to UKCS.
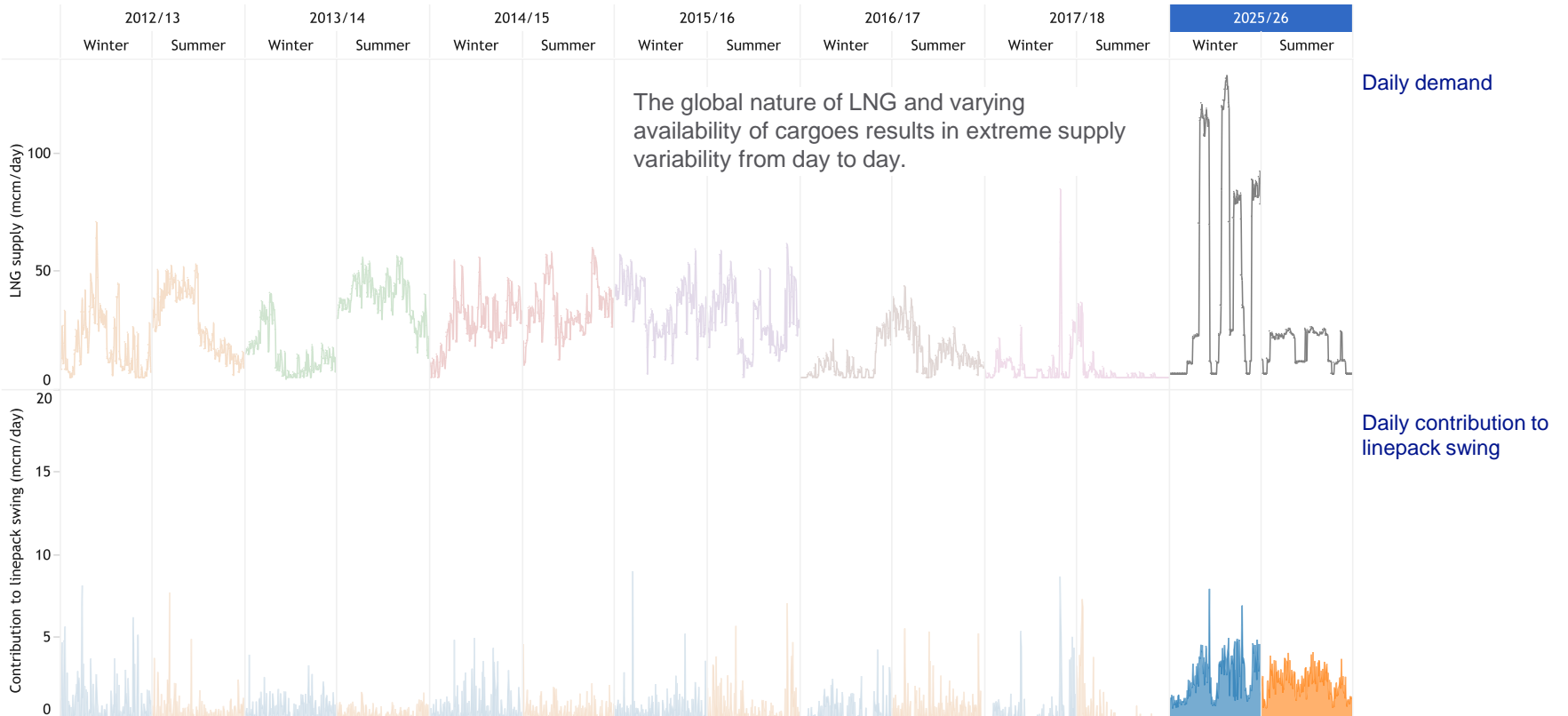
Daily demand

Daily contribution to linepack swing

National Grid Contribution to swing calculation:
For supply – if supply is less than the flat average supply rate, it is having a negative contribution to linepack (causing it to decline)

FORECAST: As LNG operation is expected to increase[1], the daily level of supply-driven linepack swing managed will increase.

Daily LNG supply and daily contribution to linepack swing

The global nature of LNG and varying availability of cargoes results in extreme supply variability from day to day.

Daily demand

Daily contribution to linepack swing

National Grid Contribution to swing calculation:
For supply – if supply is less than the flat average supply rate, it is having a negative contribution to linepack (causing it to decline)

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The frequency and magnitude of storage operation has reduced. This has reduced overall contribution to linepack swing across a gas year.

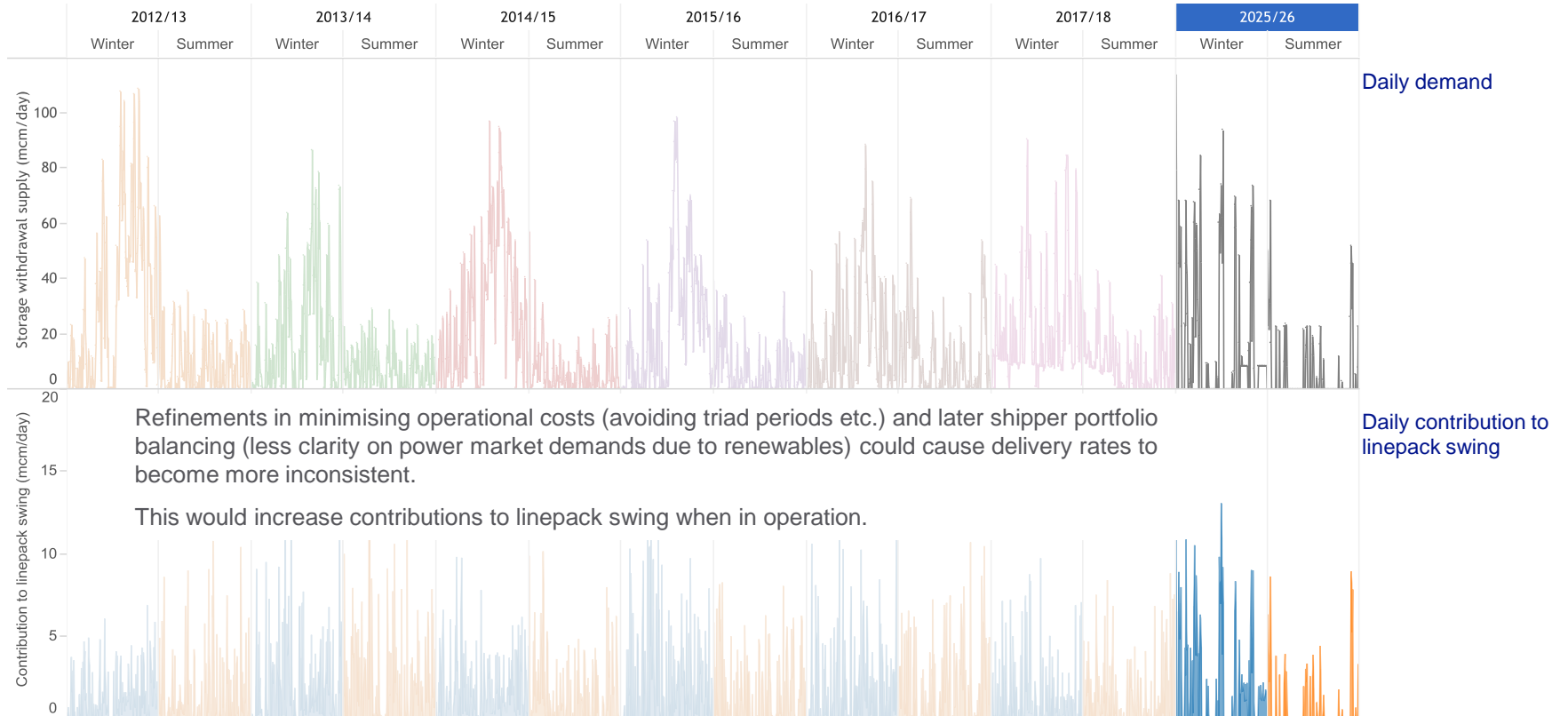Daily storage supply and contribution to linepack swing

The level of seasonal-to-season variation in storage supply has reduced.

Daily demand

Instructions to flow later in the gas day (shipper balancing) and flow optimisation to reduce costs typically drive inconsistent delivery rates. This results in high levels of linepack swing contribution when operating.

Daily contribution to linepack swing

National Grid Contribution to swing calculation:
For supply – if supply is less than the flat average supply rate, it is having a negative contribution to linepack (causing it to decline)

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Supply – Storage withdrawal

FORECAST: We expect this trend to continue with storage operation becoming less frequent. When operating, we expect within-day delivery rates to become less constant.

Daily storage supply and contribution to linepack swing

Daily demand

Daily contribution to linepack swing

Refinements in minimising operational costs (avoiding triad periods etc.) and later shipper portfolio balancing (less clarity on power market demands due to renewables) could cause delivery rates to become more inconsistent.

This would increase contributions to linepack swing when in operation.

National Grid Contribution to swing calculation:
For supply – if supply is less than the flat average supply rate, it is having a negative contribution to linepack (causing it to decline)

Supply - Norwegian Continental Shelf (NCS)

NCS has historically provided a large proportion of gas supply (especially in the winter). Within-day delivery rates are typically less constant in the summer when supply volumes are lower.
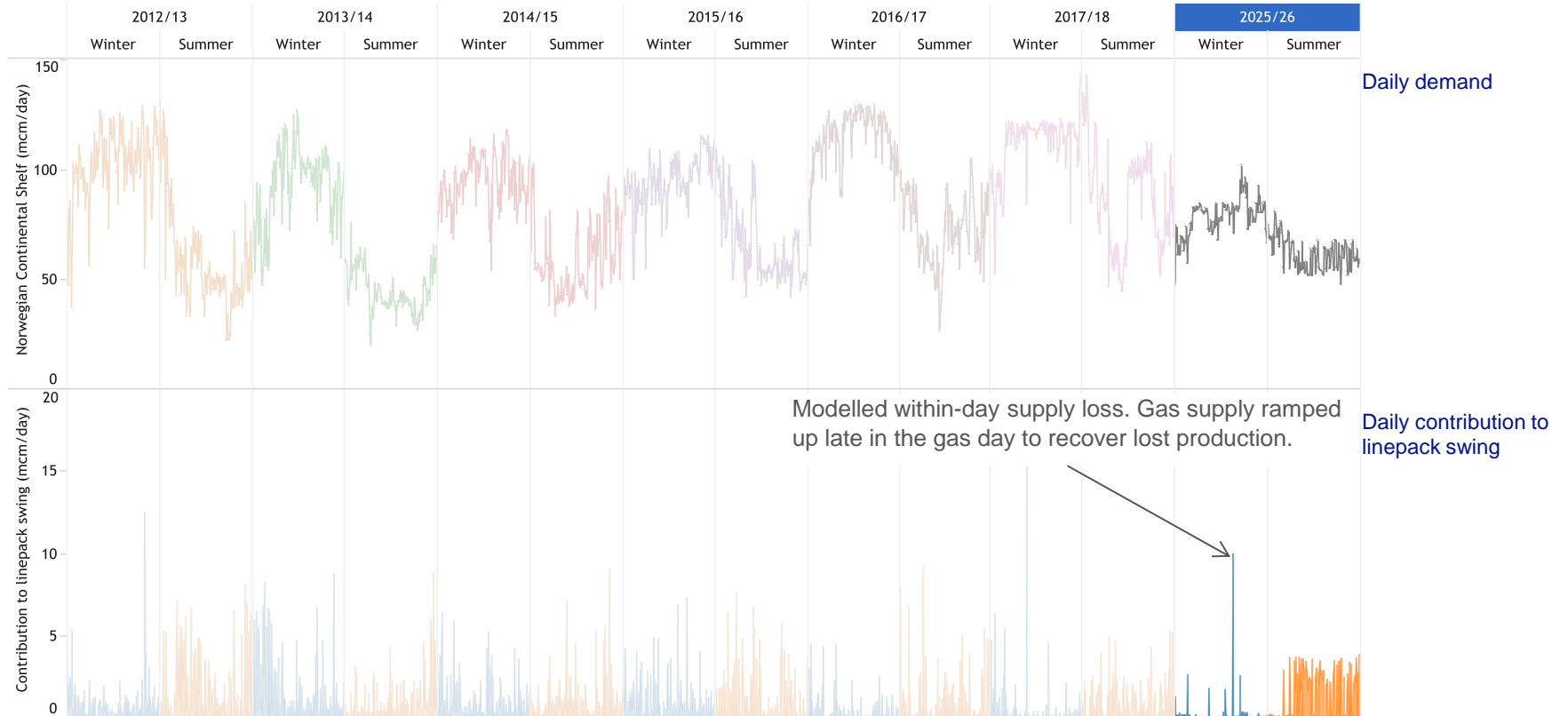
Daily NCS supply and contribution to linepack swing

NCS has historically shown a clear variation in supply from season to season. This trend has declined slightly.

Daily demand

Contribution to linepack swing tends to be higher in the summer (less constant delivery rates at lower supply levels, more maintenance etc.)

Any spikes in contribution to linepack swing tend to be driven by within-day production losses.

Daily contribution to linepack swing

National Grid Contribution to swing calculation:
For supply – if supply is less than the flat average supply rate, it is having a negative contribution to linepack (causing it to decline)

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FORECAST: NCS supplies could decline in the future[1]. We have seen historically, that at lower supply levels, within-day flows tend to be more variable.

Daily NCS supply and contribution to linepack swing

Daily demand

Modelled within-day supply loss. Gas supply ramped up late in the gas day to recover lost production.

Daily contribution to linepack swing

National Grid Contribution to swing calculation:
For supply – if supply is less than the flat average supply rate, it is having a negative contribution to linepack (causing it to decline)
[1]*Future Energy Scenarios*

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:

Having now forecast how gas may be brought on and off the network in 2025, we are working to assess our physical network's ability to meet future within-day customer needs.

In a previous GFOP study, we highlighted that the south east region is sensitive to how gas is brought on and off the network within-day. Therefore, our analysis will initially focus solely on the operational impacts of **within-day behaviour in the south east in 2025**.

To strengthen the next step in our study **we want you to challenge our future forecasts.**

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 continue to meet future within-day customer needs.