The August 9th “Blackouts” in GB

Reasons and implications for the future

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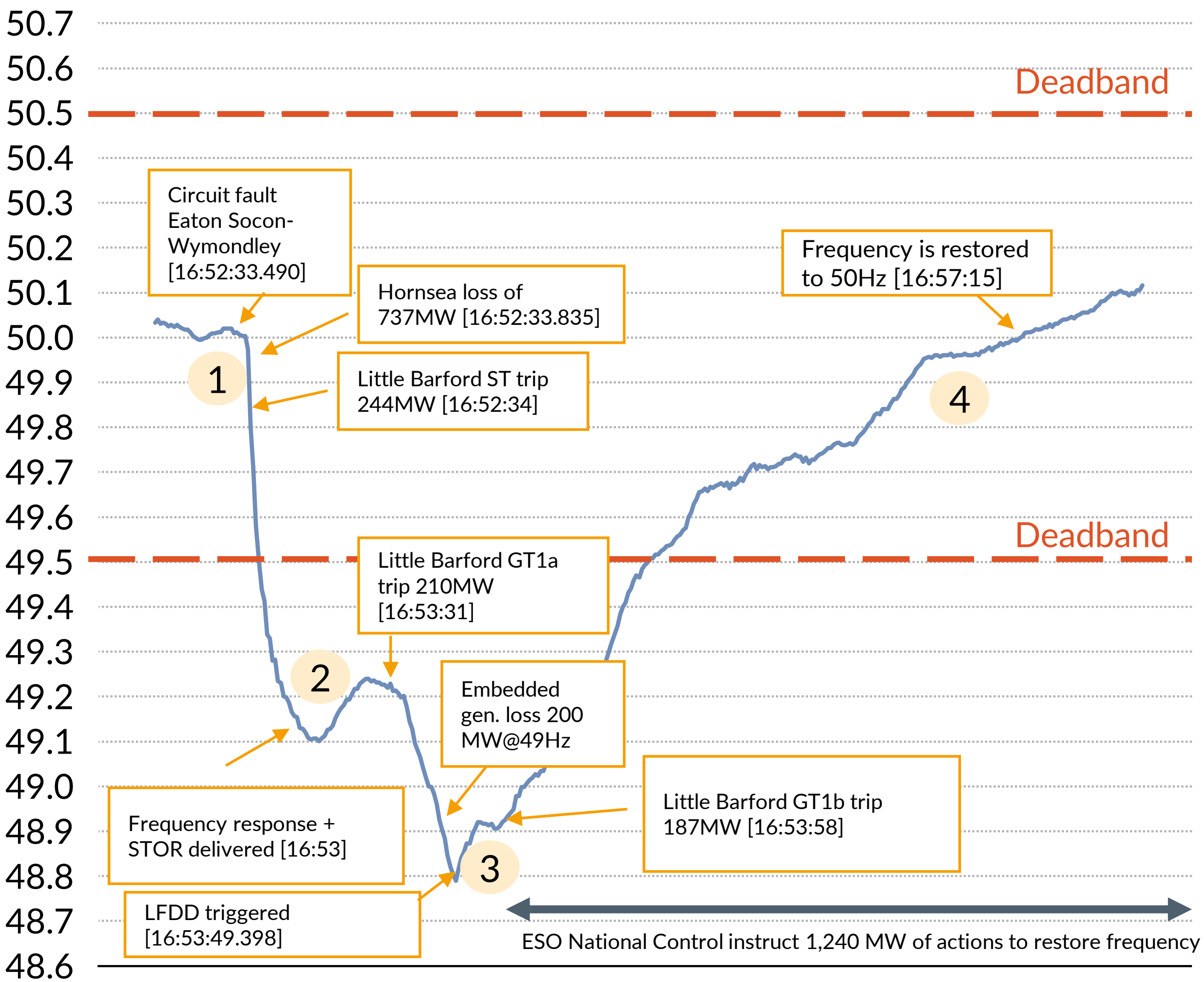
On 9th august, 1 million customers lost power when both Little Barford and Hornsea tripped

Frequency, Hz



- At 4.52pm on 9th August, 1 million customers lost power when both Little Barford CCGT and Hornsea Offshore wind farm, as well as 150 MW of small embedded generation (cumulative 1691MW) disconnected simultaneously
- "Backup" ancillary services responded as expected and managed to curb the frequency fall at 49.1 Hz briefly, before a further trip of 210 MW at Little Barford resulted in system frequency falling to 48.8 Hz
- With all available "backup" power having been deployed, secondary backup systems acted to disconnect approximately 931 MW (3.2%) of demand
- While power was mainly restored by 5.37pm, critical services such as Trains saw further delays

Source: Aurora Energy Research, National Grid, Ofgem

Several key reasons could have contributed towards the blackout

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Potential/cited reasons for blackout

1. Simultaneous lightning strikes
2. Oversensitive protection mechanisms
3. Low system inertia
4. Insufficient ancillary services procured

Lightning records prior to blackout

- Weather conditions on 9 August were not unusual - 12,370 lightning strikes were recorded across mainland UK on 9^{th} August, 2106 of which within the 2 hours preceding the black out
- Three simultaneous lightning strikes occurred at Eaton Socon – Wymondley circuit – any one of these could have hit the circuit
- However, lightning strikes happen all the time and the short circuit was cleared within 74ms – it was the protection mechanisms at the various generation assets which resulted in an automatic shut down in the respective systems

Source: Aurora Energy Research, National Grid, Ofgem

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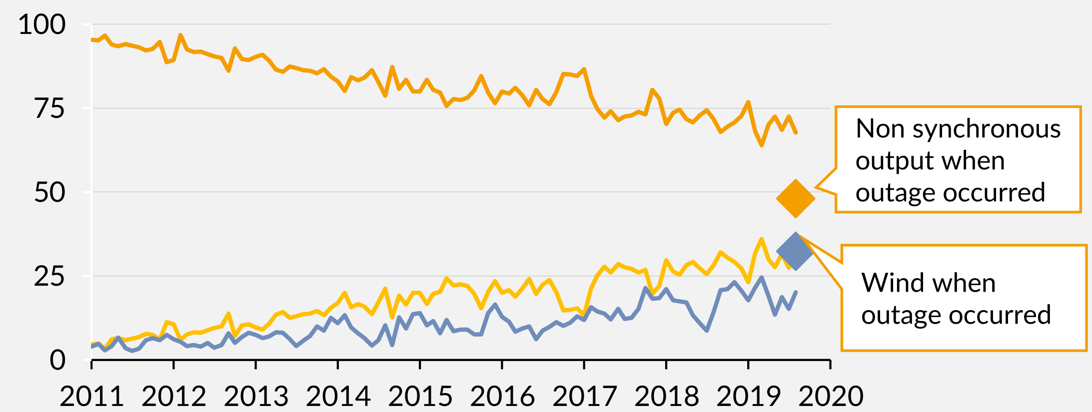
Historic generation in GB[1]
% of total generation, monthly average



- GB has seen an increasing penetration of non-synchronous generation
- As wind output was high prior to the incident, system inertia (which limits changes in system frequency) on the system would likely be low
- While wind variability in itself was not the root cause of the blackout, it could have limited the amount of available inertia on the system

Source: Aurora Energy Research, National Grid, Ofgem

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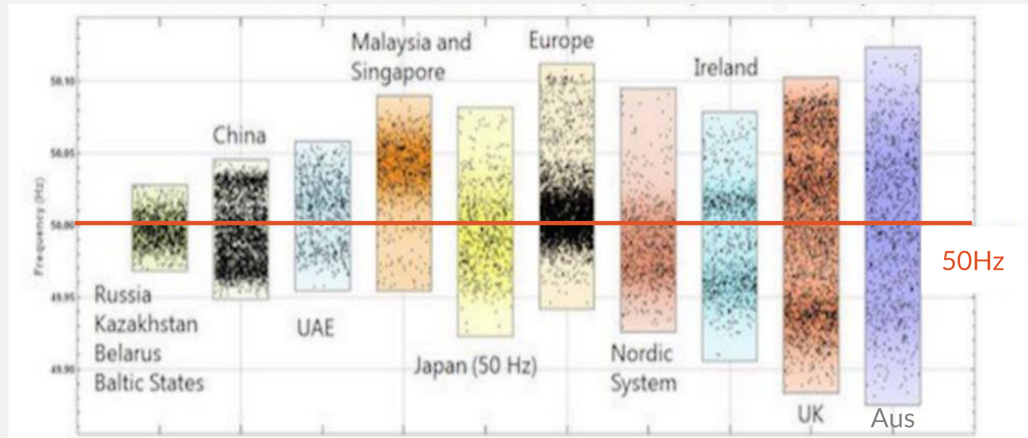
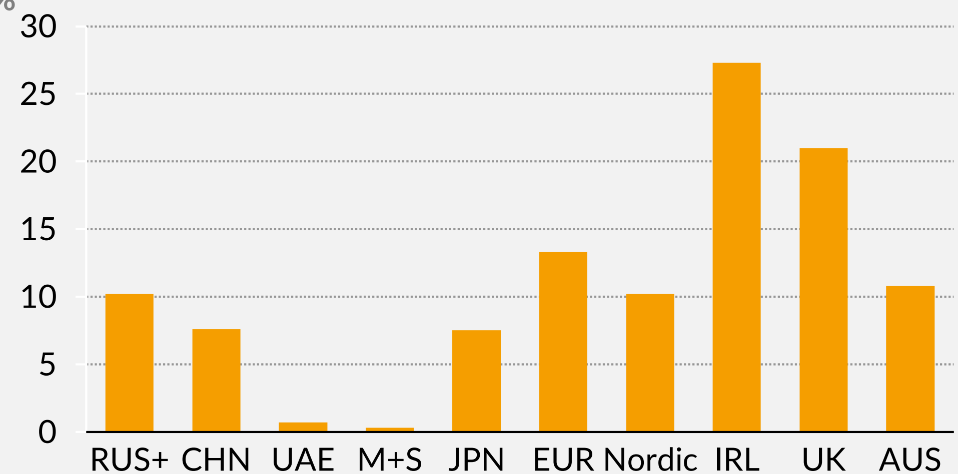
Comparative frequency performance across various 50 Hz power systems (sample from Jan 2018)



2018 Wind and Solar share of generation, %



Sources: Aurora Energy Research, AEMO,BP

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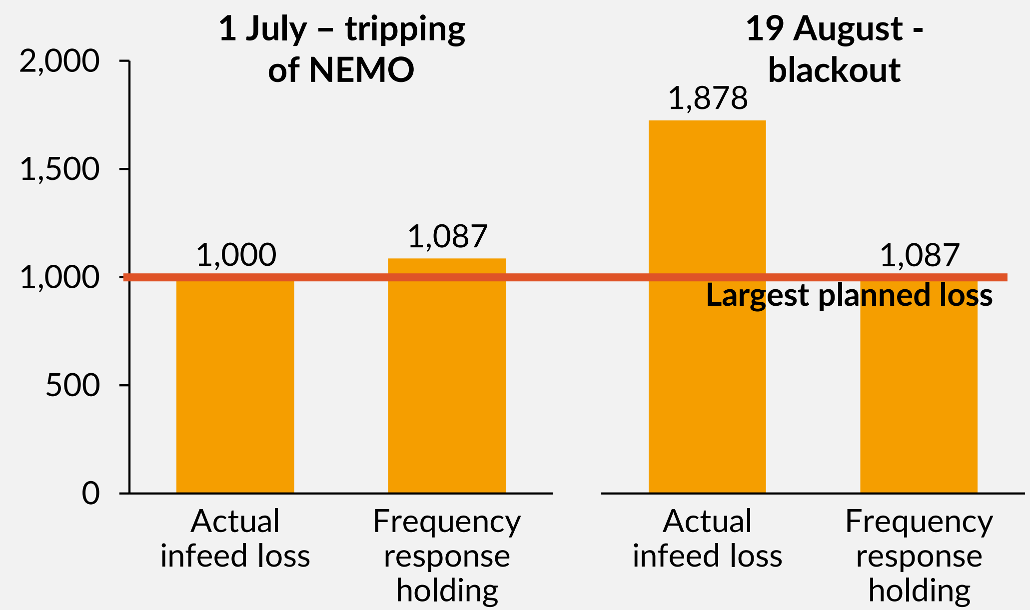
Capacity, MW



- GB currently procures ancillary services in accordance with the largest planned infeed loss – which is typically an interconnector to France or Belgium
- This procurement methodology would typically suffice – with similar system conditions between 1 July and 19 August, the available frequency response holding maintained system frequency as the 1 GW Nemo interconnector to Belgium tripped
- 19 August resulted in outages due to the simultaneously tripping of power plants

Sources: Aurora Energy Research, National Grid, Ofgem

Going forwards, several key questions will have to be answered

Focus today

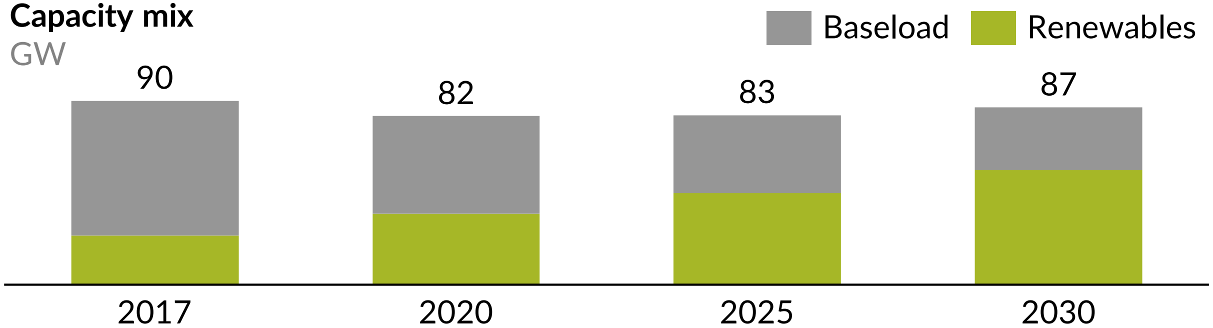
- Are we procuring sufficient services to ensure system security, and how would these evolve with the rise in renewables?
- What technologies are best placed to provide for ancillary services?
- Can we rely on our neighbours to provide for security of supply?

- Are plant settings too sensitive? Do regulators have a role to play?

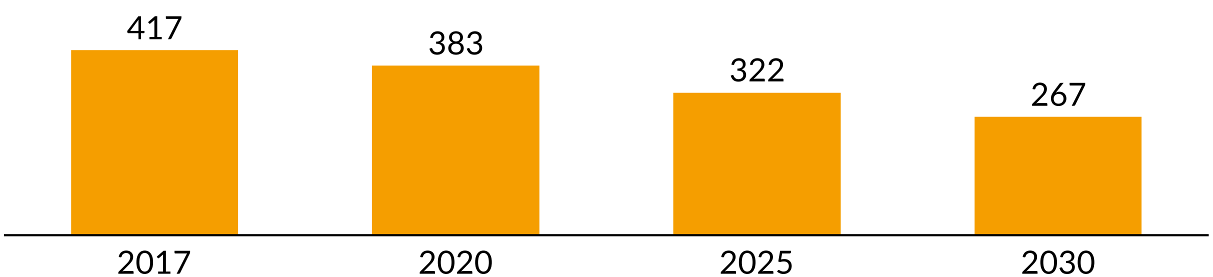
Source: Aurora Energy Research

System inertia decreases as renewable penetration increase, necessitating additional procurement of backup capacities

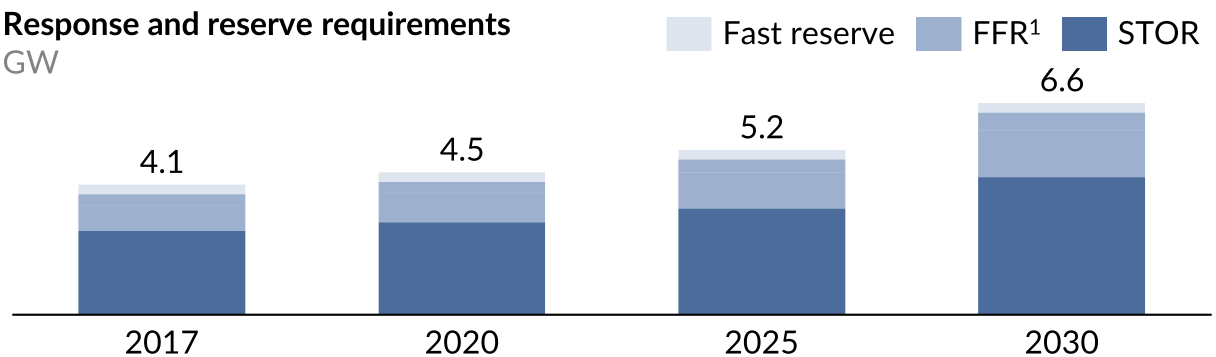
Capacity mix
GW



System inertia
GVA.s



Response and reserve requirements
GW



1. Includes Static and Dynamic

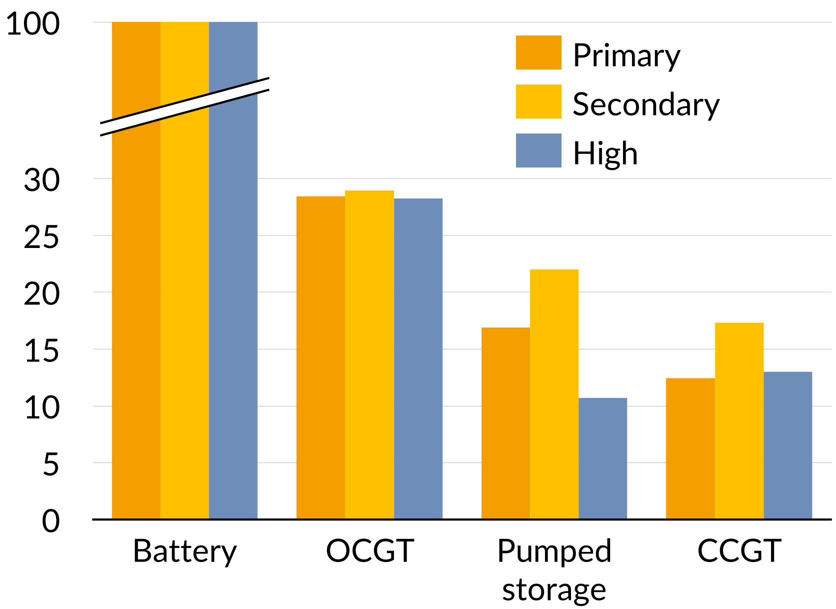
- NG claimed this to be an extremely rare event – a simple analysis points that the event of two independent trips within a 2-minute window would occur once every 4 years, but chances could be much higher if the events were related
- Fundamentally, back up services will also be required as thermal plant retires, renewables uptake increase and new nuclear delivers
- These services aren't expensive - £170m per year is currently spent on frequency response, doubling this only adds £2 to the average household bill

Source: Aurora Energy Research

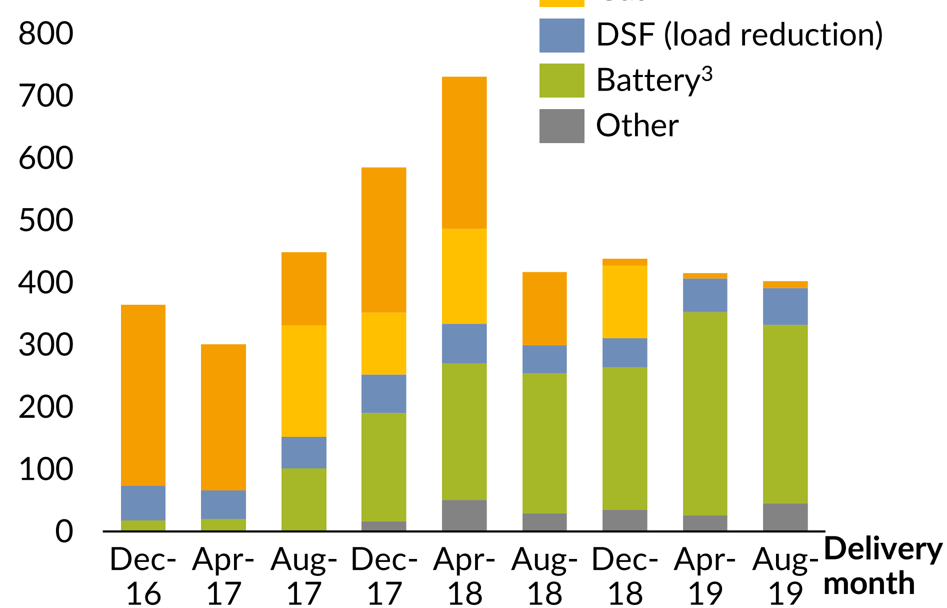
Flexible assets are best placed to provide power in unforeseen circumstances due to fast response times

Example of FFR (dynamic)

Frequency response capability when running[1]
Percentage of capacity, dynamic at 0.5 Hz, %



Average holding volume,
Weighted by duration,[2] MW



- For FFR, sub-minute frequency response requirements[1] mean that most technologies can provide capacity whilst running, but cannot respond in time if not already operational
- Batteries, pumped storage and aggregated DSR are the only technologies capable of responding quickly enough from a 'cold start'
- Batteries have therefore started to dominate FFR markets, although gas recips could outcompete batteries in longer duration reserve markets (such as STOR) or static FFR

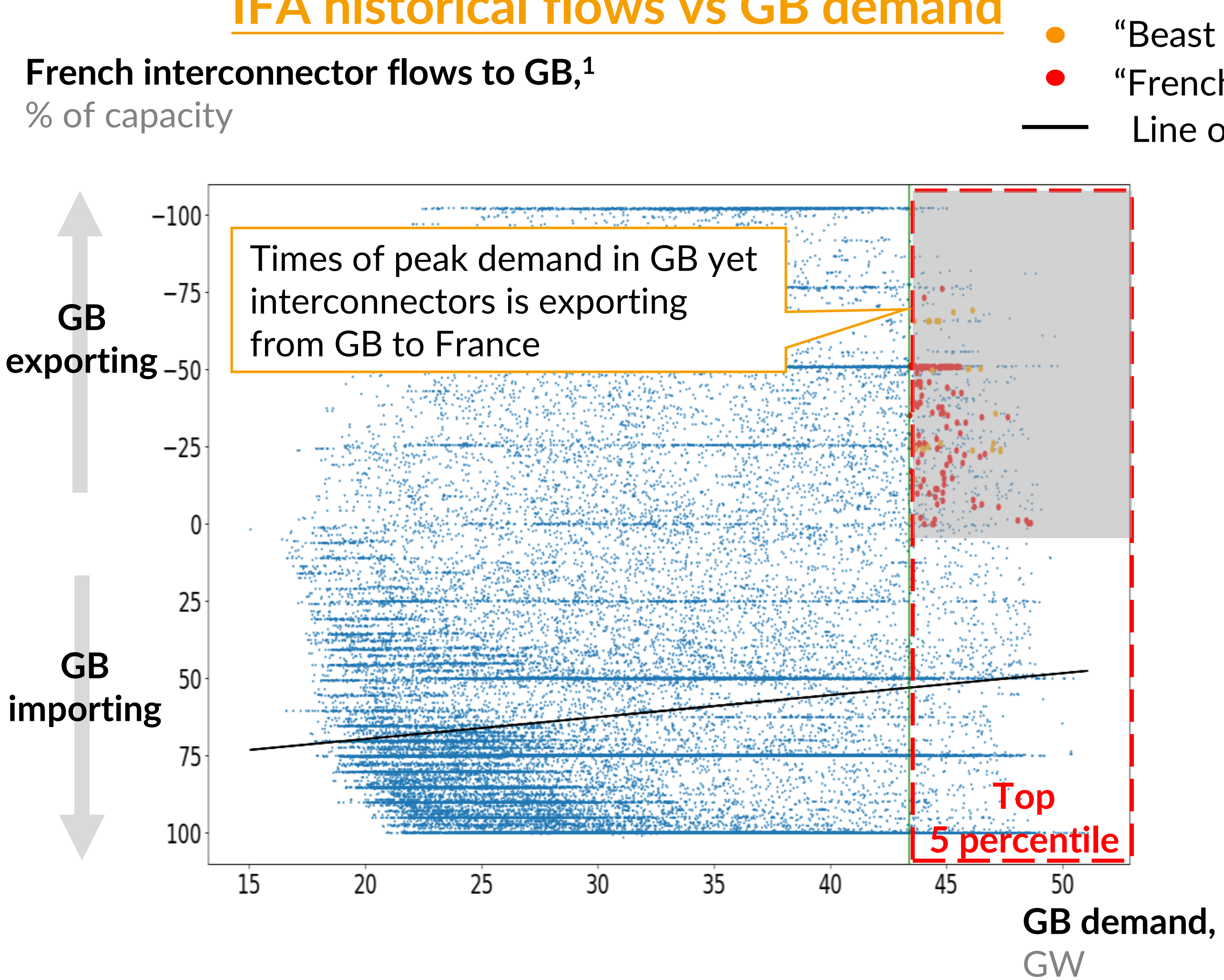
1. Full output within 10 (Primary) and 30 (Secondary and High) seconds

Source: Aurora Energy Research

Relying on interconnectors could be risky – GB has been exporting during scarcity events

IFA historical flows vs GB demand

French interconnector flows to GB,[1]
% of capacity



- Historic IFA interconnector flows to GB are positively correlated to GB demand, implying a tendency to export power from GB to France during periods of high demand in GB
- This was most prominent during two historic stress events – the "Beast from the East", and "French Nukes Down"
- This signals that relying on interconnectors for security of supply could be risky – although a definitive answer can only be made if wholesale price caps have been reached on both sides of the channel

1. Blue dots represent half-hourly interconnector flows 2015-18. De-rating refers to actual 2021/22 T-4 Capacity Market de-rating factor. 2. Beast from the East in GB represents an extended period relative to France, of 6 days from 26th Feb – 3rd March 2018.

Sources: Aurora Energy Research, Entso-e, Elexon

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