Evolution of the GB Electricity System to get to Net Zero

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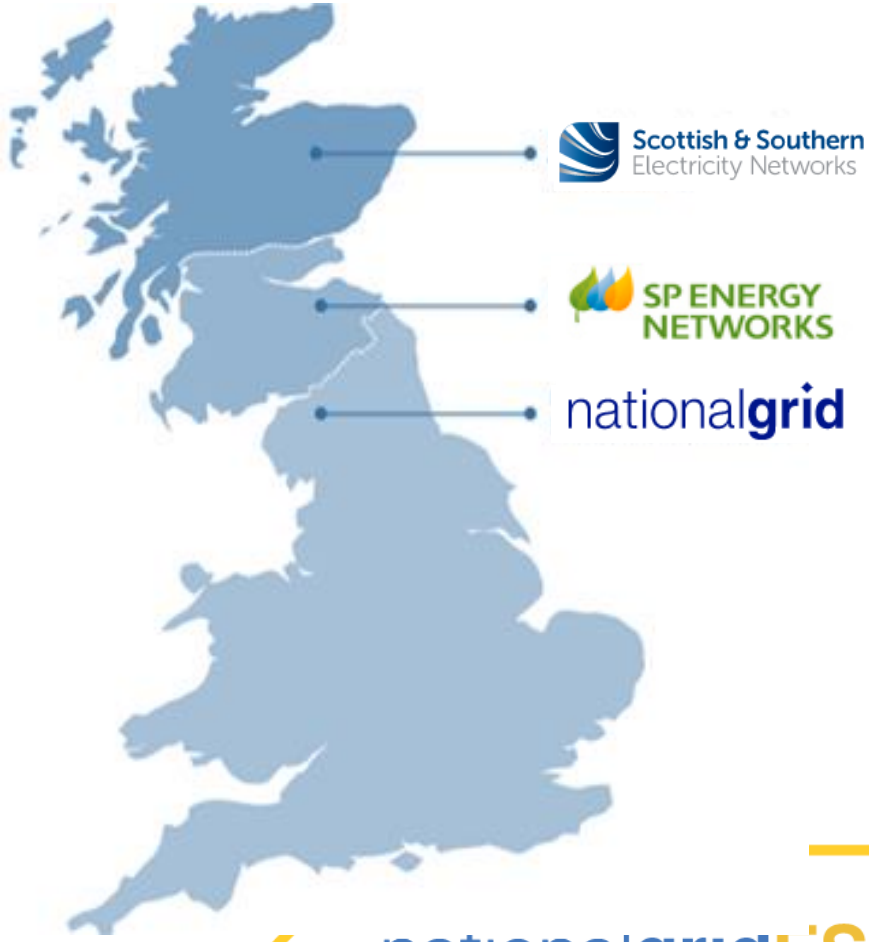
Agenda

- Seven Technical Challenges to Integration of Renewables
  - GB ESO Ambitions and Government targets
  - Engineering Challenges

National Grid ESO's role

- Operates and balances the system
- Widens access, promotes competition
- Network recommendations
- Operational planning
- Connection agreements
- GB charging and billing

The **transmission operators** (TOs) own, build and maintain Britain's transmission infrastructure.



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GB Context and the Seven Engineering Challenges

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Environmental Targets

- Clear Government ambition over a sustained period
  - 15% of all generation to be renewable by 2020
  - All coal to be closed by 2024
  - 100% zero carbon 100% of the time by 2035
  - 50GW offshore wind by 2030
  - 10GW of H2 by 2030
- ESO ambition to have the ability to operate zero carbon in 2025

Zero-carbon operation

Fossil fuelled generation is reducing fast, causing operational challenges

- Frequency management
- Inertia and voltage control

Our plan for 2025:

- For short periods we can operate the transmission system carbon free and can accommodate all the zero carbon generation the market provides

Notable records

- **87.6% zero carbon** on Jan 4th 2023
- **67% share of wind** on Jan 5 & 11th 2023

Our plan for 2035:

- Zero carbon operation all the time
- Manage new challenges of flexibility and adequacy

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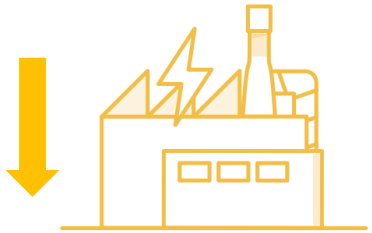
7 Engineering Challenges

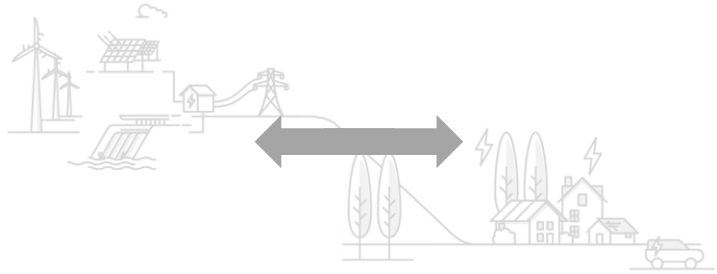
Decarbonisation of the GB power system has resulted in changes in four key areas:



Less dispatchable generation

More variable sources of generation

More asynchronous generation



Generation moving to different areas.

Each of these changes brings about new engineering challenges which have to be resolved to operate a zero carbon network.

- **Frequency** - As more non-synchronous generation connects, system inertia lowers requiring faster acting response. More variability in the system requires fast acting reserves. Large and small loss sizes require services which respond dynamically to the frequency.
- **Stability** - More non-synchronous generation is reducing the levels of stability capability provided to the network. To ensure the system is stable for faults on the network services to provide inertia and short circuit levels need to be procured.
- **Voltage** - Less dispatchable generation and changes to network flows brought about by generation moving away from demand is increasing the requirements to absorb reactive power on the GB network.
- **Thermal** – More variable sources of generation combined with generation moving to different areas are creating more thermal constraints on the network requiring more innovative solutions to manage congestion prior to network build
- **Resource Adequacy –** the right generation mix, flexible demand and storage
- **Flexibility -** what, where and when can we leverage flexibility

Ongoing initiatives to meet stability challenges

- NOA Stability Pathfinder Projects
  - Phase 1 – awarded contracts in Jan 2020 for 12.5 GW.s of inertia
    https://www.nationalgrideso.com/future-energy/projects/pathfinders/stability/Phase-1
  - Phase 2 – will buy inertia of 6 GW.s and SCL of 8.4 GVA in Scotland
    https://www.nationalgrideso.com/future-energy/projects/pathfinders/stability/Phase-2
  - Phase 3 – will buy inertia of 15 GW.s and SCL of 7.5 GVA in areas of England & Wale
    https://www.nationalgrideso.com/future-energy/projects/pathfinders/stability/Phase-3
- Introducing GB Grid Code change for Grid Forming Technologies
  - Grid Code Working Group GC0137
    https://www.nationalgrideso.com/industry-information/codes/grid-code-old/modifications/gc0137-minimum-specification-required
- Stability Market development Innovation project
  - Aims is to understand if there is a need for a stability market
    https://www.nationalgrideso.com/future-energy/projects/stability-market-design
- Accelerated Loss of Mains Change Program (ALoMCP)
  - Under which initiative the electricity distribution companies are updating settings for the RoCoF loss of mains protection relays from 0.125 to 1Hz/s, with a definite time delay of 500ms
  - This will allow us to reduce spend on RoCoF related system constraints.