Power Available Signals, Zero-carbon ESO and New Revenue Streams

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nationalgridESO

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SCOTTISHPOWER

Contents

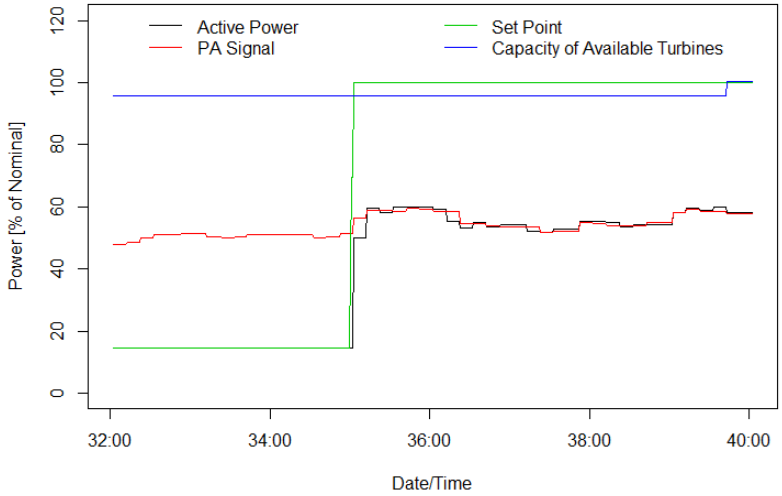
- Power Available
  - What is a power available signal?
  - What is it for?
- Wind Providing Frequency Response
  - Today and in the future…
- PA accuracy and proposed standard

Power Available Signals

- Estimate of power that could be produced if a wind farm is not constrained

- Required to:
  - Know how much power will be produced at the end of a constrained period
  - Know how much headroom is being held if providing a service, e.g. frequency response
  - Settle service provision and lost energy capture

A Power Available Signal



Production of PA Signals

Anemometer Method

- PA based on turbine anemometer measurement and power curve

Notes:

- Anemometer in wake
- Noisy point measurement
- Anemometers are prone to failure

Power Coefficient Method

- Rotor-effective wind speed estimated using *turbine as a sensor*

Notes:

- Requires multiple controller/SCADA feeds
- Aerodynamic and dynamic characteristics of turbines and farm
- Highly accurate provided SCADA is accurate and parameters are tuned correctly
- Included in modern OEM SCADA systems

Modern wind turbines come with this as standard, but it requires set-up/tuning!

Power Available: State of Play

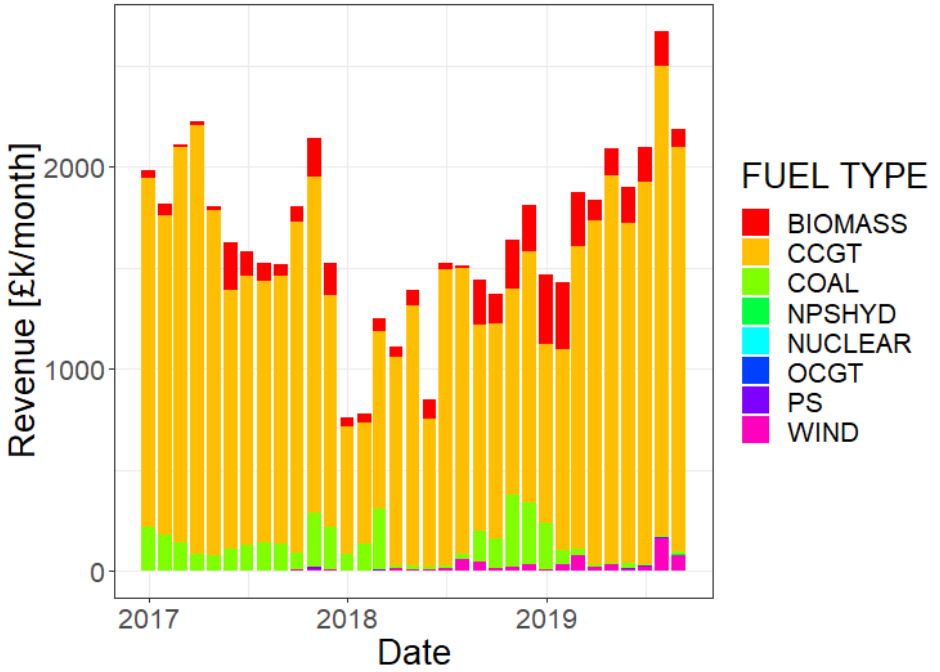
- Part of NGESO pathway to zero-carbon operation in 2025
  - Six deliverables in 2019-2021 Forward Plan
  - Best Practice Guide v1.0 published
  - Various code mods
  - Accuracy standard proposed (more later…)
  - Compliance testing under development

- Zero-carbon system operation requires **zero-carbon ancillary services**!

Frequency Response from Wind

- Vary power output to maintain the system frequency at 50Hz
  - Wind can provide **very fast** response!
  - Opportunity cost if holding headroom for upward response
- £100m market and growing!
  - Incumbent fossil fuel generators being displaced…
- **Today**, wind can only access MFR
  - Month-ahead FFR tenders not practical
  - Auction trial products unfavourable

Revenue from Mandatory Frequency Response by Fuel Type



Frequency Response from Wind

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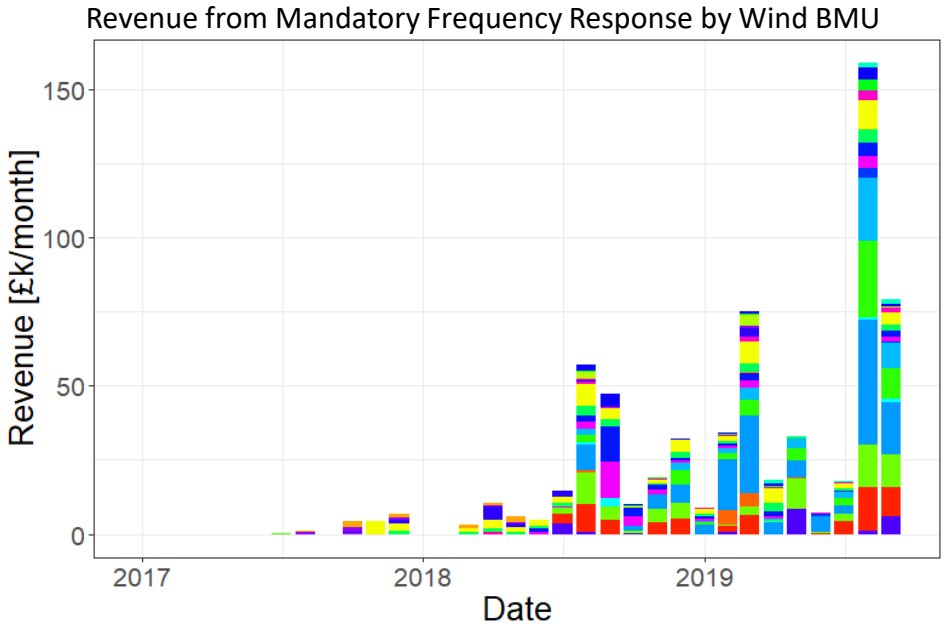
In the future:

- New procurement mechanisms:
  - Day-ahead auction (trial underway)
  - Portfolio participation (on the horizon)

- New products:
  - Unbundled up- and downward response
  - Faster response times (<1 second)
  - Aggregate response, e.g. EFCC



PA Signal Accuracy

- **Accuracy standard as pre-requisite for market access**
  - National Grid ESO commissioned a report from the University of Strathclyde to advise on accuracy assessment methodology
  - Evaluation of historic PA and related data from over 40 diverse wind farms

- **Setting accuracy threshold is a trade-off between:**
  - Maximising competition, and
  - Additional spend to secure against possible error

- **Evaluation should reflect operational requirement and experience:**
  - **Requirement:** identify problems quickly
  - **Observation:** accuracy is generally high until a problem manifests
  - **Operational experience:** on its way…

PA Signal Accuracy Challenge

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Problem:

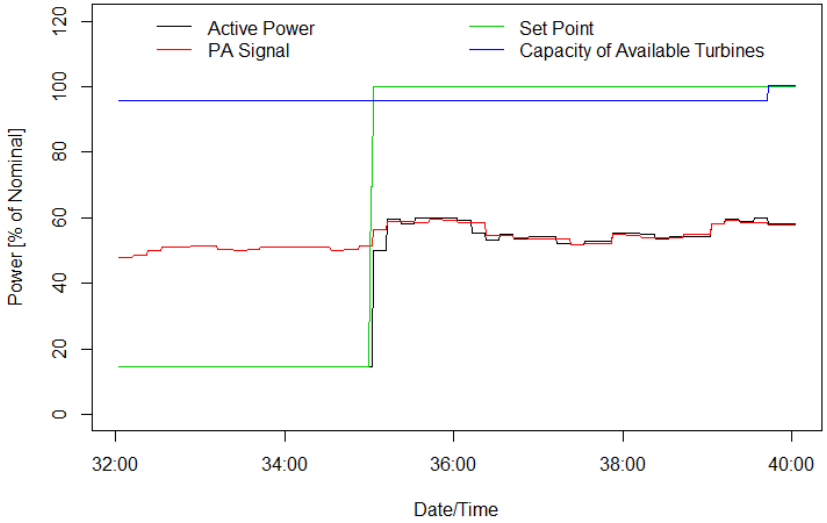
- When accuracy really matters no “ground truth” is available
- Easy to *fake* accuracy during normal operation

Solution:

- Inspect behaviour around beginning and end of constrained operation
- Initially manual task, automation possible later

A Power Available Signal

“Was it under-estimating the actual available power before the Set Point changed?”



NGESO Proposal

A wind farm is flagged as inaccurate if:

1. Absolute error **exceeds 1.5%** of installed capacity **continuously for 5 minutes**
2. Indicators of inaccuracy are observed in any of the following manual checks:
    a) Evidence of inaccuracy at the **beginning or end of constrained operation**
    b) Volatile PA accuracy that does not fail test (1)

A wind farm has flag removed once above test is passed, e.g. error is below 1.5% of installed capacity continuously for 5 minutes or accuracy demonstrated w.r.t. (2)

Strathclyde Analysis:

- A median of **5 flags-per-year**, i.e. half of wind farms we flagged 5 times or fewer
- 10% were flagged frequently (>30 times per year)
- Duration of flag: **less than 2 hours in 80% of cases**, less than 24hours in 95% of cases

NB: data from a period where PA accuracy was not an operational priority!