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

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RenewableUK Onshore Wind Conference

Glasgow, 5 November, 2019
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  – 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
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
Frequency Response from Wind

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

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 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 24 hours in 95% of cases

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