

The Impact of Tightening Margins on Plant Availability

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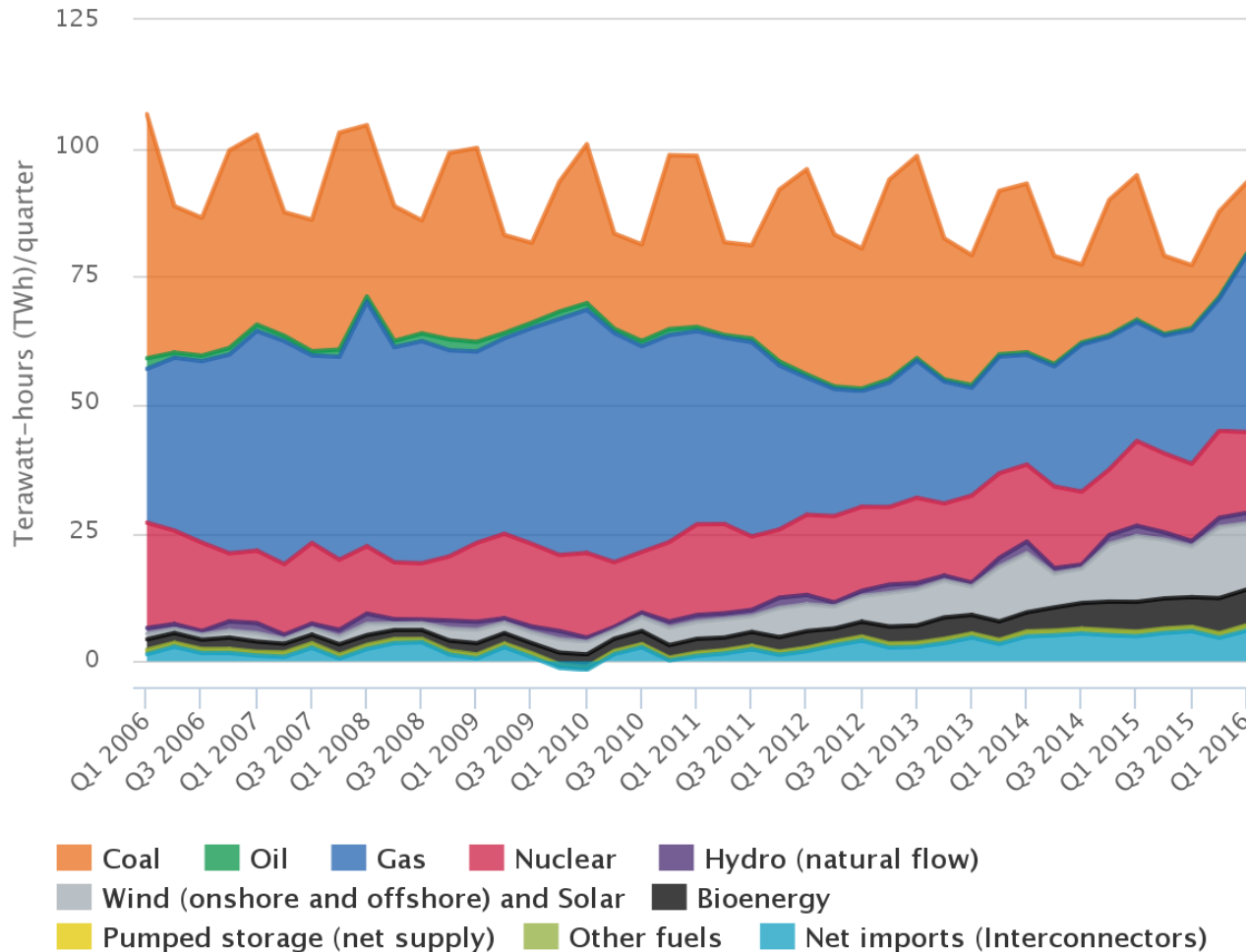
1. Background
2. Research Overview
3. Research Aims & Hypothesis
4. Research Design
5. Preliminary Findings
6. Conclusion and Next Steps

1) Background: Changing GB Generation Mix

Key Changes

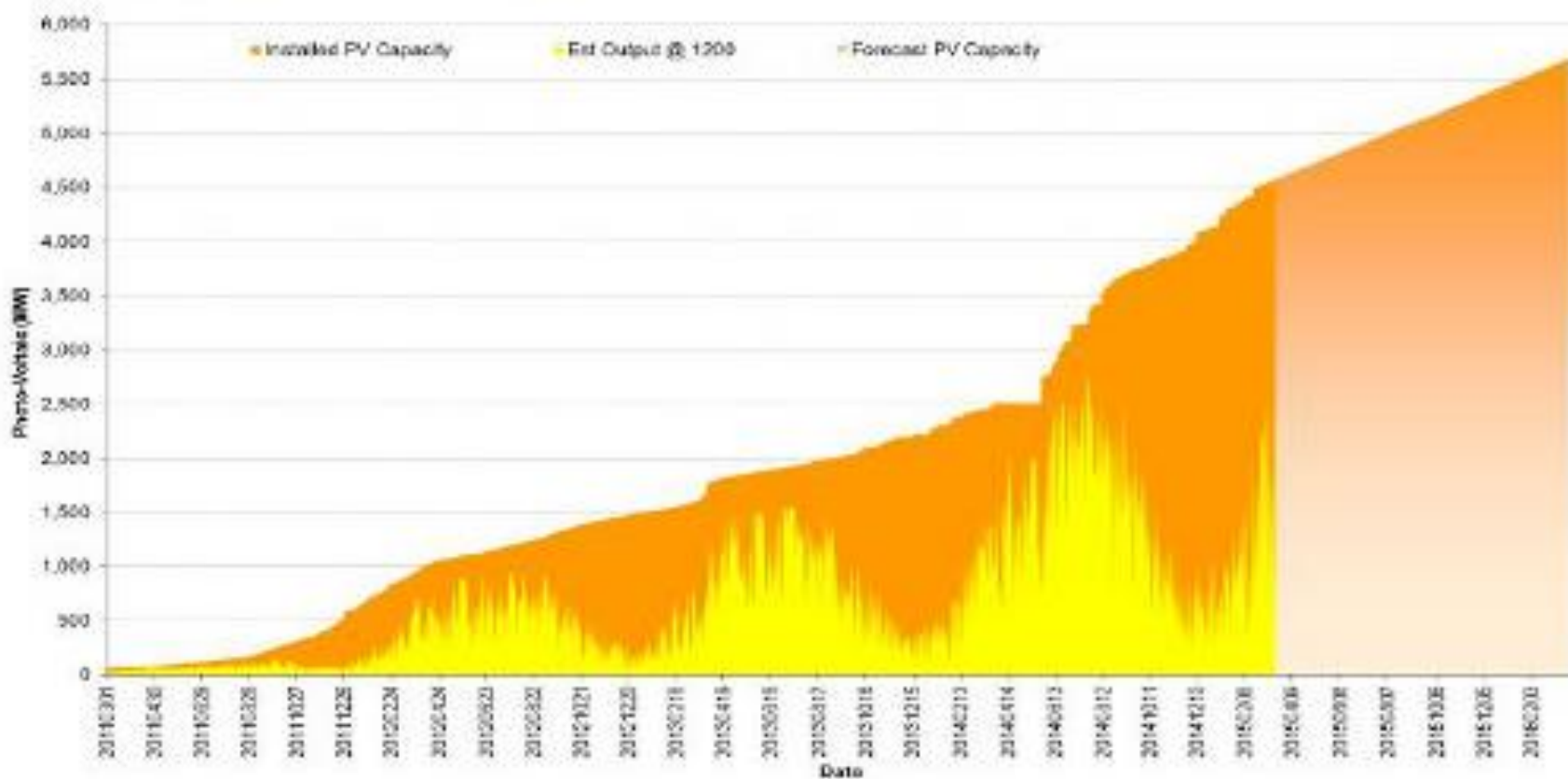
- ↑ **Renewable generation**
 - Solar and Wind share of the generation mix:
 - Q1 2006: 1%
 - Q1 2016: 13%
- ↓ **Coal**
 - Coal share of the output fell:
 - Q1 2006: 48%
 - Q1 2016: 14%

Electricity generation mix by quarter and fuel source (GB)



1) Background: Rapid installation of solar

- Solar capacity and output has risen rapidly over the last few years
- Intermittent and embedded nature of solar creates challenges



1) Background: Impact of Increasing Renewable Generation

Technical and Economic Impacts of Increasing RES on Power System

- Variability of wind/solar gives NG a greater challenge in managing the system
- Difficulty of predicting RES output means ↑ price uncertainty
- Intermittent generation not always able to deliver in periods of system tightness
- Growing need for operational flexibility to mitigate potential disturbances
- Thermal plant required to operate differently than historic usage
- Displacement of marginal power plants, challenging economics for thermal plant
- ↓ Marginal prices
- ↑ Negative prices
- Lower transmission demand and changing profile
- ↓ System stability
- ↑ Need for balancing services

1) Background: Impact of Increasing Renewable Generation

- The growing number of coal plant closures in GB has contributed to reduced electricity margins over the winter period.
- Spare electricity capacity in the GB market during winter has decreased each year from 2011-12 through to 2015-16.
- National Grid says it still has a manageable margin for the coming winter

Spare electricity capacity in the market during winter

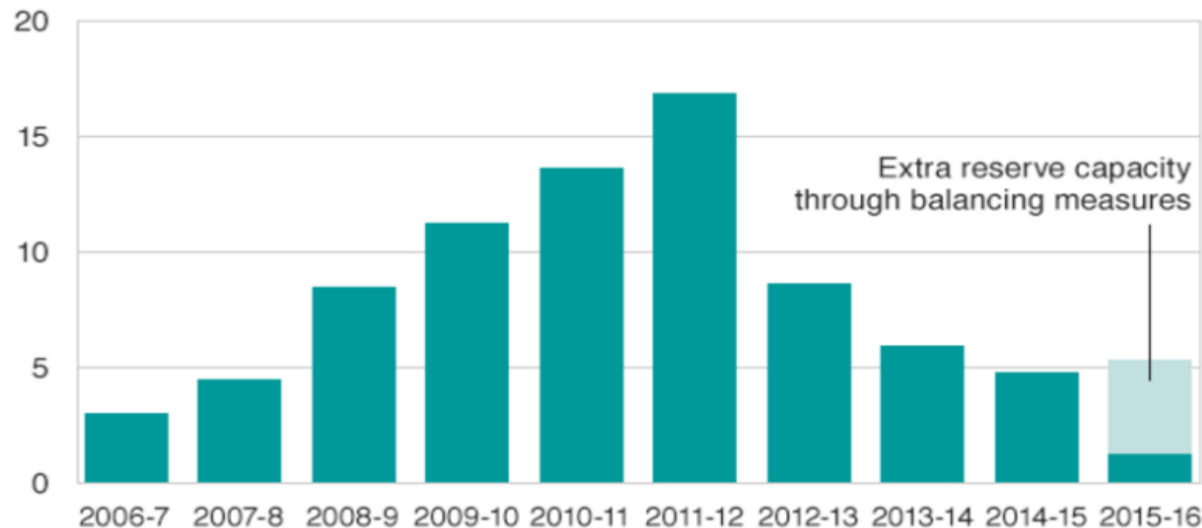


Chart constructed by BBC (2015) drawing on data provided by National Grid

2) Research Overview: Research Problem

These changes have altered the market, and participants behaviour (including their availability) may be affected

Empirical research is needed to understand this

2) Research Overview: De-Rating Generation Capacities

- % values used to adjust the installed capacity to reflect when actual available capacity in peak periods
- Take into account factors such as planned maintenance, breakdowns and commercial availability
- Used by Ofgem, NG and BEIS for electricity security of supply assessments, implications for system planning, can impact on the economics of CCGT plant financing

2) Research Overview: Current approach and further research

- At present, National Grid use historic data for assumptions about winter availability
- As the market design evolves and we move towards reduced electricity margins over winter, we think this approach can be updated to capture the changing nature of the market in the outlook
- We've identified a gap in the current analysis, think it's important to address this gap
- **We are keen to get your views and feedback into this discussion**

2) Research Overview: Research to date

- Existing research details the impacts of increased renewable output on conventional generation
 - ie as wind output ↑, conventional output ↓
- Less research into how plants respond when most needed
 - **scheduling maintenance etc.**

3) Research Aims & Hypothesis: Purpose

To assess what happens to CCGT availability when capacity of other fuel types is low, reducing electricity margins

Our research focuses specifically on availability within GB, as margins have been falling here over the past number of years

3) Research Aims & Hypothesis: Hypothesis

We expect our analysis to show that:

- CCGT availability increases when needed, i.e. when less alternative sources of generation are available

3) Research Aims & Hypothesis: Research implications

- If our hypothesis is correct (that lower CCGT availability is a result of market conditions), then **CCGT potential in GB may currently be slightly underestimated.**
- As availabilities are used in the capacity market to determine the necessary volume of capacity to procure, **increased availabilities may reduce the amount of procurement required** in future analysis.
- ↓ procurement = ↓ costs to consumers (while still ensuring security of supply)

4) Research Design: Core arguments and assumptions

- We expect that prices would increase during periods of reduced electricity margins, which would further support CCGT plant economics.
- The expectation that gas power plants should respond to market price signals has already been established in the academic literature.

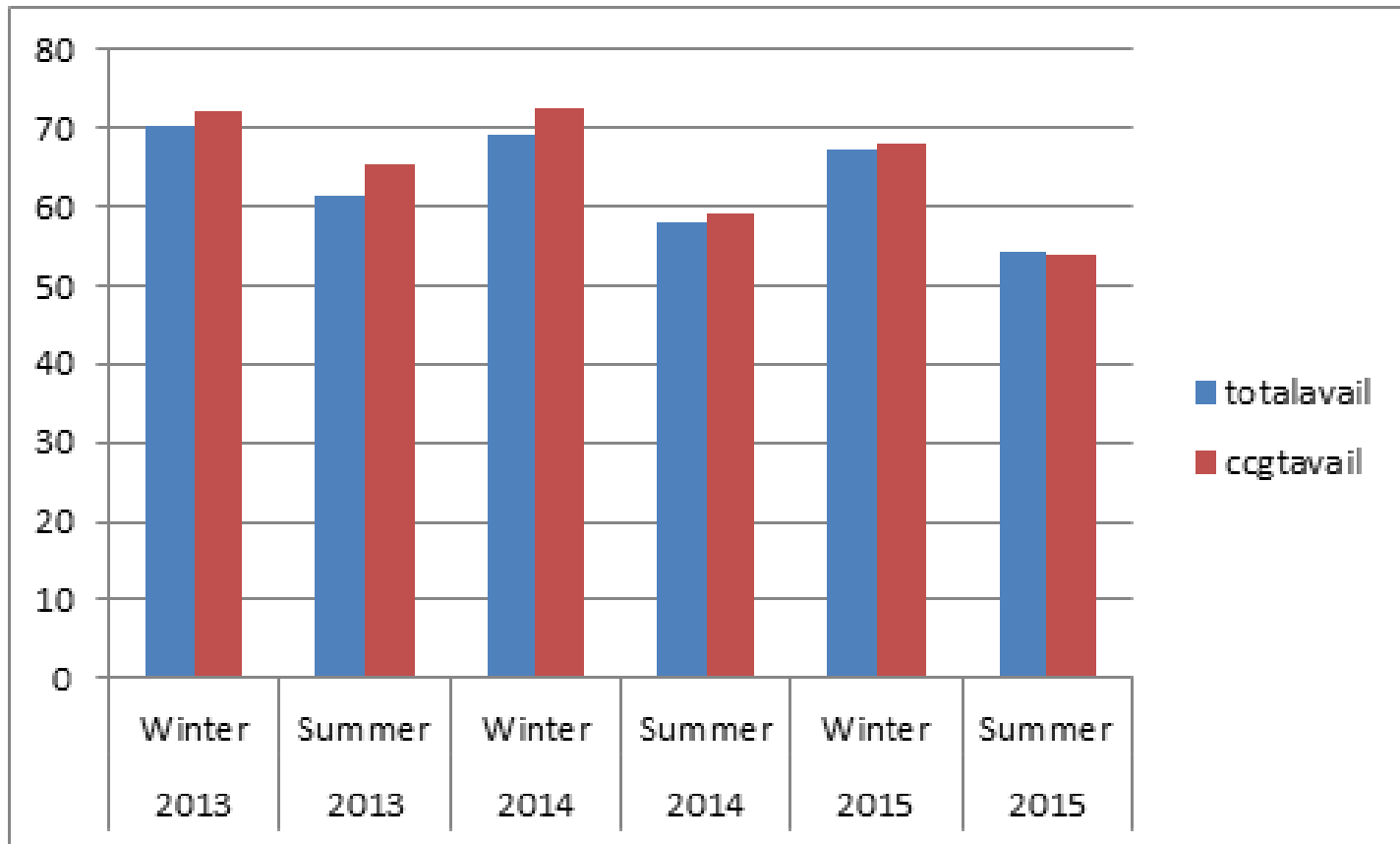
Data Collection

- Use half-hourly data from April 2013 – March 2016
- Profile of the max level at which each Balancing Mechanism Unit (BMU) may be exporting to the GB Transmission System at the Grid Supply Point, defined as the Maximum Export Limits (MELs)
- Current results are indicative as we are not convinced that the data we have is complete

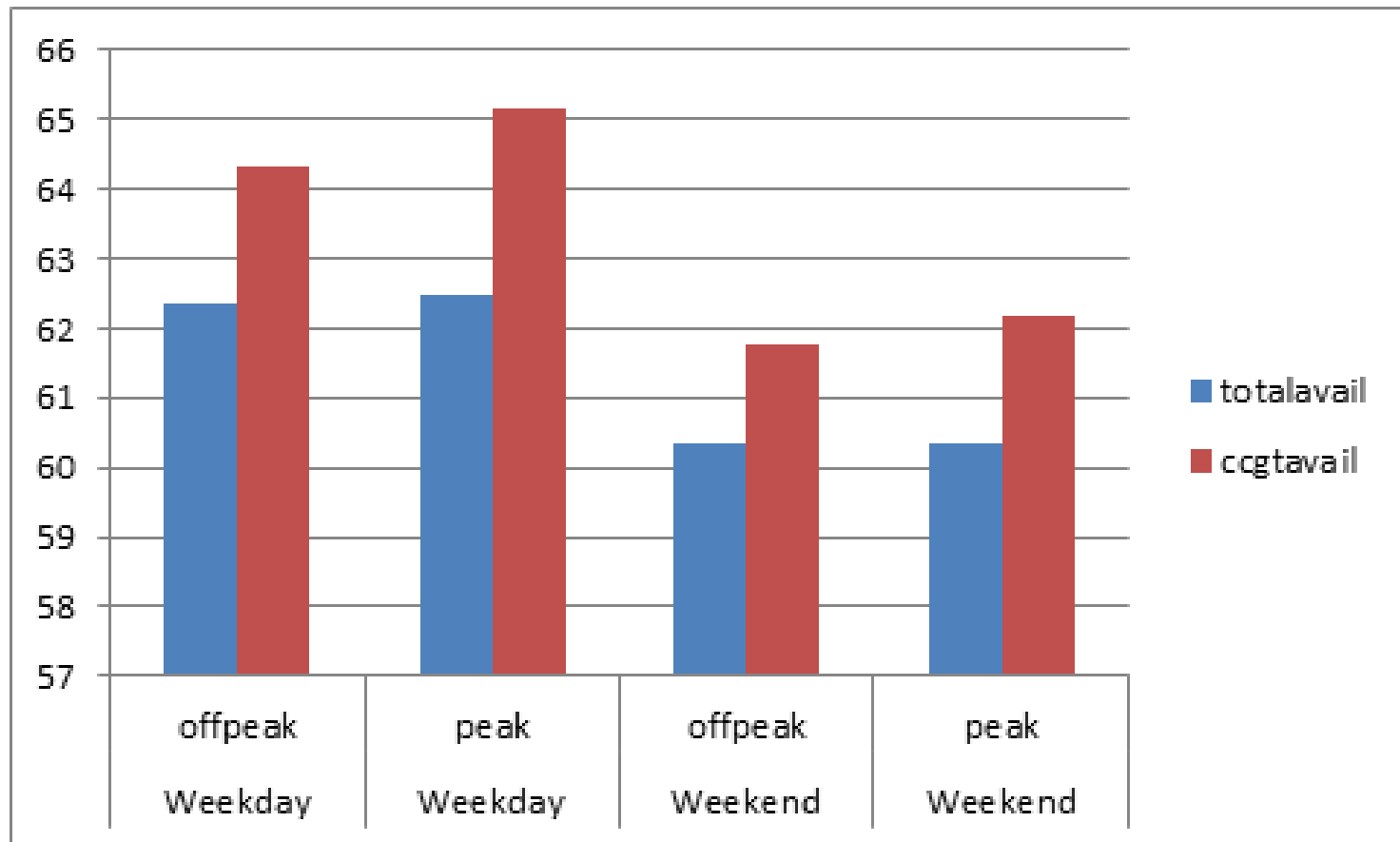
Data Analysis

- Use time series regression analysis
- Control for periods where less flexible plant on the system were unavailable to meet demand
- Focus on impact of CCGT availabilities during times of reduced electricity margins

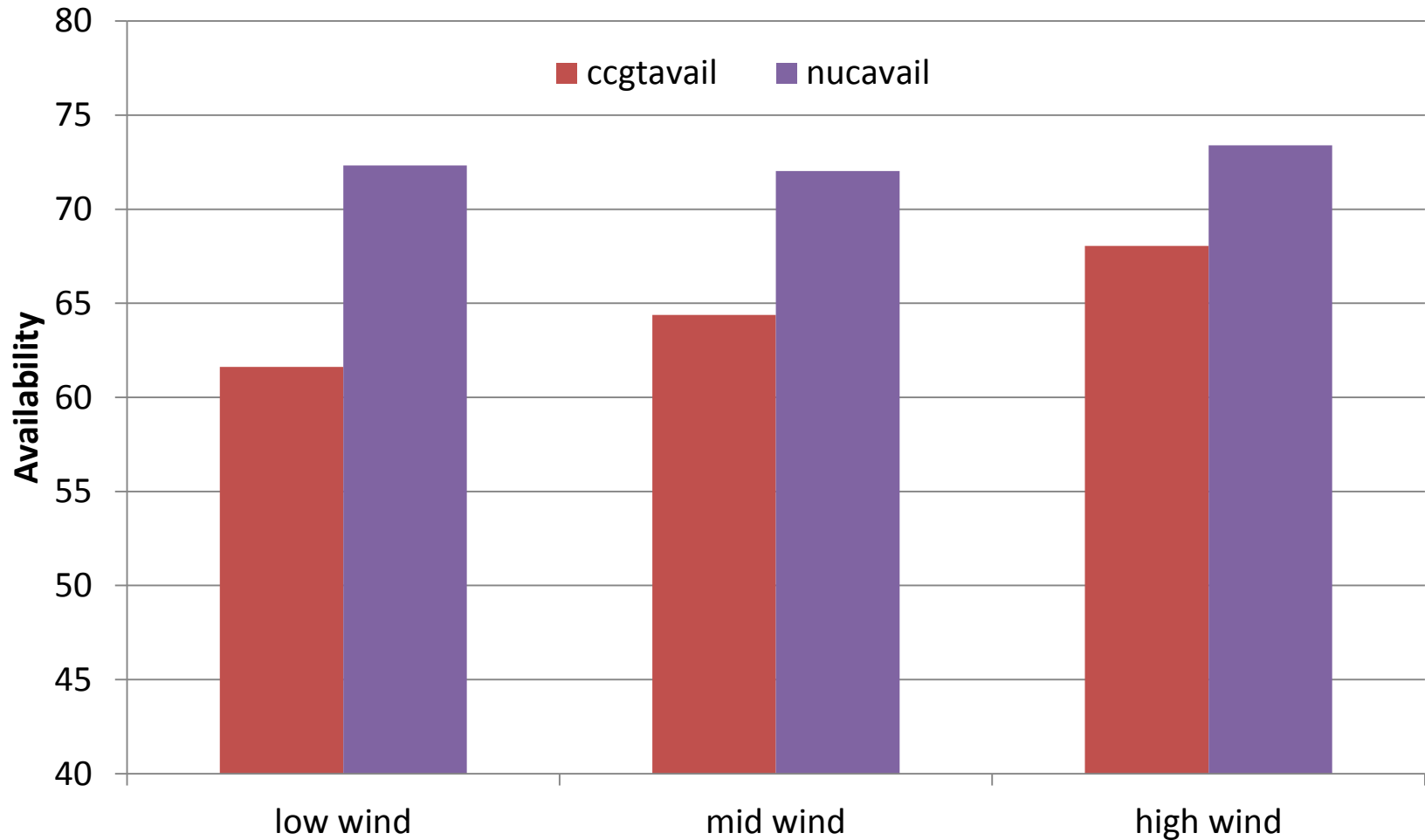
5) Preliminary Findings: CCGT Availabilities



5) Preliminary Findings: CCGT Availabilities



5) Preliminary Findings: CCGT Availabilities



6) Conclusion and Next Steps

- Establishing an empirically-grounded understanding of this relationship is important as plant availability is used in the GB Capacity Market as a measure to help determine the necessary volume of capacity to procure.
- Preliminary findings lend support for hypothesis that CCGT availability increases in periods of reduced electricity margins, when demand is higher and less alternative sources of generation are available.
- This suggests that historic lower CCGT availability is a result of market conditions, and as a result, that CCGT potential in GB may currently be underestimated.
- However, preliminary findings in are drawn from a dataset that we assume to be currently incomplete

6) Conclusion and Next Steps

- Need to clean data and ensure we have a completed dataset for analysis
- Rerun regression analysis including all plant availability
- Refine methodology based on feedback
- Incorporate any views or analysis that you can share with us

Comments/feedback are welcome. Please contact:

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Thank you

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