Wind, flexibility and the wholesale Power market in the 2030s

John Tindal - SSE

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Issues to be covered

- What is economic modelling for ?
- What does “flexibility” mean ?
- What might variations in wind generation look like ?
- What are the implications of wind for flexibility:
  - Very fast response and fast response
  - Load following
- Illustrative market modelling 2030s

What has economic modelling done for us ?

- What will the wholesale electricity market look like in the 2030s?
  - No-one knows
- Can economic modelling tell us the answer?
  - No
- What can economic modelling do ?
  - Better understand the question
- What is the question ?

What is flexibility ?

A subjective grouping of flexibility services:

- **Very fast :** 0-30 seconds (Enhanced, primary, secondary frequency response)
- **Fast :** 30 seconds to 30 minutes (Fast reserve)
- **Load following :** 30 minutes plus

National Grid Enhanced Frequency Response FAQs Nov 15

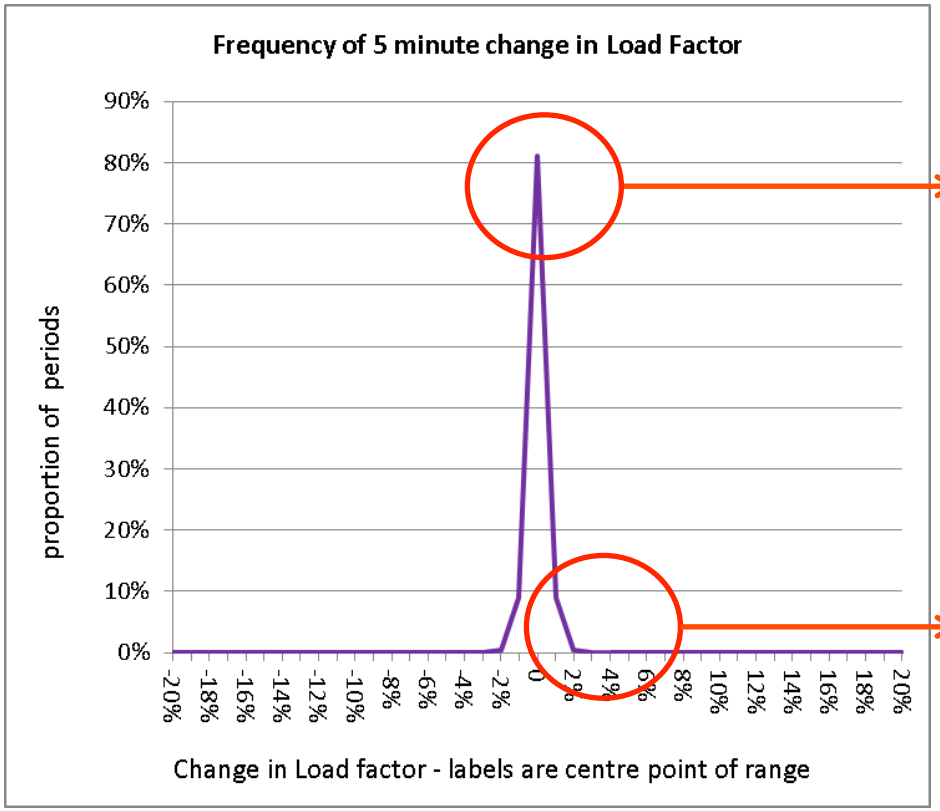
What might variations in wind generation look like ?

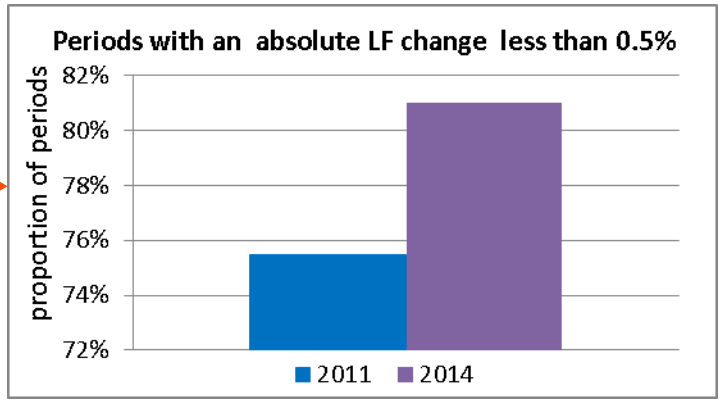
Wind profile – The future may be different

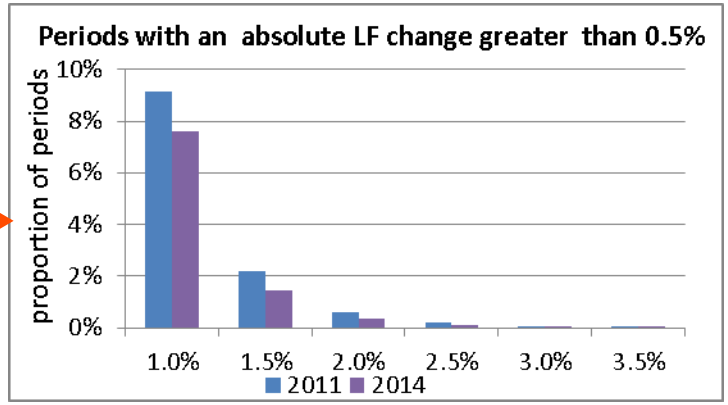
- **Lower site specific variability –** New offshore stations likely less variable
- **Better portfolio diversity –** Likely reduced short-term variability with less extreme peaks and troughs
- **Higher load factors** – Less installed capacity for same low carbon MWh
- **Better forecast accuracy –** Improved methods and reduced underlying variability
- **Wind is variable, not intermittent**

What might variations in wind generation look like ?

At 5 minutes – Wind is relatively stable and improving



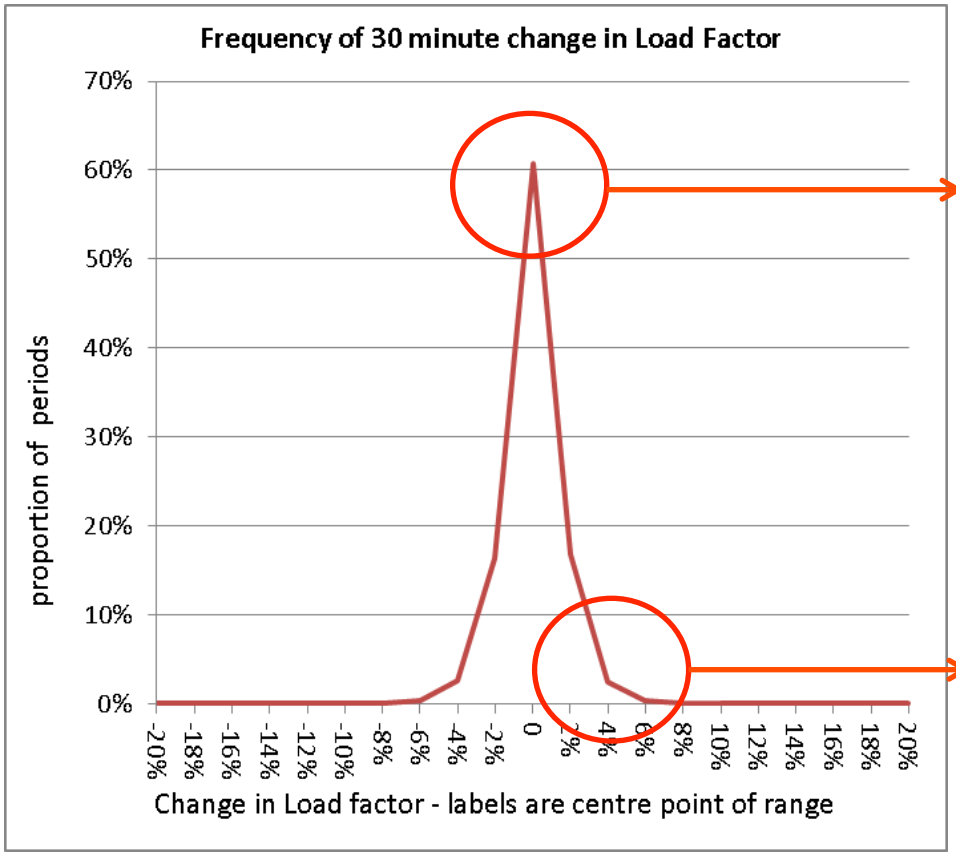


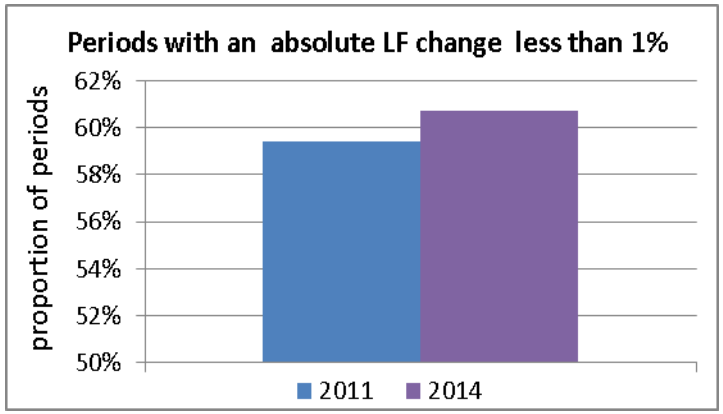


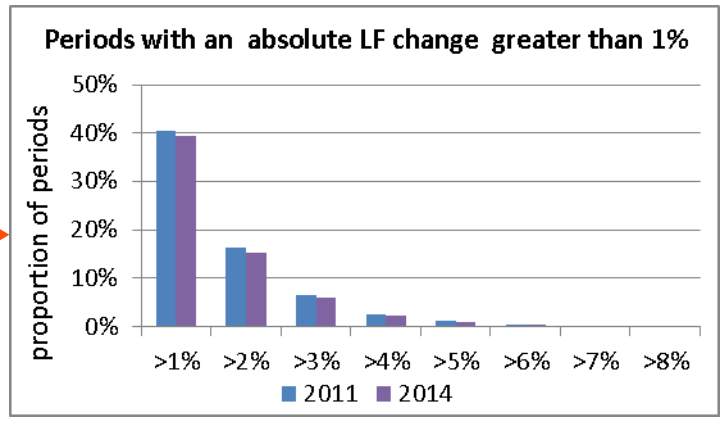
At 13GW 1 % LF equates to 130 MW

What might variations in wind generation look like ?

At 30 minutes – Wind is relatively stable and improving





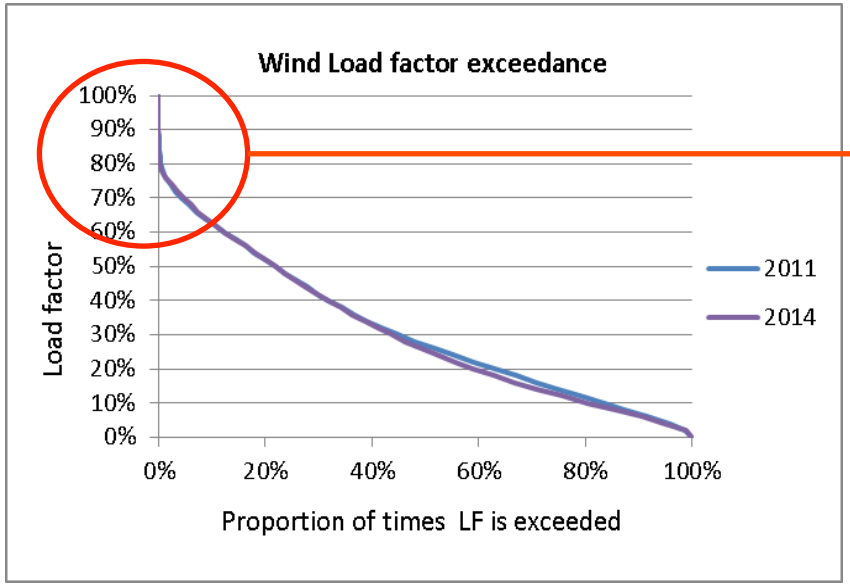


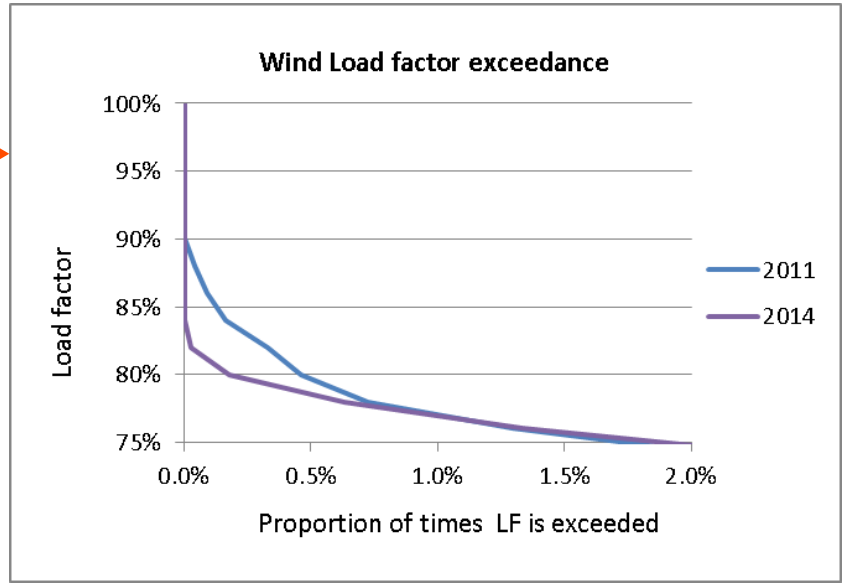
At 13 GW 4 % LF equates to 520MW

What might variations in wind generation look like ?

Daily – Peaks and troughs

- GB wind peak output has been substantially below 100%
- GB wind peak load factor may continue reducing





What are the implications of wind for flexibility?

Fast and very fast (0 seconds to 30 minutes)

- **Demand –** Wind may not significantly change demand for short-term flexibility

- **Supply** – Reduced CCGT running may mean inertia and fast services from different providers e.g. : wind farms, DSR, pumped storage, batteries, super capacitors, flywheels, peaking thermal plant, others.

- **Implications for the system** – System may not need CCGTs to run at minimum load for inertia, or fast upward flexibility.

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What are the implications of wind for flexibility?

Load following (30 minutes plus)

- **Demand –** Higher wind penetration will result in increased demand for load following flexibility (demand net of wind)

- **Supply –** Low carbon load following flexibility can be provided by many different sources e.g. : Wind farms, flexible dispatchable renewables, storage, DSR, Interconnectors, carbon emitting plant

- **Implications for the system** – System may be able to manage higher penetration of wind volume using flexibility from predominantly low carbon sources

- **Capacity for Peak Security –** Different issue

Illustrative market modelling – 2030s

- **A scenario modelled using linear programming optimisation**
- **Breakdown of GW low carbon capacity in scenario**

	2014 DUKES	2030s scenario
Wind	13	35
PV	5	19
Low carbon firm (nuclear, CCS, biomass)	13	12

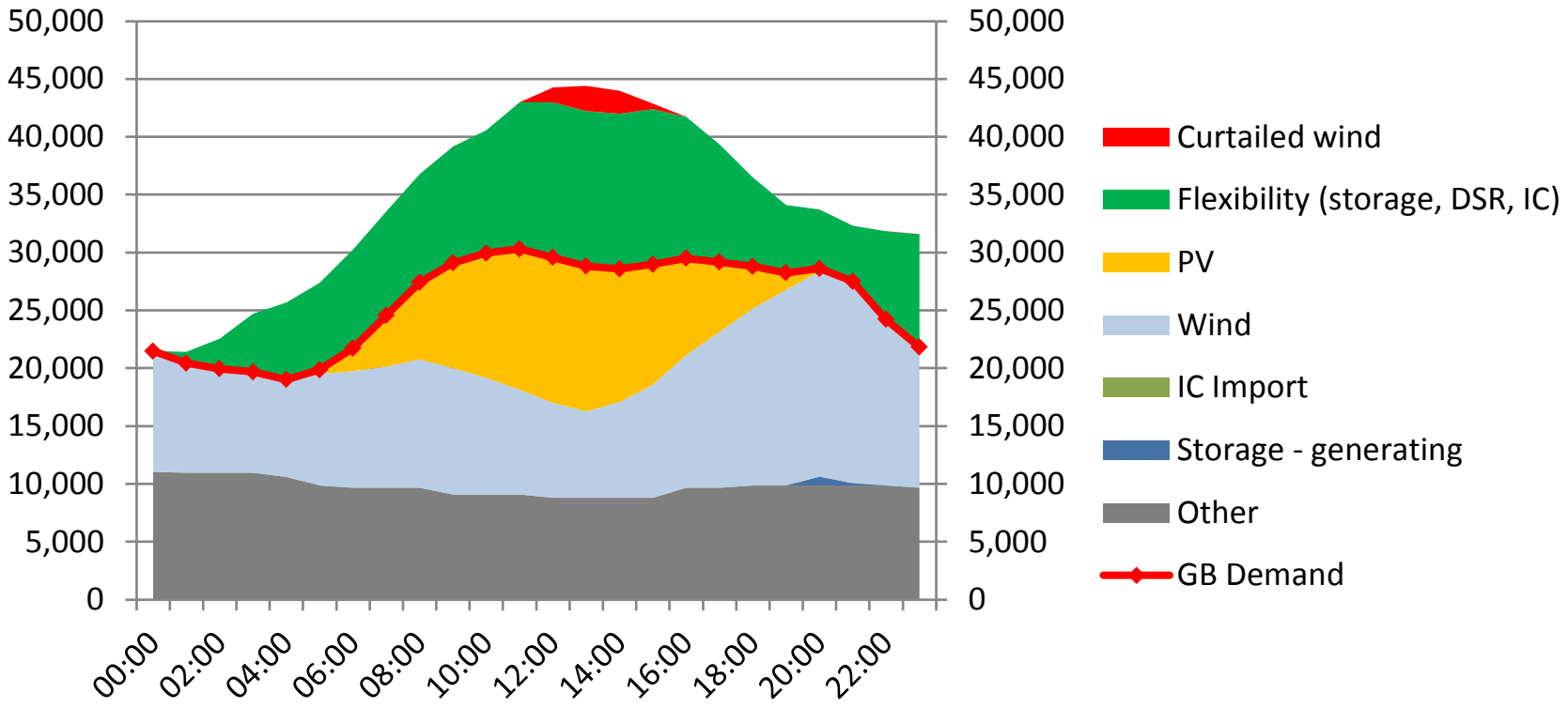
Illustrative market modelling – 2030s

- **Carbon targets met at 50g**

Percentage of demand met by different technologies	Percentage of demand MWh
Wind	39%
Other renewables (PV, hydro, other)	7%
Low carbon firm (nuclear, biomass, CCS)	31%
Net interconnector imports	12%
Carbon emitting plant	12%
Total	**100%**

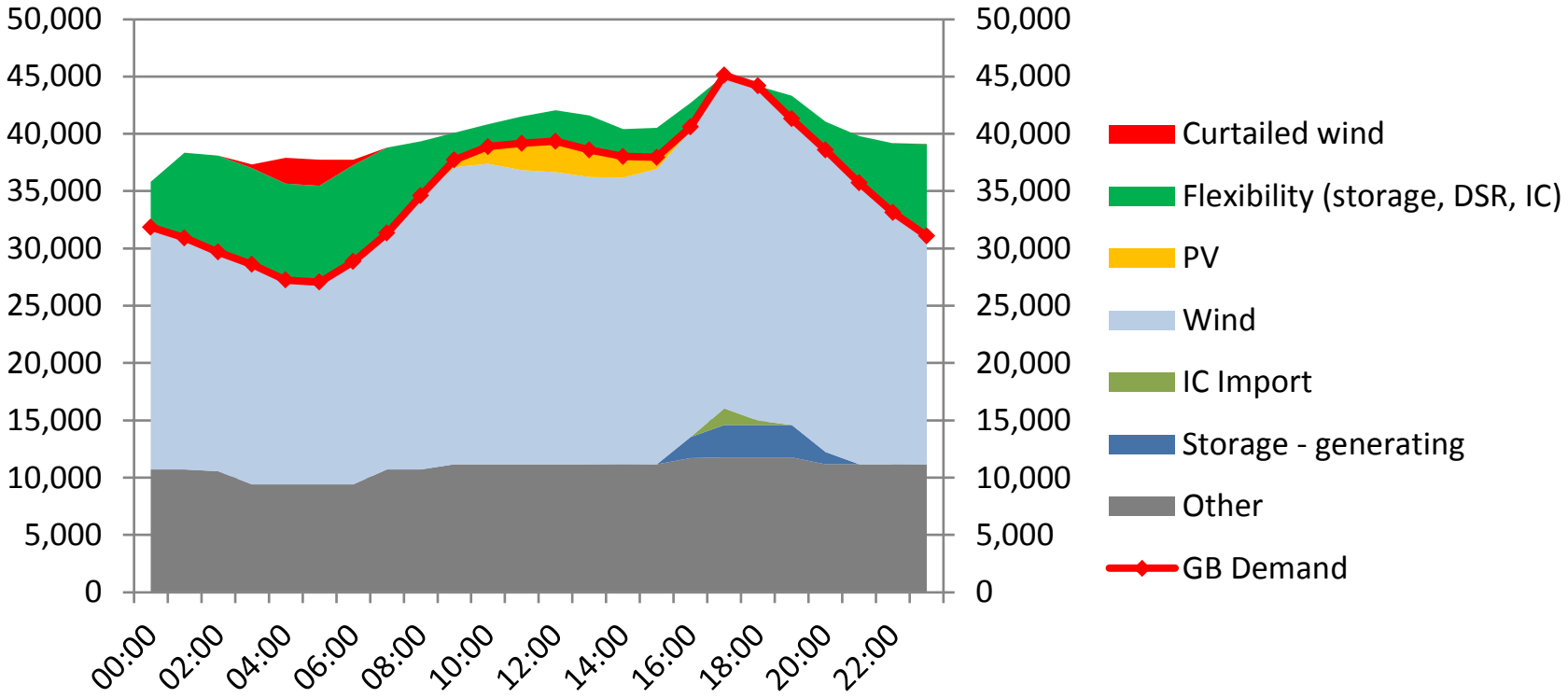
Illustrative market modelling – 2030s

Dealing with periods of "surplus" energy - Summer



Illustrative market modelling – 2030s

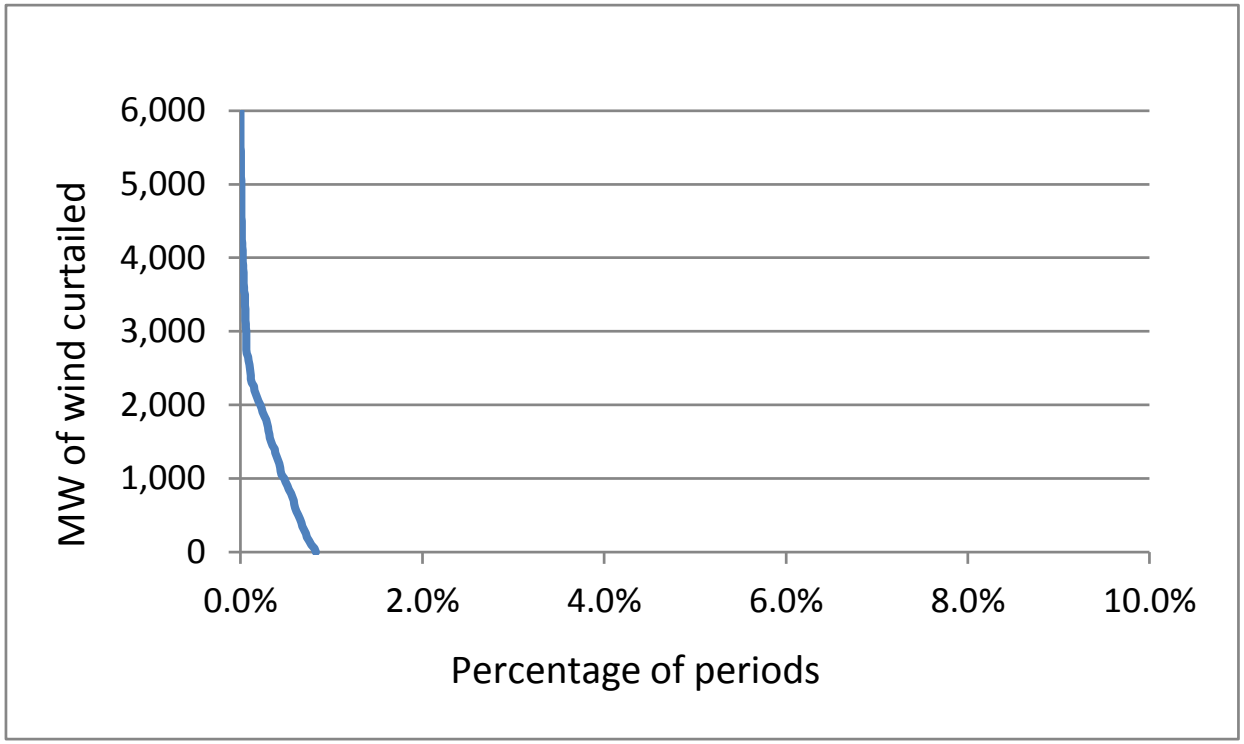
Dealing with periods of "surplus" energy - Winter



Illustrative market modelling – 2030s

"surplus" energy curtailed wind:

- **< 1% of periods**
- **Substantially <1% of wind generation volume**



Conclusion:

“There may be good value flexible system scenarios where UK could meet carbon targets predominantly with wind and PV, while avoiding costly ‘surplus energy’ issues.”

Suggested next steps

More analysis to better understand:

- Wind and PV profiles
- Interaction between profiles of wind, PV and demand
- Wind and PV forecast accuracy
- Demand for flexibility – how much? What characteristics?
- Supply of flexibility – Different solutions for different issues?
    - Storage
    - DSR
    - Interconnectors
    - Carbon emitting
    - Others