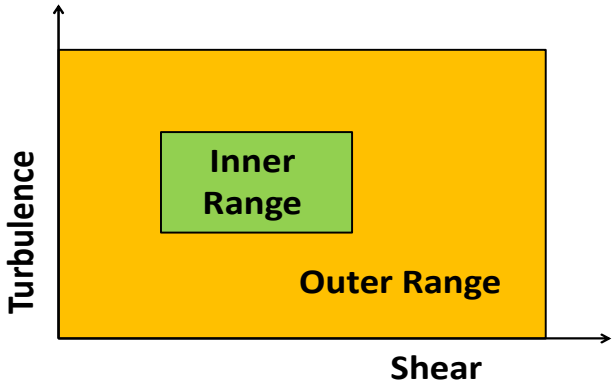
PCWG 2015 Roadmap

PCWG Meeting
9th Meeting: 12th December 2014 - Glasgow

Background: Reasons For Action

• **Real world wind conditions** are composed of both inner range and outer range wind conditions:

- **Inner range conditions** refers to moderate shear and moderate turbulence.
- **Outer range conditions** refers to high turbulence, low turbulence, high shear, low shear etc.



• **Outer range conditions are relatively frequent** and therefore the calculation of turbine power output in outer range conditions is an important consideration in wind energy resource assessment.

• There are **no industry consensus methods** for predicting wind turbine power output in outer range conditions for the purposes of resource assessment.

• **Power performance tests and associated warranties** are **normally limited to** a relatively narrow range of idealised conditions i.e. **inner range conditions.**

Current Wind Industry State

- There are no industry consensus methods for predicting wind turbine power output in outer range conditions for the purposes of resource assessment.

- Power performance tests and associated warranties are normally limited to a relatively narrow range of idealised conditions i.e. inner range conditions.

- The lack of a validated industry consensus methods for predicting power output in outer range conditions (for resource assessment applications) increases the risk perceived by wind energy investors.

- The failure to consider outer range conditions in power performance tests increases the risk perceived by wind energy investors.

Target Wind Industry State

• Well document and validated consensus methods for predicting wind turbine power output in outer range conditions for the purposes of resource assessment.

• Open source benchmarks (e.g. Excel examples) available for all validated consensus methods.

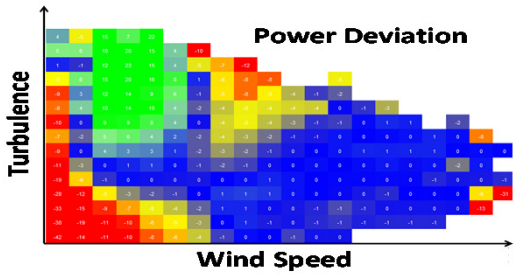
• Open source tools (which comply with benchmarks) available for all validated consensus methods.

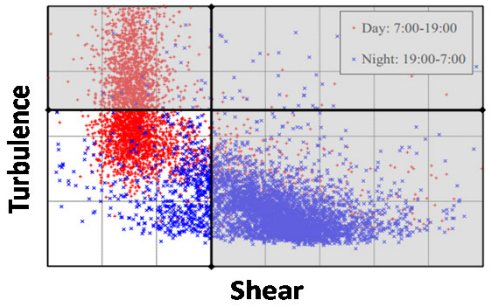
• Power performance tests routinely make some consideration of outer range conditions.

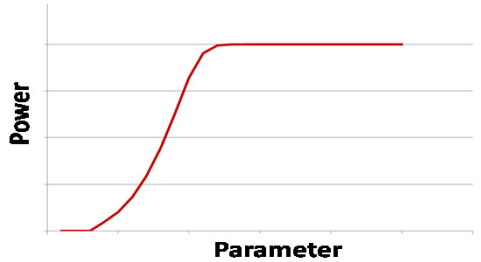
• Harmonised communication of power curve information so that corrections for outer range conditions can be unambiguously applied.

• Consensus methods embedded in real world resource assessment industry practice. Reduced resource assessment risk perceived by wind energy investors.

• Reduced power performance risk perceived by wind energy investors.







Reasons for gap between current and target

• REWS and turbulence renormalisation methods are helpful, but do not fully solve the problem.

• There are no industry standard tools for applying existing methods for modelling power output in outer range conditions.

• Several empirical (proxy) methods are available which tie observed turbine performance to key (frequently measured) parameters such as turbulence intensity and lower rotor shear exponent. However, there is a lack of industry consensus regarding which proxy methods are best.

• Minimal data sharing between key stakeholders.

• Current power curve documentation can make the application of corrections for outer range conditions difficult e.g. it can be hard to tell if a power curve is defined for hub wind speed, rotor equivalent wind speed or both.

PCWG 2015 Actions

• Define trial methods and validate them (including new and novel methods) e.g. REWS, RAWS, site/conditions specific power curves, turbulence renormalisation, power deviation matrix, production by height, modified turbulence renormalisation method.

• Implement PCWG data sharing initiate to provide a platform for developing and validating trial correction methods.

• Develop open source benchmarks (e.g. Excel examples) for applying trial methods so that methods are well understood. Where appropriate perform round robin exercises to develop consensus understanding:

- Power Curve Deviation Matrix Round Robin
- Rotor Equivalent Wind Speed Considering Inflow Round Robin

• Develop open source python tools so that trial methods can be applied to many datasets efficiently:

- Power Curve Deviation Matrix Implemented
- Rotor Equivalent Wind Speed Considering Inflow Implemented

• Promote application of Inner/Outer range concept for power performance tests by sharing experiences.

•Develop a document to harmonise the communication of power curve information

•Develop a requirements document for site specific power curves from a developer/consultant (required outputs) and manufacturer (required inputs) perspective.

Observations/Insights

Power Curve Working Group 2015 Roadmap

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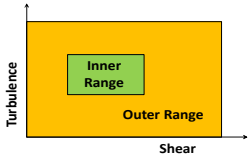

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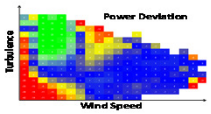

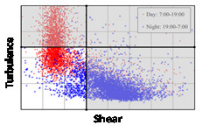

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