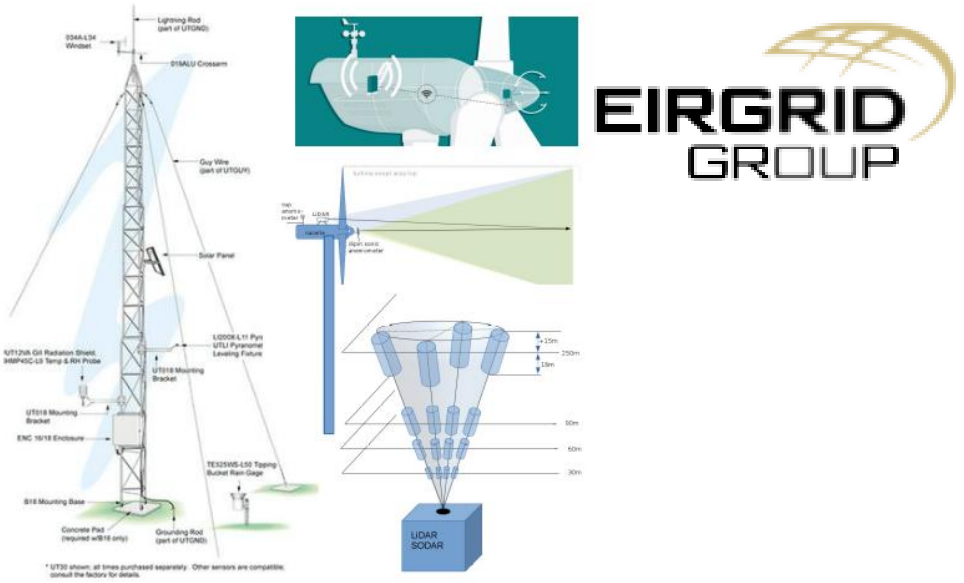
Findings from the EIRGRID Met Mast and Alternatives Study



EIRGRID GROUP

Session 1: Meteorology, Climate and the Electric Sector
Atlanta, GA, June 20, 2017

Dr. Corinna Möhrlen, WEPROG
with input from Dr. Gill Nolan, EIRGRID

BACKGROUND INFORMATION OF EIRGRID GROUP

Wind Generation in Ireland

- High penetration of wind (all-time peak demand 5000MW)
  Installed MEC > 3600 MW (All Island) | MEC >2800 MW (Ireland)
- Accurate met data is critical for scheduling and dispatch
  Wind forecasting + Real time operations
- Met data provided by wind farms is used by forecasters

Forecast use in EIRGRID:

- **Long Term Forecast**
  delivered 6 hourly | 5 day time horizon | 15 minute resolution
- **Short Term Forecast**
  delivered every 15 minutes | 36 hour time horizon | 15 minute resolution
- **Regional Forecasts**

Overview of the EIRGRID Met Mast and Alternatives Study

Objectives:

1. importance of met data to forecasting and system operation
2. analysis of alternative instrumentation to met masts

Study sub tasks:

1. Discussion of the importance of met masts in Irish context
2. Current best practice of met measurements
3. Quality status and analysis of EirGrids current measurement signals
4. Applicability of current available alternatives to met masts
5. Analysis of Lidar and nacelle measurement data at 2 wind farms
6. Current available standards for calibration and maintenance of instruments

Results and Recommendations of the *EIRGRID Met mast and Alternatives Study*

Main Results:

1. Meteorological measurements are required and add most value at high-speed events and dispatch situation

2. Alternatives fail at the most important wind speed range for forecasting

Recommendation:

1. Met data required to maintain system security and high quality wind forecasting

2. Improvement of the quality of the met data required

3. Alternatives to met masts:
    a. No alternatives recommended at this time.
    b. Leave option open for alternatives: conditionally and with requirements
    c. Pilot projects for 3 – 6 months to gain real-time experience

For those interested in the full study report:
Contact me (com@weprog.com) or Gill Nolan (Gill.Nolan@eirgrid.com)

What can we learn from the study ?

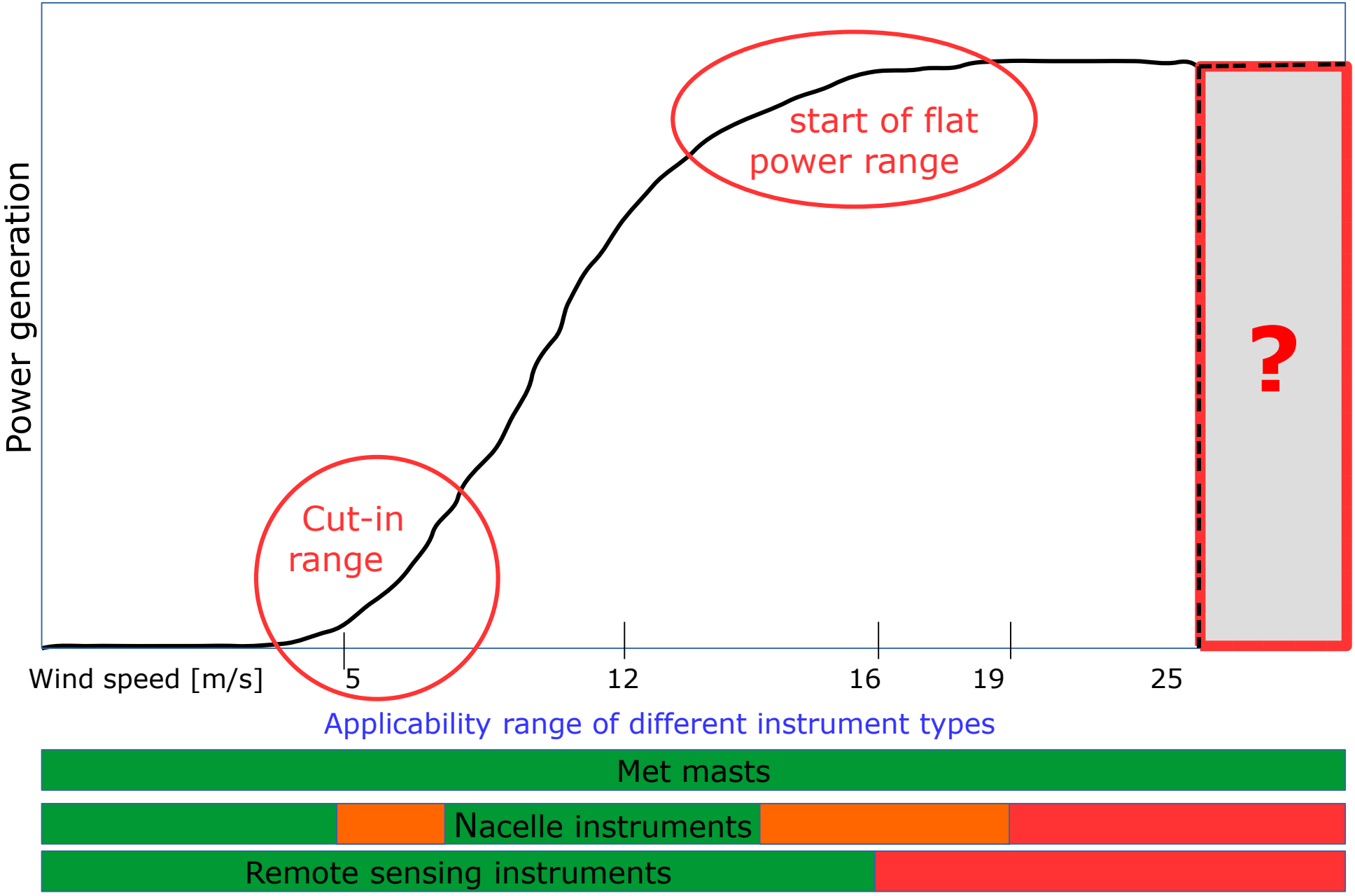
There exist **gaps in current utility system knowledge** with respect to:

Value of meteorological data

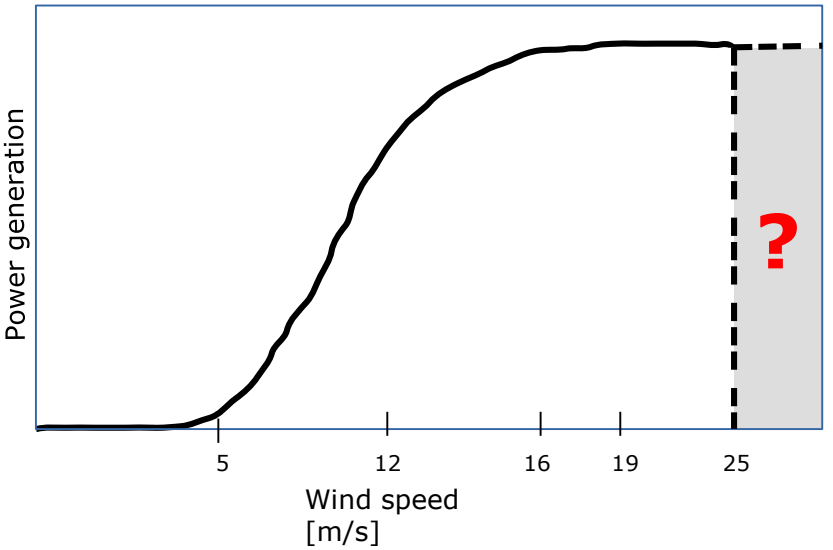
Collection of meteorological data for system operations

- Quality of data is important
- Applicability of instruments
- need for standards / guidelines

Importance of Meteorological Measurements and Applicability of various Instrumentation



Why we need meteorological information



Met measurements are important when dealing with:

- cut-in and cut-off (high-speed shut down) uncertainty

- dispatch / curtailment

- computing current turbine availability

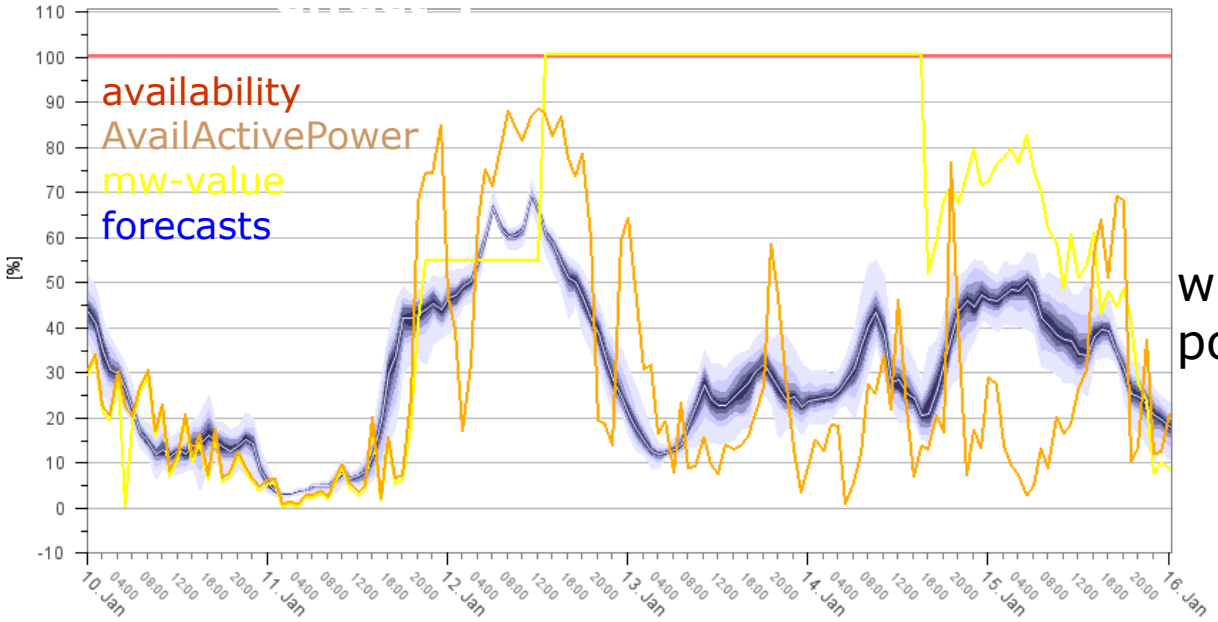
- situational awareness in the control room

- fills the gap of time resolution difference in meteorology and the power industry

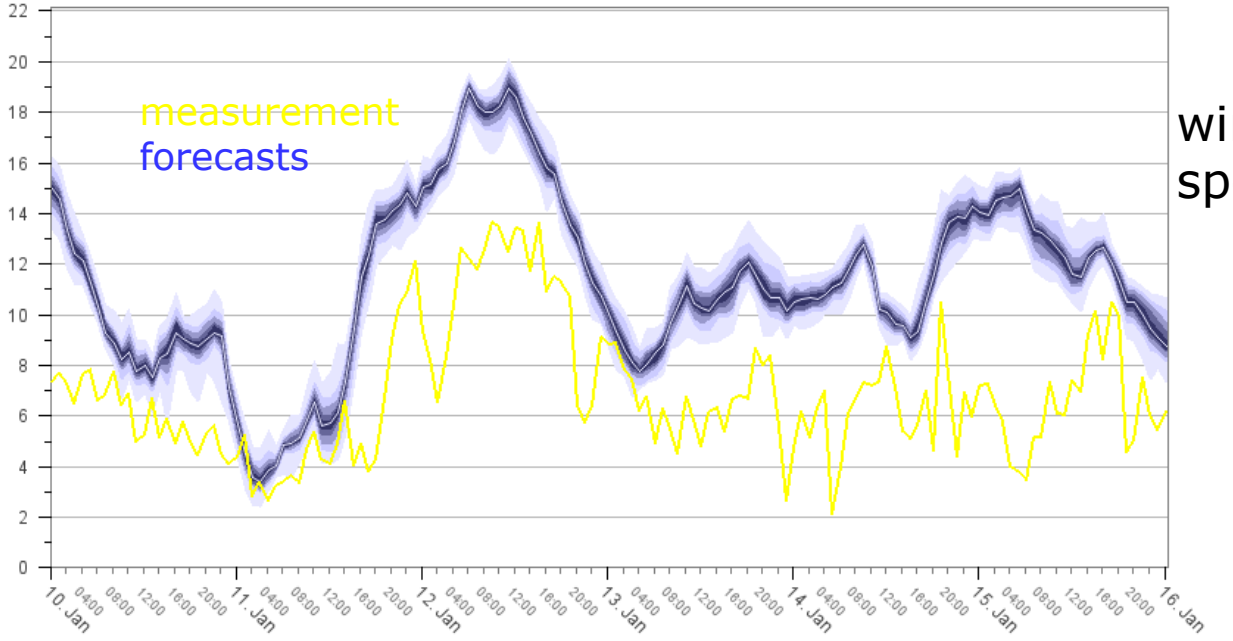
- "background" errors
  (e.g. turbine failure, non-reported maintenance, phase error in weather forecast ..)

Quality of delivered Measurements is important

Bad data can be worse than no data → forecast "damaging



wind power



wind speed

incorrect power data that are difficult to interpret

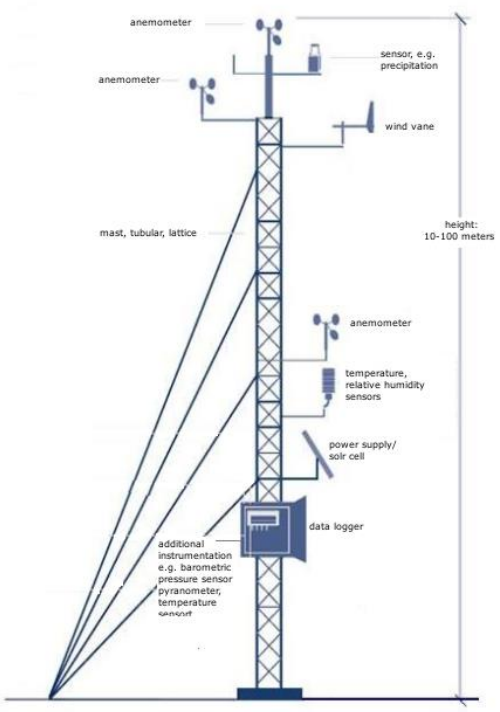
Incorrect power data can damage forecast, when adjusted with measurements

Wind speed example shows that AvailActive Power is directly computed from the wind via a power curve.

Every spike on the AvailActivePower has a similar one in the wind speed. *Is it a nacelle measurement ?*

Review of available meteorological instrumentation

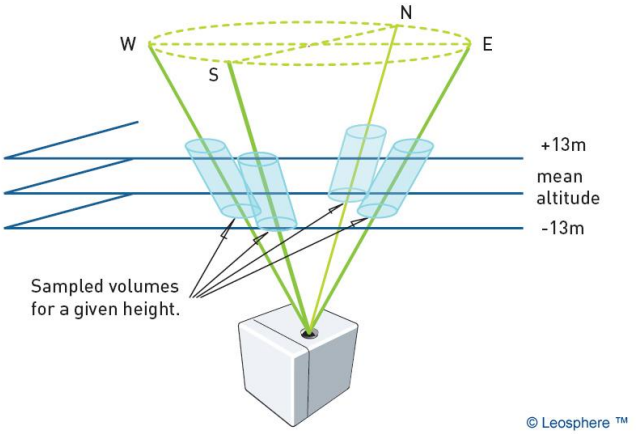
Meteorological Mast



Well known and tested

Standards for instruments

Remote Sensing Instruments

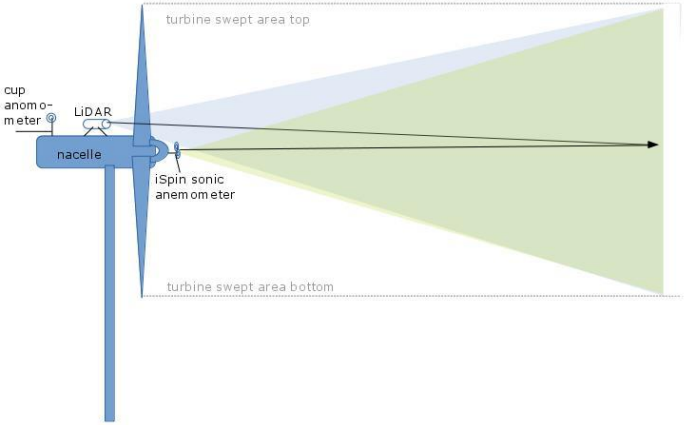


Less known in Wind Applications

Meteorologically interesting

Standards need to be adjusted for wind applications

Nacelle Instruments

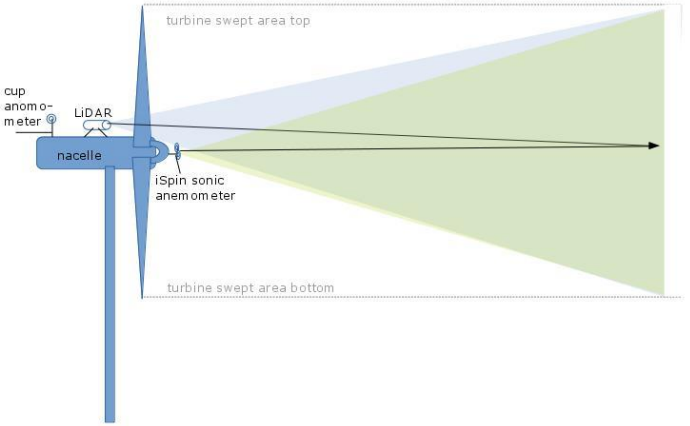


New applications with "known" instruments

advantages not tested for forecasting/grid security

Conclusion on Nacelle data

Regardless how we validated nacelle sites, we encountered wind speed quality issues compared to traditional mast measurements



The critical aspects a

1) data loss of 15-25% depending on weather

2) severe accuracy limits at high wind speeds and low wind speeds

→ Consistent with other studies in literature

Marquis, M., Wilczak, J., Finley, C., Freedman, J., Wind Forecasting Improvement Project (WFIP) final report, National Center of Oceanographic and Atmospheric Administration (NOAA), 2014.

Drechsel, S., G. J. Mayr, J. W. Messner, R. Stauffer, Wind Speeds at Heights Crucial for Wind Energy: Measurements and Verification of Forecasts, J. Appl. Meteor. Climatol., 51, 1602-1617, 2012.

Allik, A. Uiga, J., Annuk, A., Deviations between wind speed data measured with nacelle-mounted anemometers on small wind turbines and anemometers mounted on measuring masts, Agronomy Research

Findings from analysis of remote sensing instruments

ADVANTAGES
vertical wind profile information

Volume-averaged

Upstream scanning

The **instruments are interesting, especially for situational awareness,** but showed highest reliability issues under:

- →active weather
- →strong precipitation

These are situations where met data is most critical and important

–> **conclusion**: **real-time tests required**!

Applicable Standards

EWEA minimum technical requirements for anyone "intending to make bankable wind measurements":

- the International Electrotechnical Committee (**IEC**)
- the International Energy Agency (**IEA**)
- the International Network for Harmonised and Recognised Wind Energy Measurement (**MEASNET**)
- United States Environmental Protection Agency **(EPA)**

e.g. **IEC 61400-12** standard deals with
"Power performance measurements of electricity producing wind turbines"

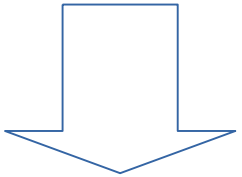
All standards (except EPA) are focusing on RESOURCE ASSESSMENT

NEEDS ADJUSTMENT TO BE APPLICABLE FOR REAL-TIME SYSTEM OPERATION!!!

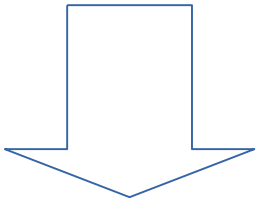
Recommendations for Quality Measures of Meteorological Measurements

What is needed:

- **Recommended instrumentation**
- **Requirements for instrumentation**
- **Protocols of equipment setup**
- **Protocols of regular maintenance schedules**



Recommended practices for setup, operation and maintenance



Suggestion to prepare an industry guideline will be brought forward and discussed at IEA Wind Task 36 meeting next week

THANK YOU FOR YOUR ATTENTION

Questions ?

Contact me:
Corinna Möhrlen
WEPROG

com@weprog.com