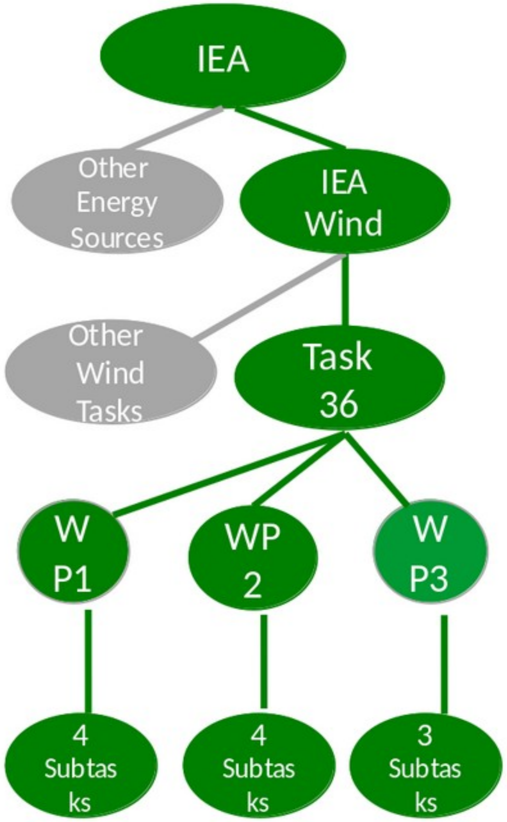
IEA Wind Task 36

Workpackage 3.3: Develop data requirements for real-time forecasting models for use in grid codes

Summary

June 2020

IEA Task 36 - Forecasting for Wind Energy



What is the IEA (International Energy Agency)? (www.iea.org)

- International organization within OECD with 30 members countries and 8 associates
- Promotes global dialogue on energy, providing authoritative analysis through a wide range of publications
- **One activity: convenes panels of experts to address specific topics/issues**

Task 36: Forecasting for Wind Energy: (www.ieawindforecasting.dk)

- One of 17 Tasks of IEA Wind: https://community.ieawind.org/home
- Phase 1: 2016-2018; Phase 2: 2019-2021
- Operating Agent: Gregor Giebel of DTU Wind Energy
- Objective: facilitate international collaboration to **improve wind energy forecasts**
- Participants: (1) research organization and projects, (2) forecast providers, (3) policy-makers and (4) end-users & stakeholders

Task 36 Scope: Three "Work Packages"

- WP1: Global Coordination in Forecast Model Improvement
- WP2: Benchmarking, Predictability and Model Uncertainty
- WP3: Optimal Use of Forecasting Solutions

Task homepage: http://www.ieawindforecasting.dk/

Task 36 Phase 2: Work Package Scope

- WP 1: **Global Coordination in Forecast Model Improvement**
  - 1.1 Compile list of available wind data sets suitable for model evaluation
  - 1.2 Annually document field measurement programs & availability of data
  - 1.3 Verify and validate NWP improvements with common data sets
  - 1.4 Work with the NWP centers to include energy forecast metrics in evaluation of model upgrades
- WP 2: **Benchmarking, Predictability and Model Uncertainty**
  - 2.1 Update the IEA Recommended Practice on Forecast Solution Selection
  - 2.2 Uncover uncertainty origins & development through the whole modelling chain
  - 2.3 Set-up and disseminate benchmark test cases and data sets
  - 2.4 Collaborate with IEC on standardisation for forecast vendor-user interaction
- WP 3: **Optimal Use of Forecasting Solutions**
  - 3.1 Use of forecast uncertainties in the business practices
  - 3.2 Review existing/propose new best practices to quantify value of probabilistic forecasts.
  - 3.3 Develop data requirements for real-time forecasting models for use in grid codes

Summary of Subtask 3.3:

Meteorological Data Requirements to be provided in the grid codes for real-time forecasting models

Subtask 3.3: Data Requirements to be provided in the grid codes for real-time forecasting models

- BACKGROUND -

Combination of **actual wind measurements + trend from wind forecast** provide necessary input to a number of areas in grid operation: e.g.

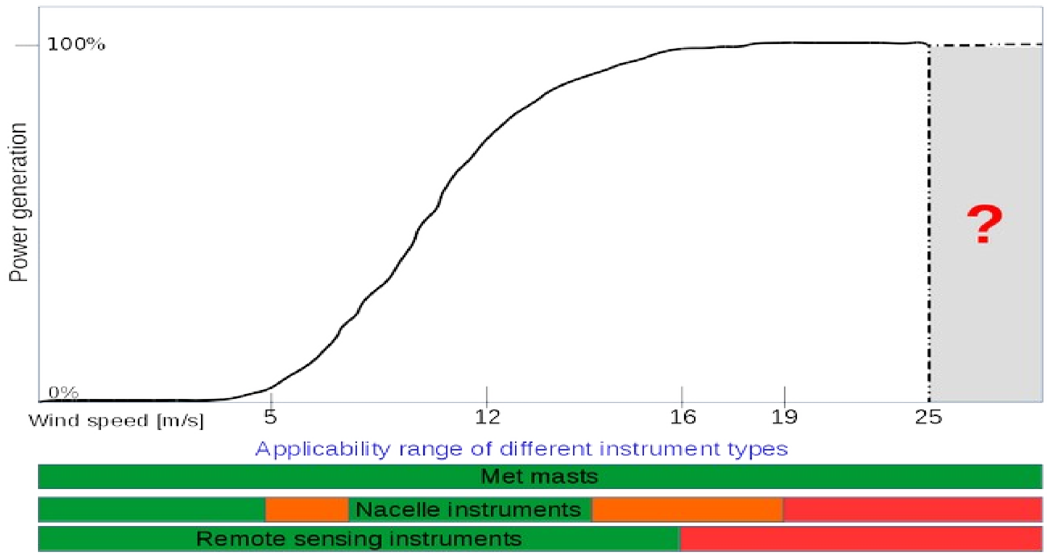
- forecast of high-speed shut-down events
- strong ramping events
- potential power computation
- compensation for curtailments
- etc.

Currently every ISO/TSO has to develop their own requirements for the grid code

→ a industry guideline would make this process much more efficient!

Subtask 3.3: Data Requirements to be provided in the grid codes for real-time forecasting models

The most common instrumentation and their applicability



Met Masts
- cup/sonic anemometer

Nacelle instrumentation
- cup/sonic anemometer
- computation via pressure

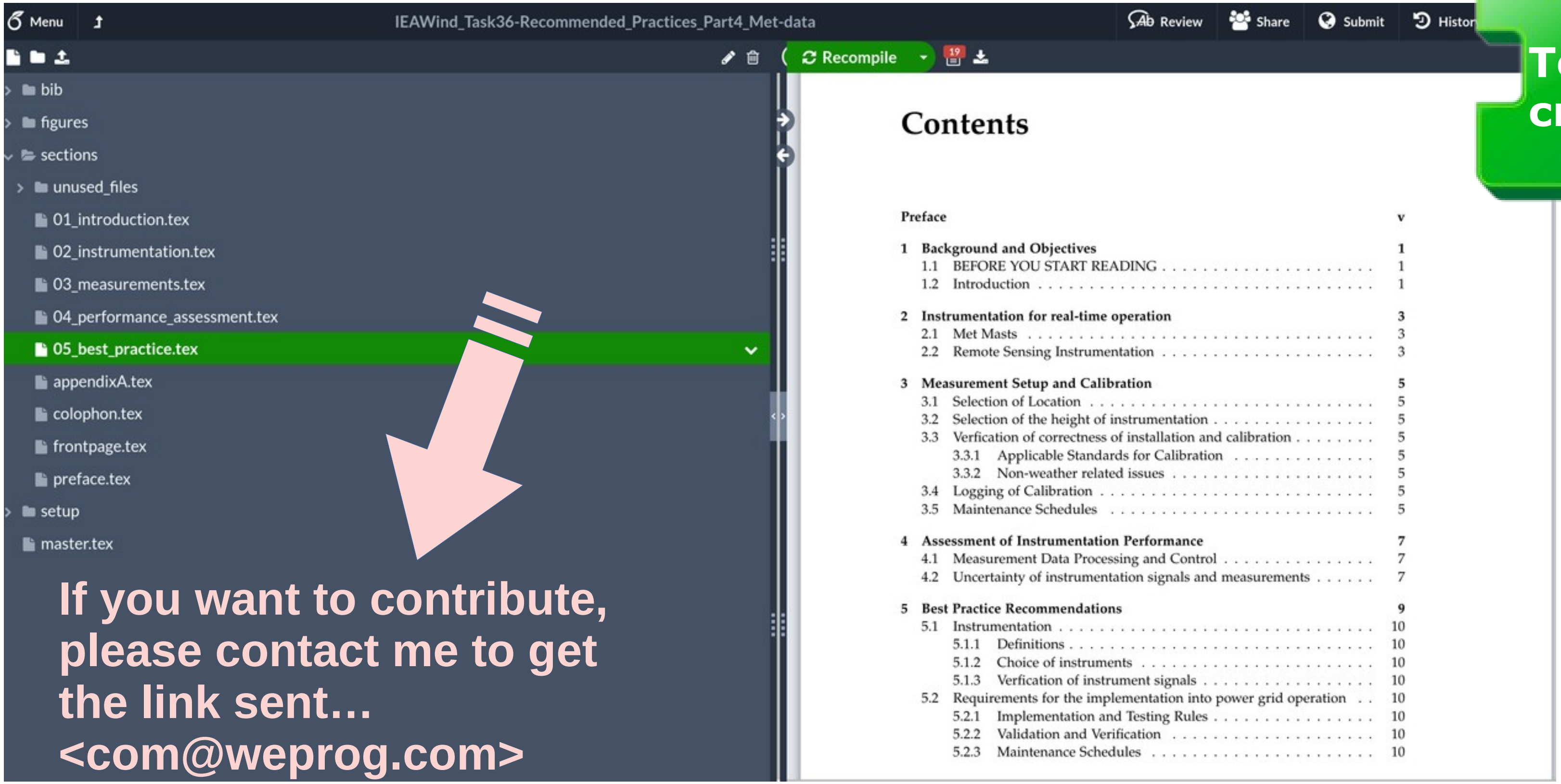
Remote Sensing
- LiDAR
- SODAR
- RADAR

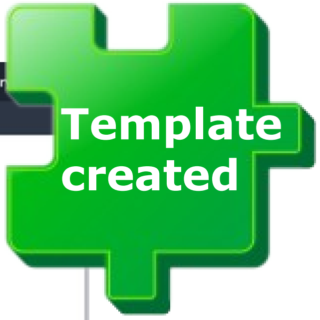
Status and plans for the next period

- Summarize types of instrumentation used today
- Creating Table of Contents for a RP and setup Writing Platform -→ Overleaf Template ready now…
- Studying and summarize existing standards
- Develop the recommendations
  -

--→ volunteers needed …please contact me
@ <com@weprog.com>

Next Step: Development of the Recommended Practice Guideline in Overleaf

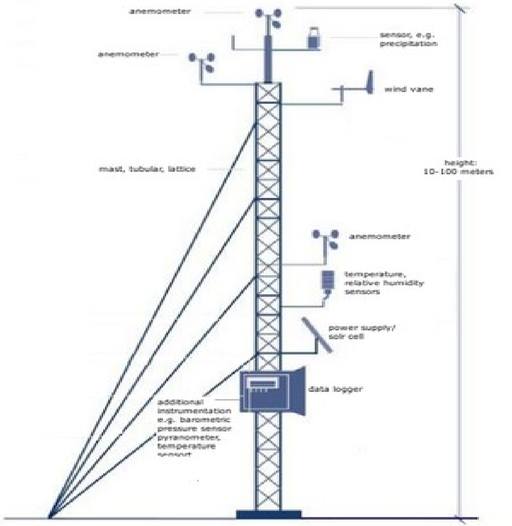




If you want to contribute, please contact me to get the link sent… <com@weprog.com>

Review of instrumentation and industry Best Practice

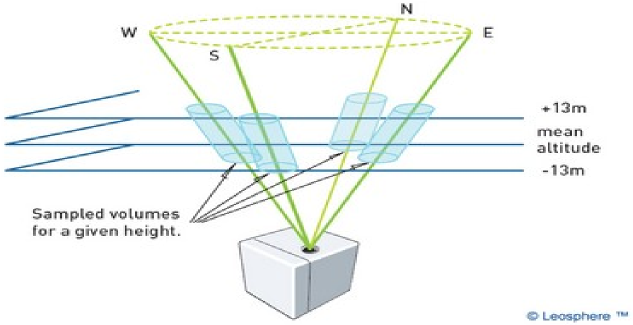
Meteorological Mast



Well known and tested

Standards for instruments

Remote Sensing Instruments

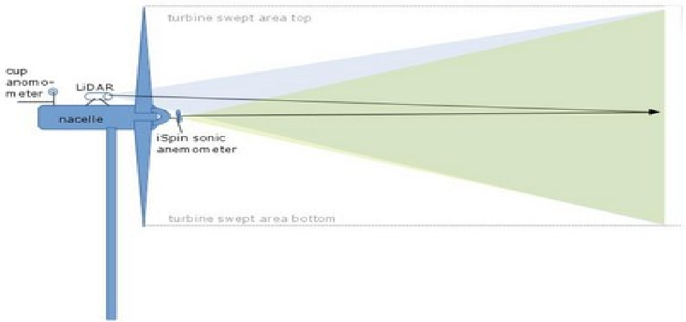


Less known in Wind Applications

Meteorologically interesting

Standards need to be adjusted for wind applications

Nacelle Instruments



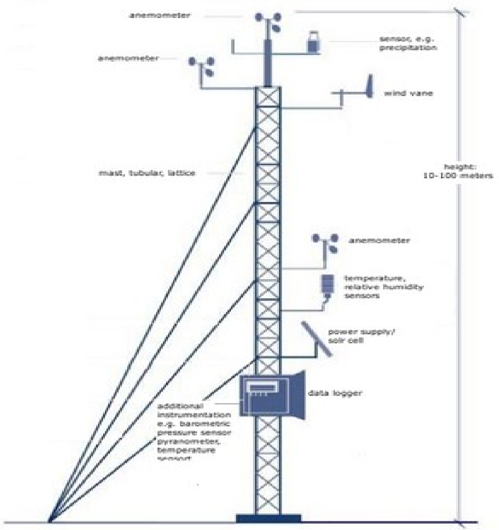
Relative new application

“old” technology (cup anemometer) insufficient

advantages not tested for forecasting/grid security

Review of instrumentation and industry Best Practice

Meteorological Mast



simple, realiable, less information

more information, but also more complex and more expensive….

Cup anemometers
well tested and standardised

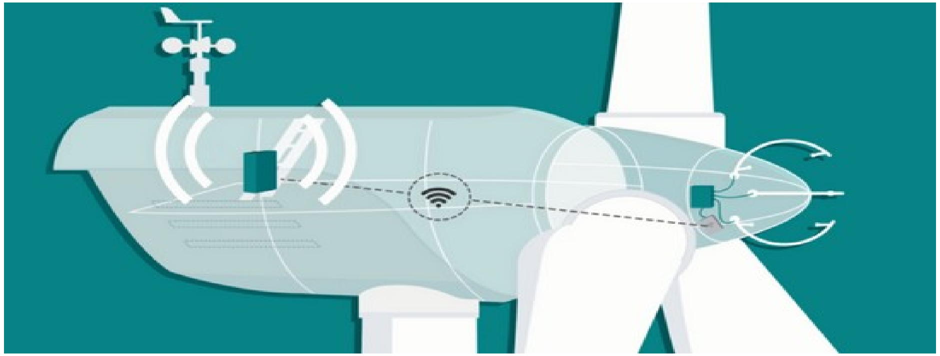
IEC 61400-12-1/2 and ISO/IEC 17025 standards describe how these instruments must be:

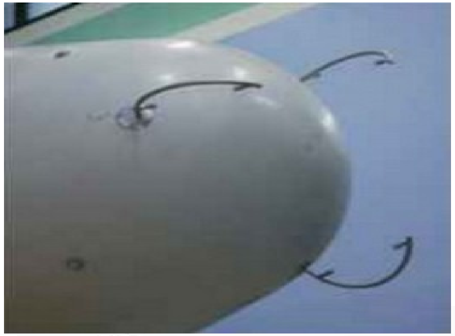
- calibrated
- mounted
- describe the process and the integrity of the measurement processes
- describe design of mast, instruments and measuring procedures.

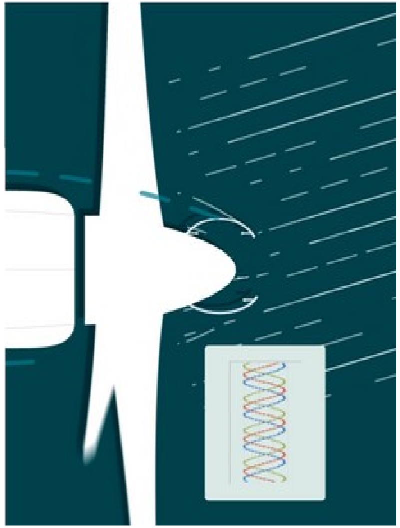
3D sonic anemometers have:
long tradition in atmospheric science and meteorology

- boundary layer studies of turbulence intensity
- phenomena like low level jets

Review of instrumentation and industry Best Practice







The iSpin technology claims to solve the following issues:

- monitor the air density corrected power curve
- monitor and correct yaw misalignments
- Observe turbulence intensity allowing you to make informed choices between power production and

Most critical for forecasting application:

- computation of flow
- not proven in real-time yet

Findings from analysis of measurement types

Identified issues with **nacelle mounted measurements**:

induction: nacelle measurement errors followed in large the angle of pitched blades (5% pitched blades equivalent 5% measurement error)

flow disturbances: changing direction gives changing inclination angles and wrong changes in wind speeds

wake effects from other turbines and of cup anemometers, where the turbine was subject to wake effects at certain directions

over-speeding of cup anemometer with errors > 10%

offsets in wind direction

snow and icing

Findings from analysis of remote sensing measurement types

Findings from analysis of **remote sensing instruments**:

ADVANTAGES

Availability of vertical wind profile information

Volume-averaged versus point measurement

Upstream scanning

DISADVANTAGES

Higher maintenance requirements

Variable data quality

Data outages correlated with active weather

Data frequency

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

- active weather
- strong precipitation

Findings from analysis of measurement types


Remote sensing instruments are mature for real-time operation, but require further development for application in power grid operation:

- measurements must be raw or technical requirements must include delivery of maintenance and software updates
- lightning protection and recovery strategy after lightning
- measurements should be taken at several heights to take advantage of the instrument type
- instruments must be serviced and maintained by skilled staff
- version control must be maintained for signal processing
- wind characteristics data must be on wind turbine level
- LiDARs and SODARs in complex terrain require special consideration and testing

THANK YOU FOR YOUR ATTENTION

Follow us:

Project webpage

http://www.ieawindforecasting.dk/

Task-page:

https://www.ieawindforecasting.dk/work-packages/workpackage-3

Publications:

http://www.ieawindforecasting.dk/publications.html

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