



sustainable energy for everyone



Wind and Meteo: Common energy

What can we learn from each other?

25/11/2016

NVBM Lustrum 2016

Mission, Vision & Values – Facts & Figures

Mission

sustainable energy for everyone

Vision

Based on our deep expertise in energy & carbon-efficiency, renewable energy, energy systems & markets, and energy & climate policy, we develop smart policies and solutions and bring them to life.

We know that, if we act now, by 2050 our global energy system can be sustainable, secure, affordable and fully based on renewable sources.

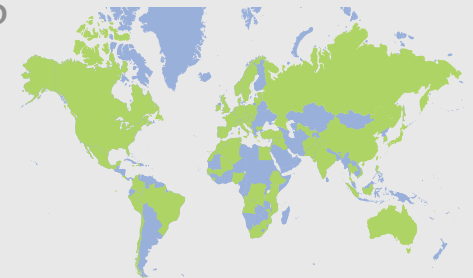
We aim to create a sustainable energy system for everyone.

Values

Dedication Originality Impact Trust

Facts & Figures

- Founded in 1984
- Over 200 professionals, 5 offices in 4 countries
- Over 1000 clients served across 70 countries
- Leading experts: the Nobel Peace Prize 2007, awarded to Al Gore and the IPCC, was supported by 10 Ecofys experts
- Navigant =shareholder since 2016



Ecofys domains of expertise

Urban Energy



Sustainable Industries and Services



Energy Systems and Markets



Energy Policies



Climate Strategies and Policies

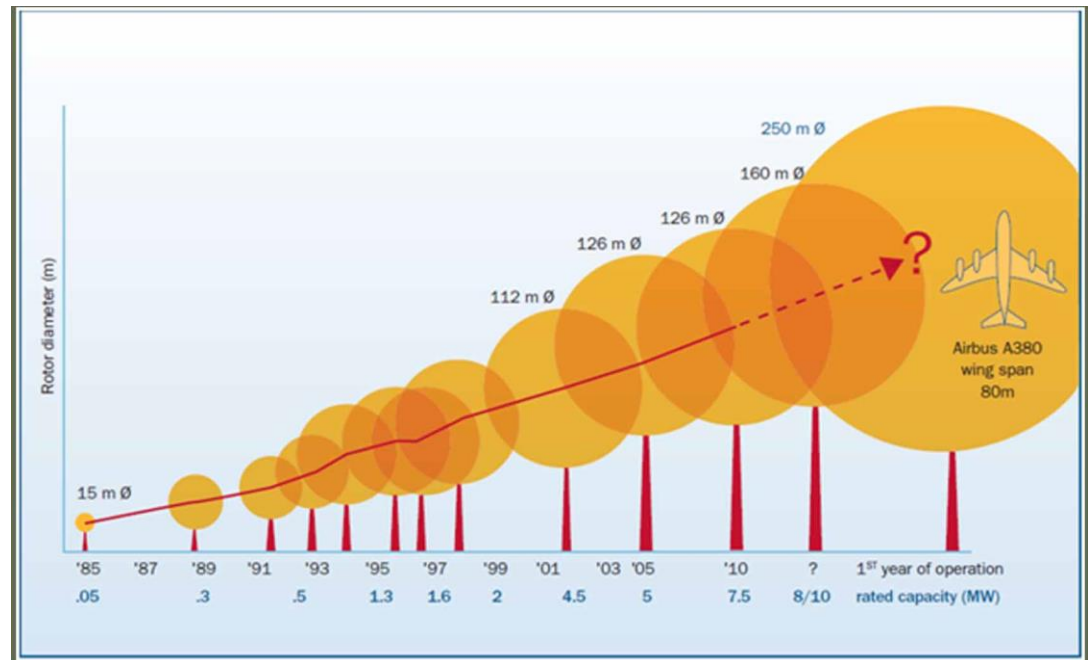


Back in the old days (2002)



What is happening in Wind Energy?

- Globally: majority of investments in energy in wind!
- Build: 430 GW (~ 250.000 wind turbines)
- China & US market leaders in capacity
- Europe market leader in technology & knowledge



Courtesy: DNV-GL

> Onshore:

- NW Europe = slow down, Africa/Asia/S America = rapid growth
- Wind turbines ranging up to 200 m hub height, 150 m rotor size, up to 8 MW power output
- Transport & Installation become challenge
- Meteorology and turbine: shears over rotor problematic

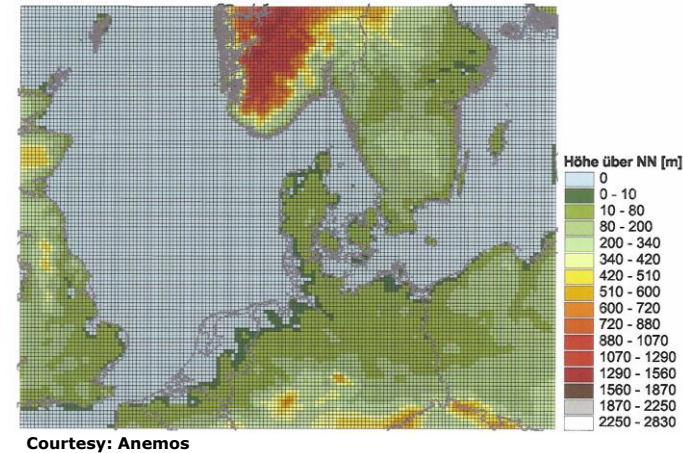
> Offshore:

- NW Europe market leader (>99%), 3500 wind turbines
- Developments: up to 150 m hub height, 220 m rotor size, of 10-20 MW range
- Wind turbines significantly changing boundary layers

How does Wind Energy currently use Meteorology?

Examples:

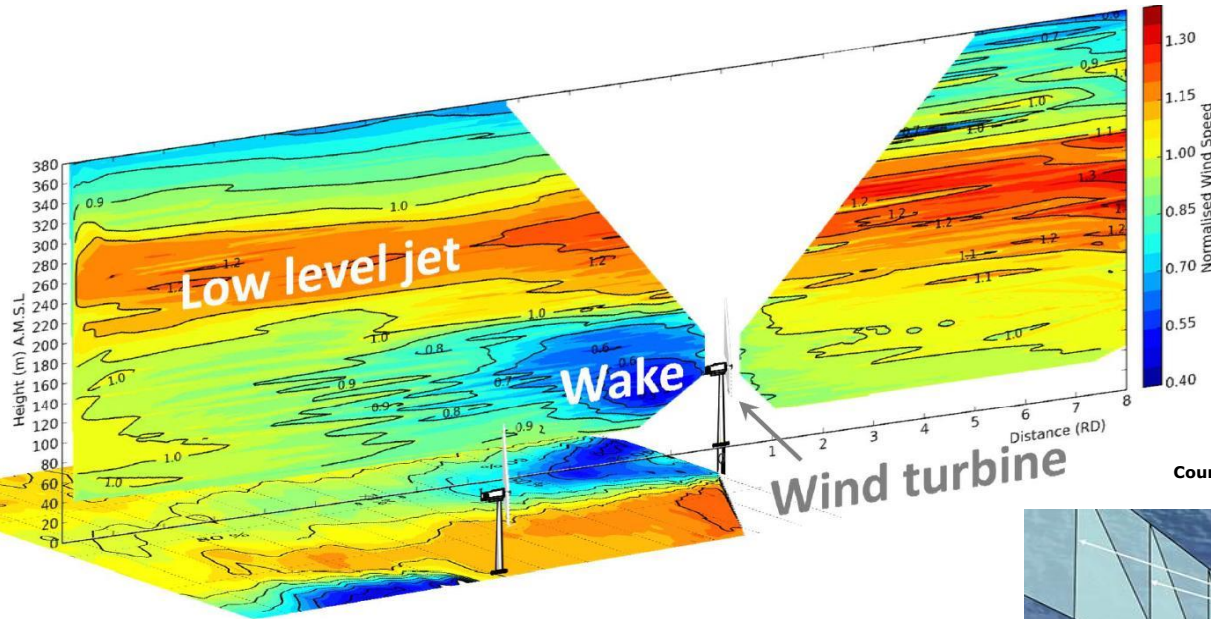
- Climatology: synop-data for yield calculations
- Mesoscale models for offshore & open terrain
- Day ahead-forecasts on power trading market



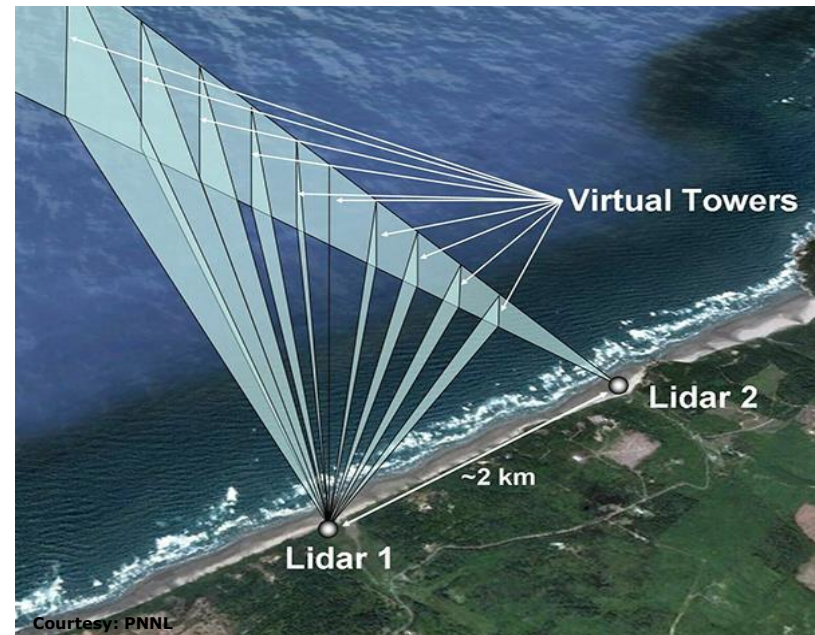
Parallel: wind-meteorology

- Very high accuracy measurement systems (met masts up to 200m, LiDARs up to 200-300m)
- Global high resolution models on wind flow (10-20 km grid)
- High resolution modelling (CFD, LES) on terrain and wake behavior (10-100m grids)

Examples: turbine or coastal based scanning LiDAR

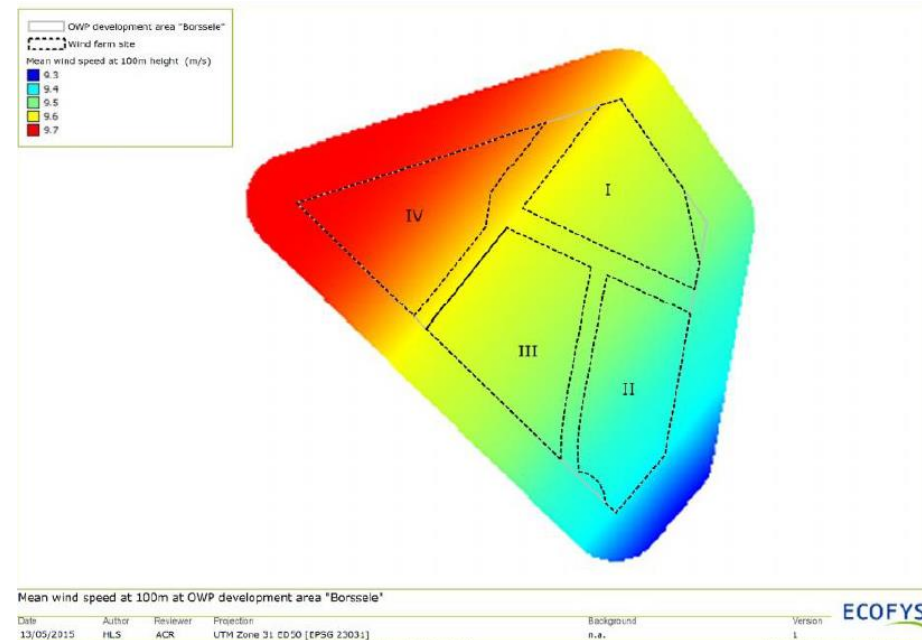


Courtesy: Anemos



Example: Offshore wind resource assessments in NL

- > Rest of the world: mast or Floating LiDAR measurements!
 - Down-side: costs (met mast ~ 10 mEUR)
- > Here: use of dense network of RWS/KNMI stations & meso scale models
- > Recent years: perform near-/onsite measurements (LiDAR on platform, floating LiDAR)
- > Currently: trend to mesoscale-only, or coastal scanning LiDAR



A prediction: 2026 will bring us...

- > **Global mesoscale models at <1 km-grid**, with integrated CFD-solvers for complex terrain to enable rapid cost-effective project development and avoid costly measurement campaigns
- > New wind turbines **permanent feedback to synoptical data-acquisition systems**
- > Offshore turbines: forward looking LiDARs, (used for enabling pro-active behavior towards extreme winds) lead to **significant evolvement of knowledge of boundary-layer processes** in terms of e.g. low-level jet formation & propagation, turbine wakes influencing turbulent mixture etc.
- > Wind farms in the North Sea coupled through ring grid, allowing **most efficient harvesting of the wind's energy**: closest to demand and w shortest distance to shore and highest market value, but similarly optimized on weather systems development
- > ...

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