Scaling New Heights: The Certification Perspective on Wind Turbine Growth

Johan Olaison, Head of Section Loads offshore

03 December 2024

Johan Olaison
Head of Section, Loads offshore

- M.Sc., Mechanical Engineering from Technical University of Linköping, Sweden
- DNV since 2016
  - Head of Section - Loads offshore
  - Senior Principal Specialist
  - Project Manager
  - Loads and environmental condition
  - Load validation (part of Type Testing)
  - Control and protection systems
  - Prototype inspection and safety and function tests
- Previously with Garrad Hassan (1997-2008) and Nordic Wind Power (2008-2012)

160 years of building trust

Since 1864, we have been guided by our purpose of:

Safeguarding life, property, and the environment

Our vision is to be:

A trusted voice to tackle global transformations

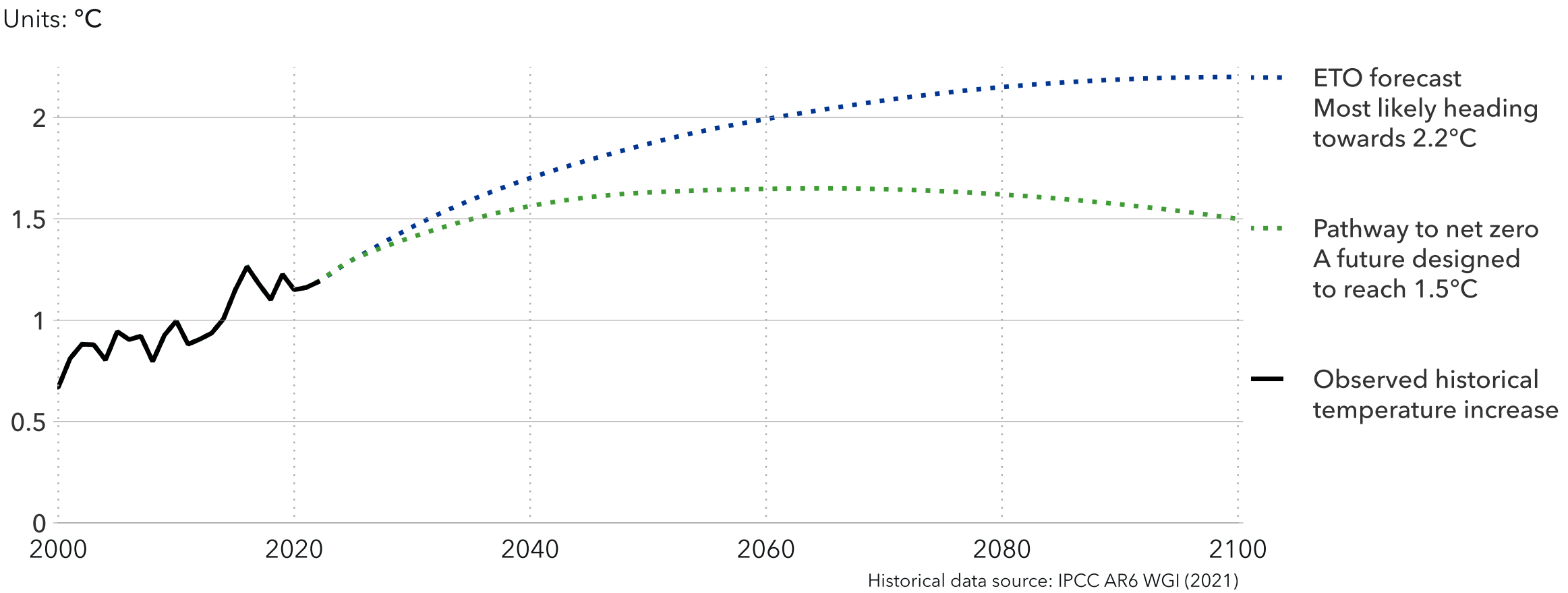
DNV

Energy Transition Outlook: The two futures

https://www.dnv.com/energy-transition-outlook/

Closing the gap to 1.5°C

Change in global surface temperature relative to 1850-1900



What is Certification?

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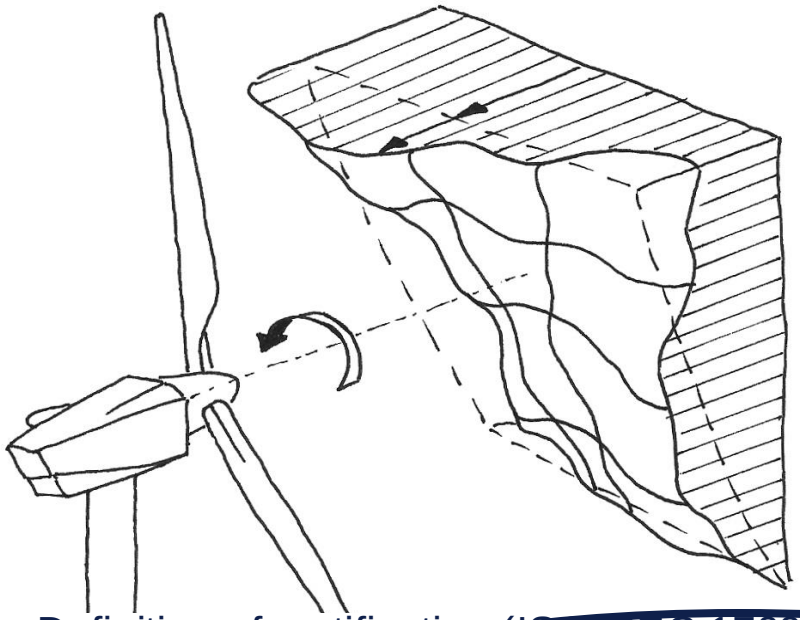


Do they match?

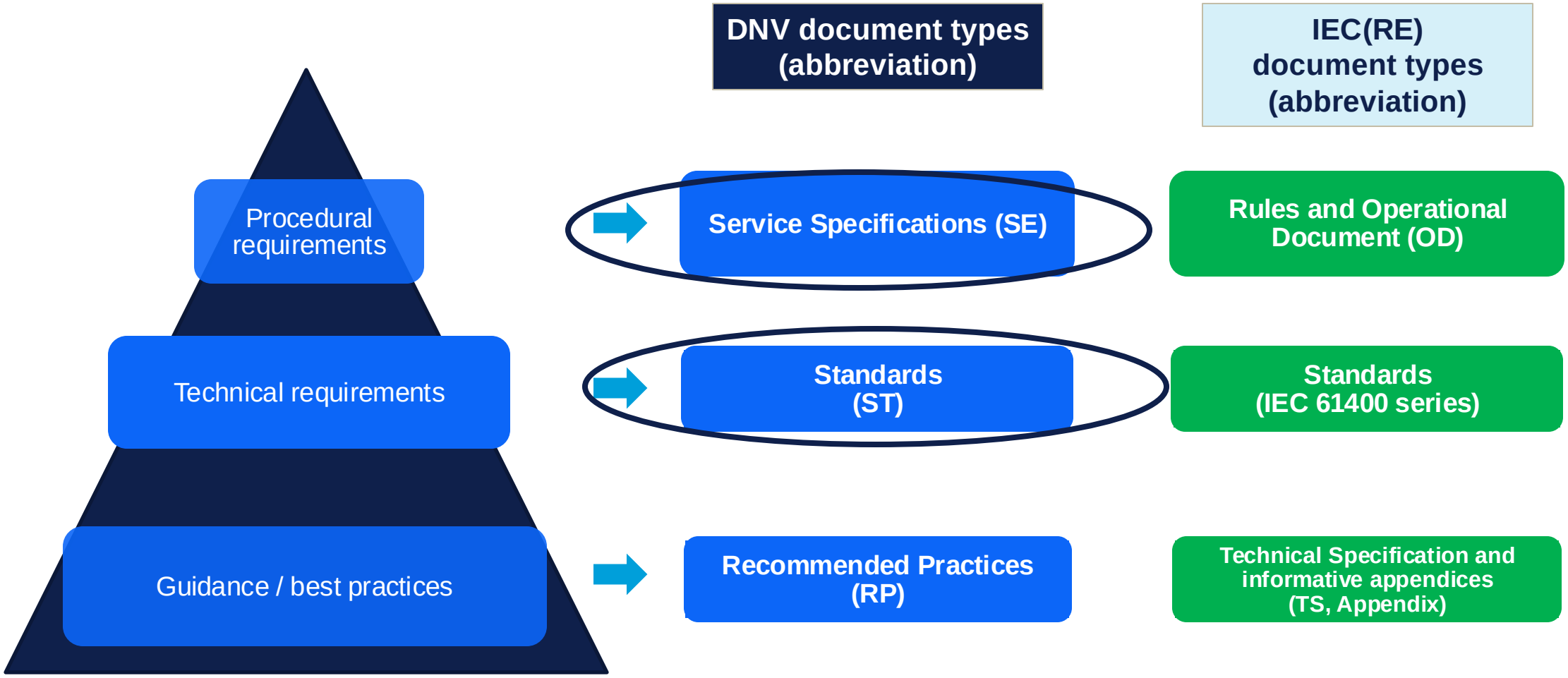
Definition of certification (ISO / IEC 17000)

Certification is a: *Third-party* ***attestation*** *related to products, processes, systems or persons*

Attestation means**:** *Issue of a statement, based on a decision following the* ***review****, that fulfilment of specified requirements has been demonstrated*

Review is done by**:** *Verification of the suitability, adequacy and effectiveness …*

DNV document hierarchy
Comparison to IEC & IECRE documents



Wind turbines size

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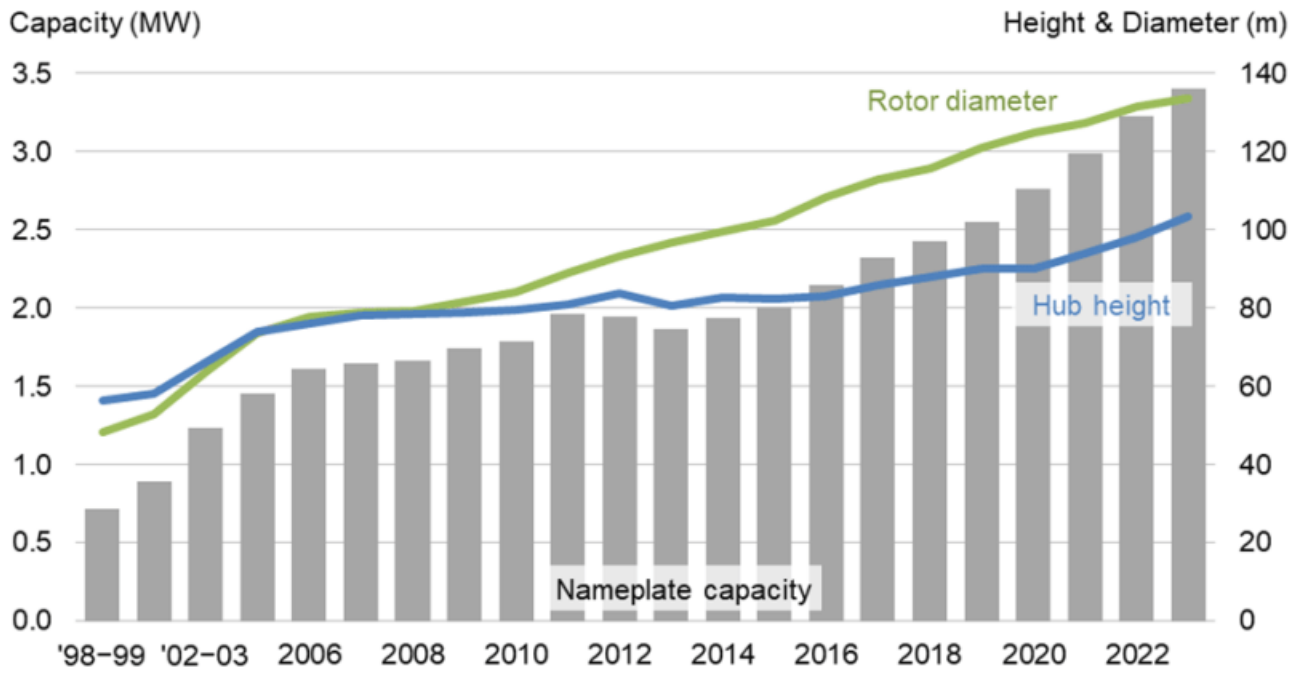
Increase of rotor diameter, hub heigh and rated power



Average turbine hub height, rotor diameter, and nameplate capacity for land-based wind projects from the Land-Based Wind Market Report: 2024 Edition.

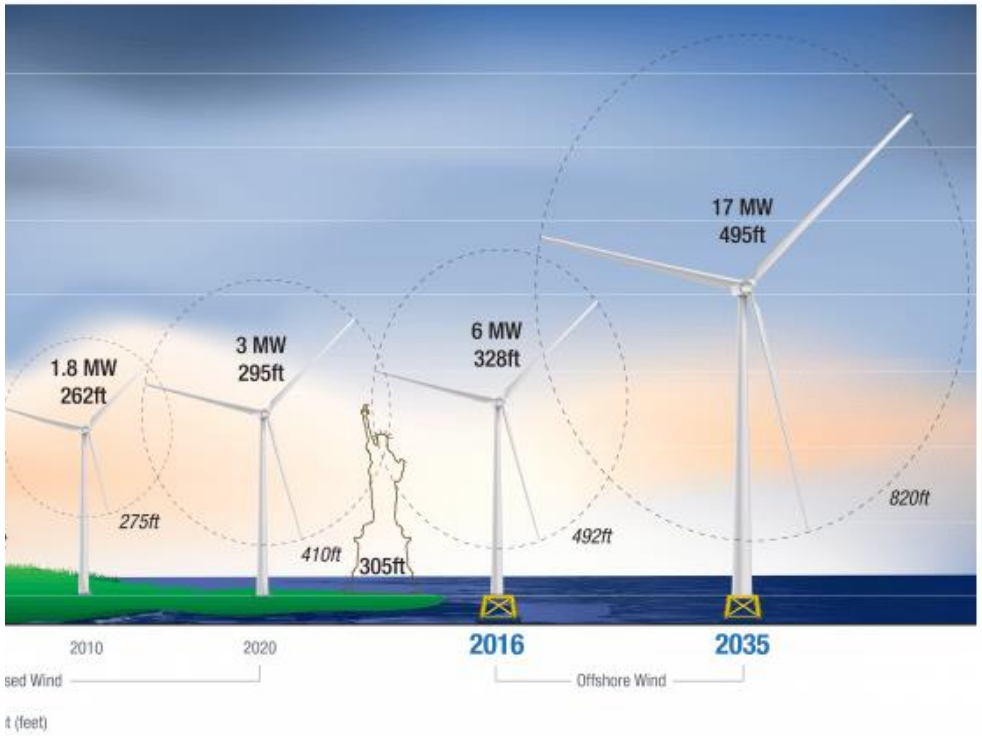


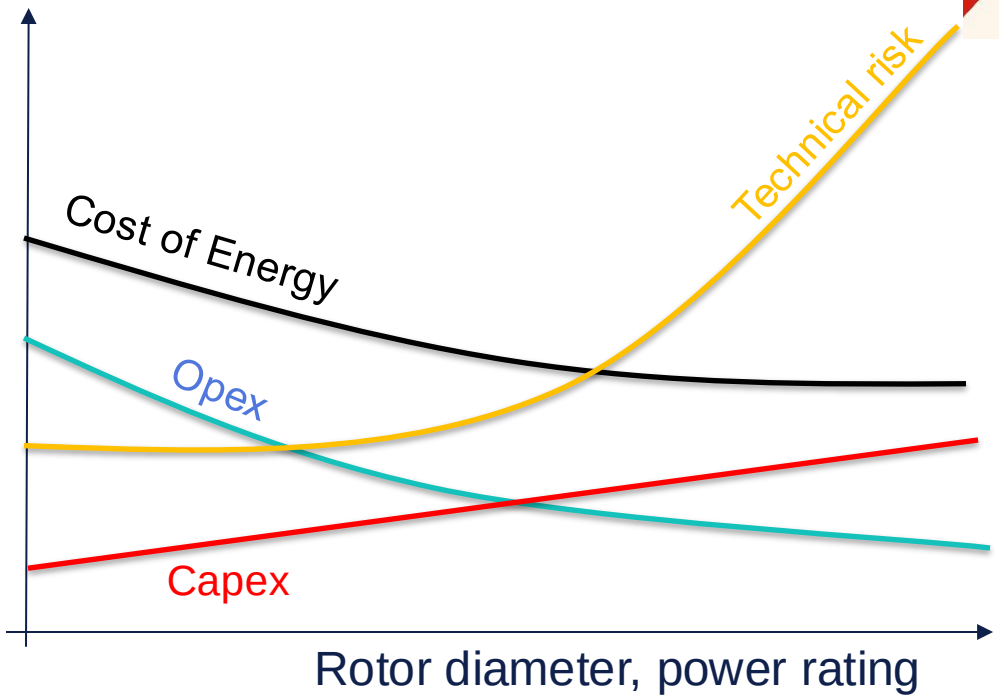
Illustration of increasing turbine heights and blades lengths over time.

Data from www.energy.gov

Is there a limit?

- Transportation
- Manufacturability
- Optimum cost of energy
- Reliability

DNV scaling study



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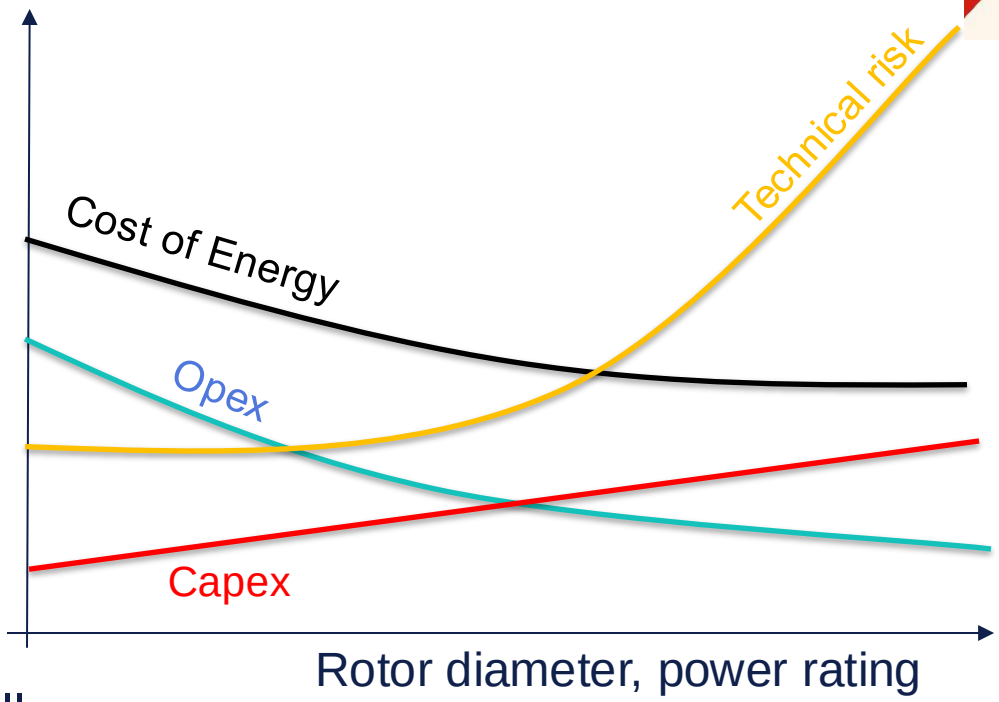
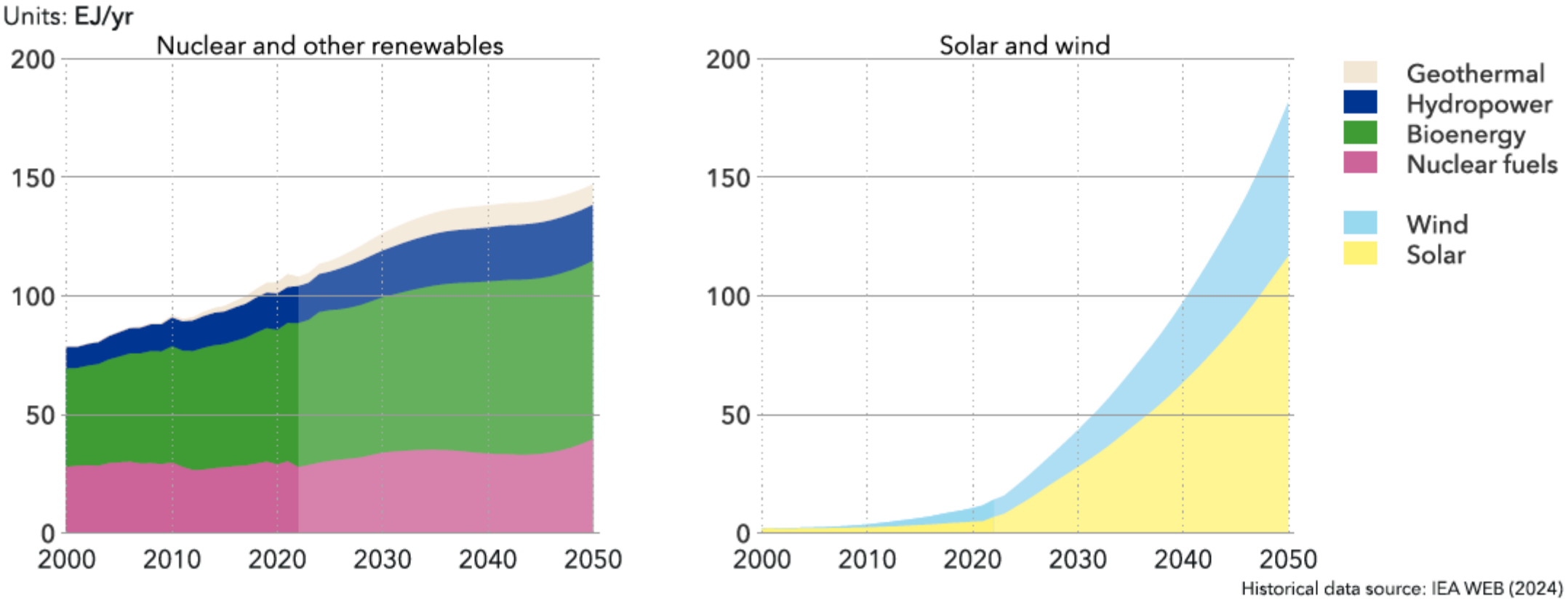


- One thing is certain. We need to get better on all accounts. DNV's ETO predicts large increase in demand of wind energy.

DNV ETO – Energy Transition Outlook

FIGURE 3.1

World renewables and nuclear primary energy supply



Looking back - What has changed in the past years?

Drivers:

- Growing wind turbine sizes
- Advanced controllers
- New materials
- Industry experience

IEC 61400-13
distributed blade loads

IEC 61400-1 Controller req.
DNV-ST-0437

DNV-ST-0376 Blades
DNV-ST-0361 Machinery components

IEC 61400-1
EOG -> Turbulence
Probabilistic methods

What lies ahead?

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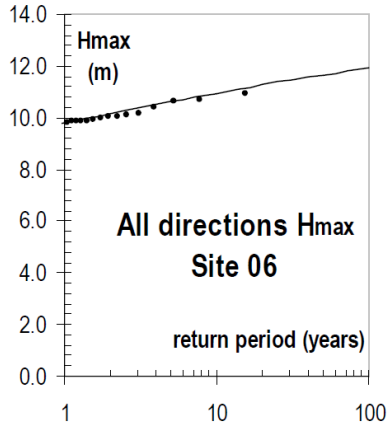
What lies ahead?

- Load effects and load modelling
- Blades
- Cast components
- Other topics

Block Island Wind Farm. Credit: Dennis Schroeder/NREL/flickr/CC BY-NC-ND 2.0

Load effects and load modelling

- Lower rotational speeds means less revolutions in 10-minutes which leads to greater turbulence seed variations.
- Greater risk of aerodynamic instabilities in standby: vortex induced, stall induced
- Ringing phenomenon of offshore support structure
- Larger diameter support structure offshore:
  - Lower Eigen Frequencies may make resonance effects more relevant, e.g. by interacting with wave time periods. The impact from larger waves with long periods could become relevant.
  - Are the wave theories applied to calculate the hydrodynamic forces sufficiently robust?
  - The water contained in the MP could lead to sloshing effects.

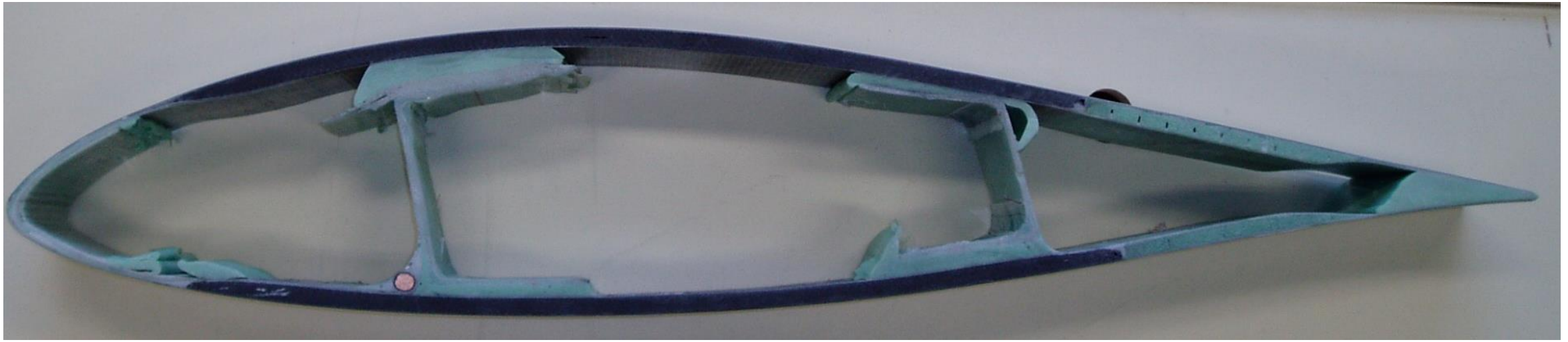


Wind turbine blades

- Design for **manufacturing**
- Requirements for Manufacturing Evaluations will evolve.

Wind turbine blades

- Design for manufacturing
- Requirements for Manufacturing Evaluations will evolve.
- There will be an increased number of **subcontractors** of parts of the blade. Certification requirement does not cover this well today.
- Longer blades are **thinner** structures (relatively). More sensitive to size of imperfections and wrinkles.



Wind turbine blades

- Design for manufacturing

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- Requirements for **transport** and **installation** will evolve. Thinner structures are more sensitive to point contact. Larger and more flexible structures makes for more cumbersome and risky handling.
- **Testing** takes longer because natural frequencies are lower. Time to market requirement will force new innovative ways for testing which needs to be captured in certification.

Cast components

- **Material properties:** Standards refers to data from tests for components up to 200mm. We see today components 300mm thick, which means that special material and/or component testing is needed. This need will increase.

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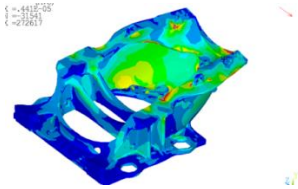

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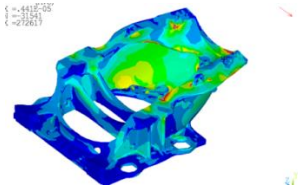
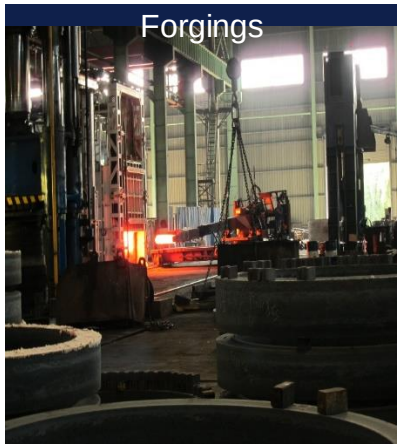
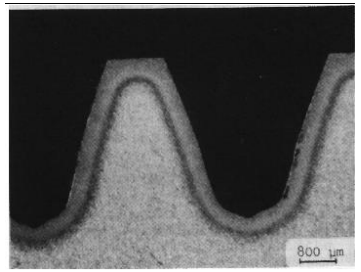
- **FE modelling** will change with layered approach with sub-models within sub-models to capture the large scale with fine details.
- **Inspections** will take longer time. Bigger component takes longer to inspect.





Other topics

- Offshore transport and installation: shortage of vessels – needs new innovative methods
- Cables: 80% of insurance claims relates to cables
- Grid code compliance – Grid forming
- Electrical:
  - Difficult to fit large components that increases in size with volt.
  - DD PMG generator: manufacturing, transport, testing needs complete nacelle (PT)
- Gearbox: Methods need to adopt
  - Bigger gears, different gear phases affects lubrication
  - Temperature distribution in large gear is different – cooling a challenge



Certification – a key role in the future of Wind Energy

- Larger turbines / Larger projects – Higher risk
- Certification – High value / Low cost

DNV

TYPE CERTIFICATE

Certificate No.: TC-DNV-SE-0074-[ID with 5 digits]-[rev.] | Issued: [YYYY]-[MM]-[DD] | Valid until: [YYYY]-[MM]-[DD]

Issued for:

<Wind Turbine Type>

Specified in Annex 1

Issued to:

<Wind Turbine Manufacturer>

< Address line >

< Address line >

According to:

DNV-SE-0074:2021-09 Type and component certification of wind turbines according to IEC 61400-22

Based on the document:

FER-TC-DNV-SE-0074-[ID]-[rev.] Final Evaluation Report, dated yyyy-mm-dd

Additional references according to above report are given in Annex 2.

Changes of the system design, the production and erection or the manufacturer's quality system are to be approved by DNV.

<Select SLL location>, [YYYY]-[MM]-[DD]
For DNV Renewables Certification
[Name of SLL for "Cert. decision"]
[Function]

DAkkS

By DAkkS according DIN EN ISO/IEC 17065 accredited Certification body for products. Not accredited or in valid for the fields of activities listed in the certificate.

Place, [YYYY]-[MM]-[DD]
For DNV Renewables Certification
[Name of PM "doing it"]
[Function]

The accredited certification body is DNV Renewables Certification GmbH, Brooktorkai 18, 20457 Hamburg.
DNV Renewables Certification is the trading name of DNV's certification business in the renewable energy industry.

DNV

Thank you!

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www.dnv.com