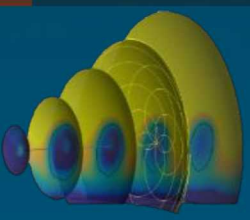
Sandia National Laboratories

SAND2018-12158PE

Wind Energy Technologies Department

October 24, 2018



DEVELOPED BY

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Wind Energy Technologies Department Staff

SAND2018-XXXX

DOE ENERGY NNSA

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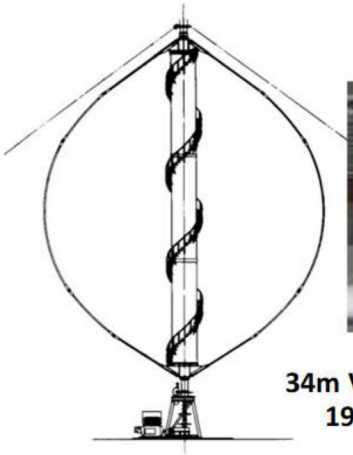
Sandia Wind Program History

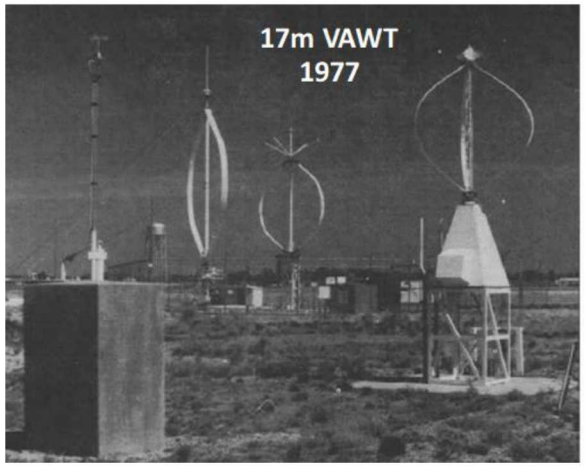
Wind Program Established 1975



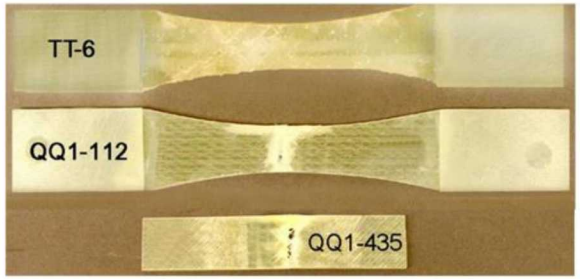
34m VAWT 1984

HAWT Blade Program 1994

SWiFT Facility 2013



Composite Materials Database 1988



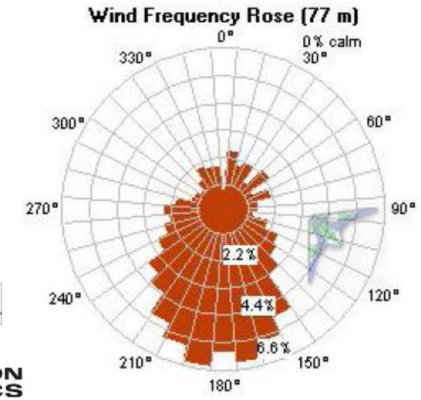
Advanced Manufacturing Initiative 2008

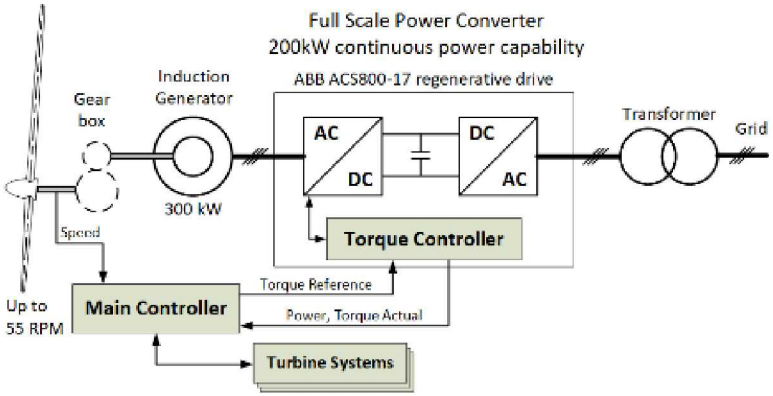
Scaled Wind Farm Test (SWiFT) facility

- Only open-source wind farm in the world comprised of three research-grade wind turbines to study turbine-turbine interaction and advanced rotor blades

SWiFT meets the challenge:

- Large commercial turbine/wind farm R&D has frequently been restricted and conservative because of high-cost, high-risk, proprietary constraints and high uncertainty in the results
- Smaller SWiFT scale allows for considerable reduction in measurement uncertainty synonymous with an outdoor wind tunnel
- Hardware-in-the-loop wind turbine simulator test stand at Sandia

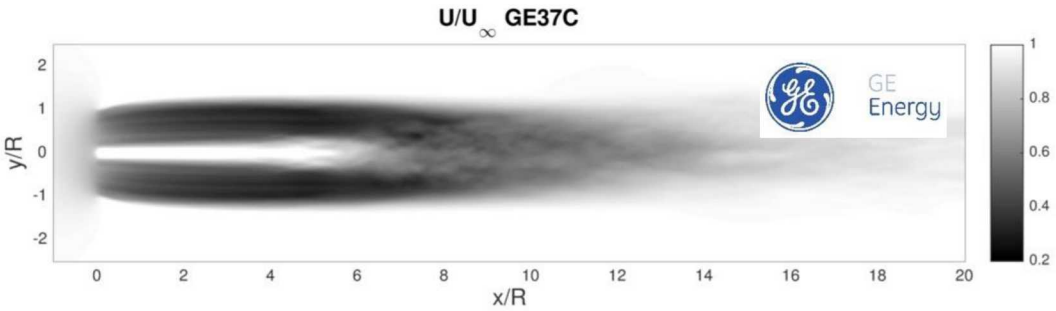


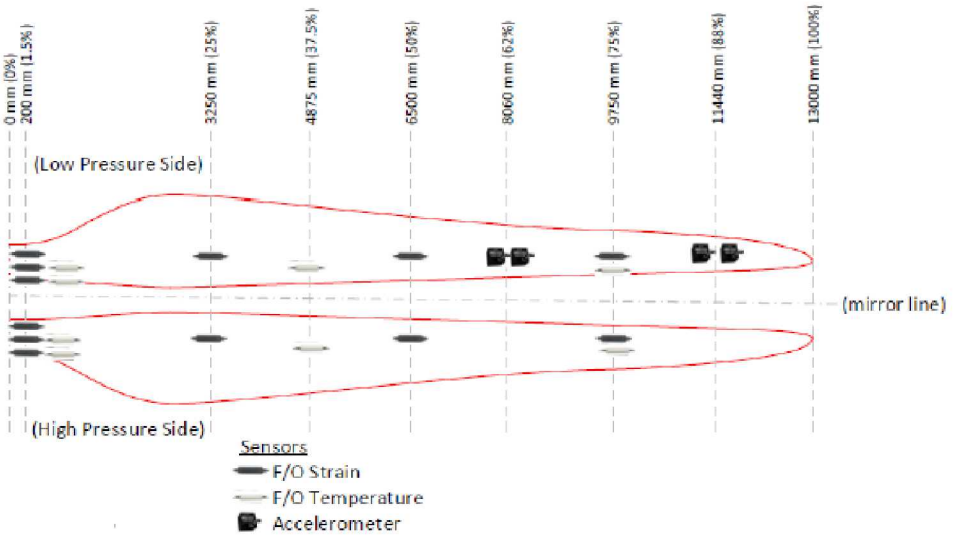


NRT – designed to mimic wake of GE turbine

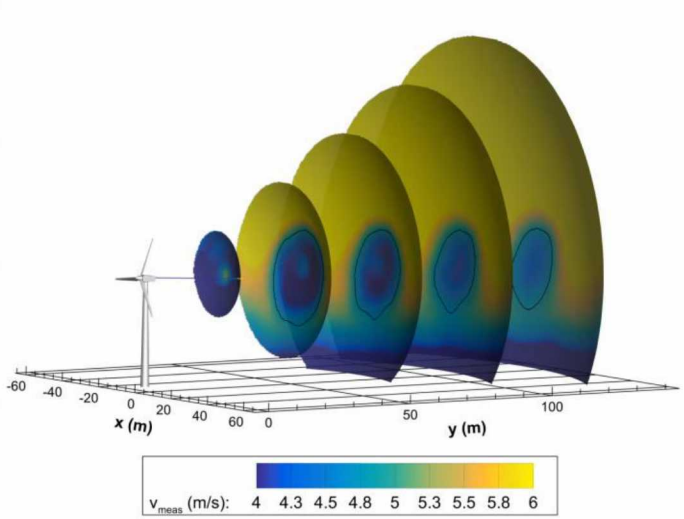
- National Rotor Testbed (NRT) rotor designed functionally to produce a wake similar to commercial turbine

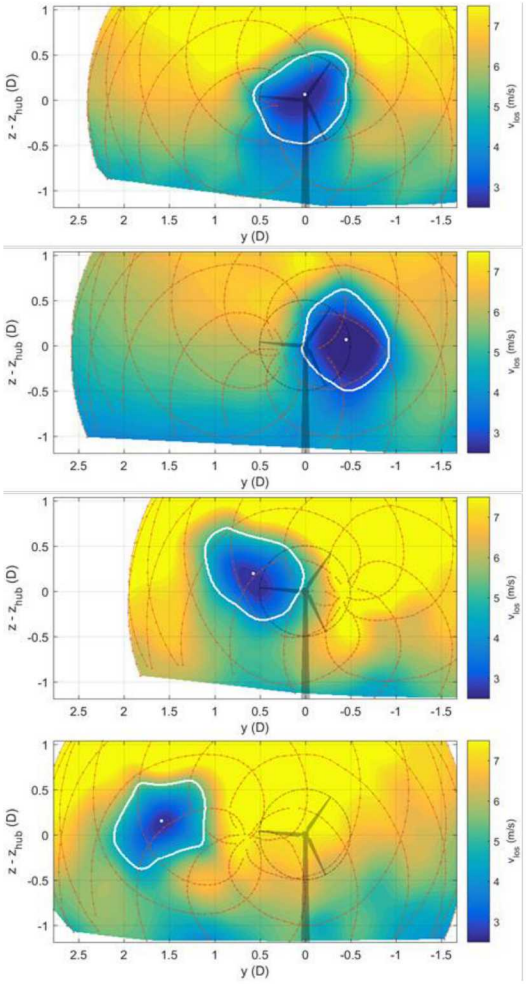
- Build with Oak Ridge and TPI composites
- Serve as a research platform for rotor innovations (aero, structural, sensors, control)

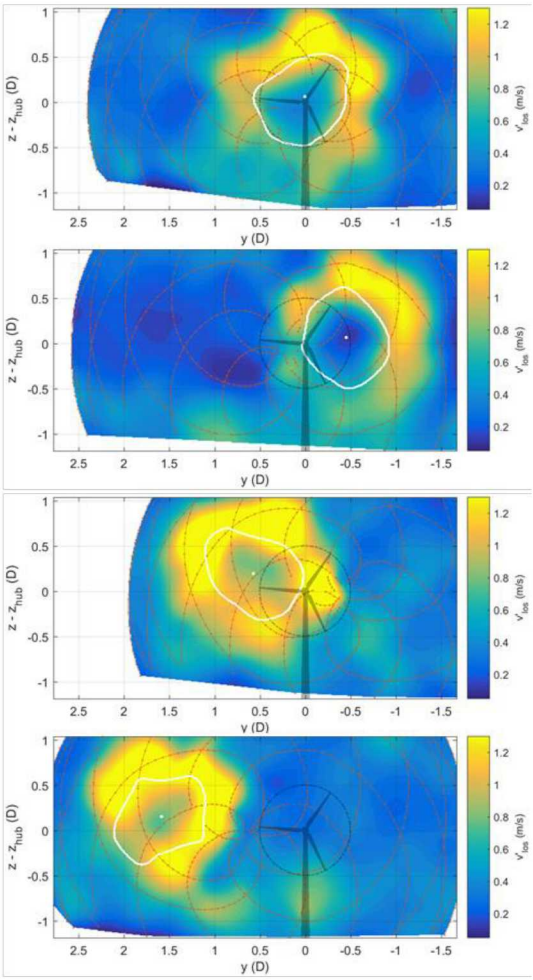




Wake Dynamics / Wake Steering

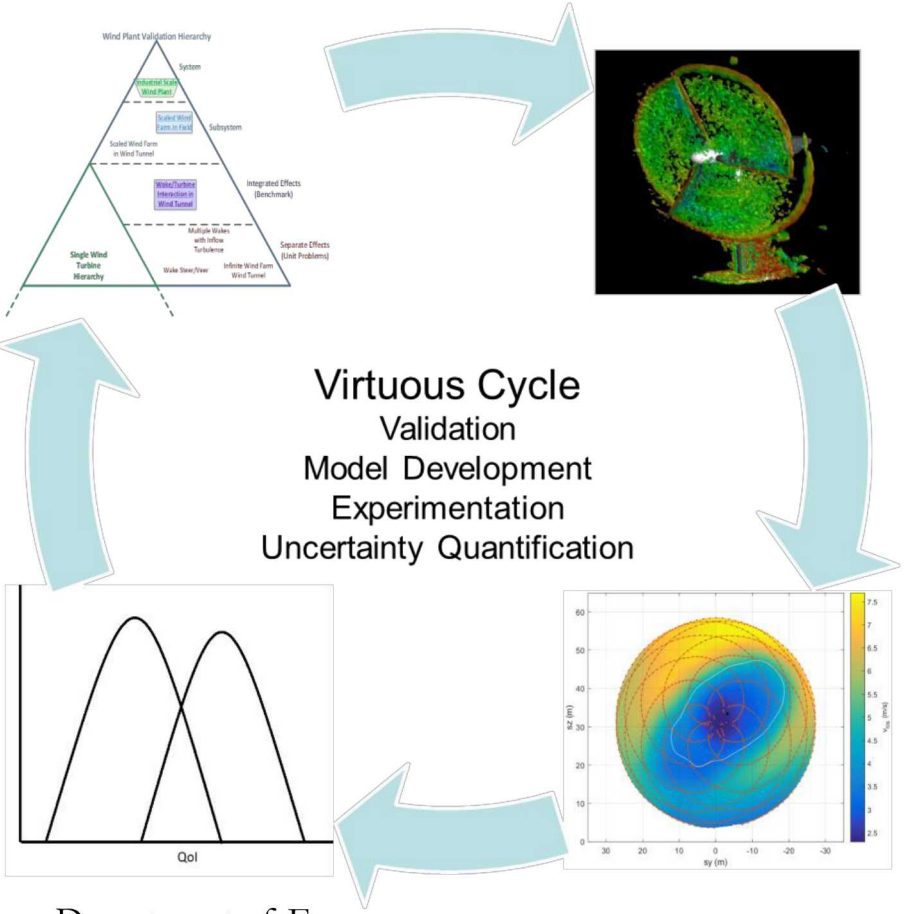




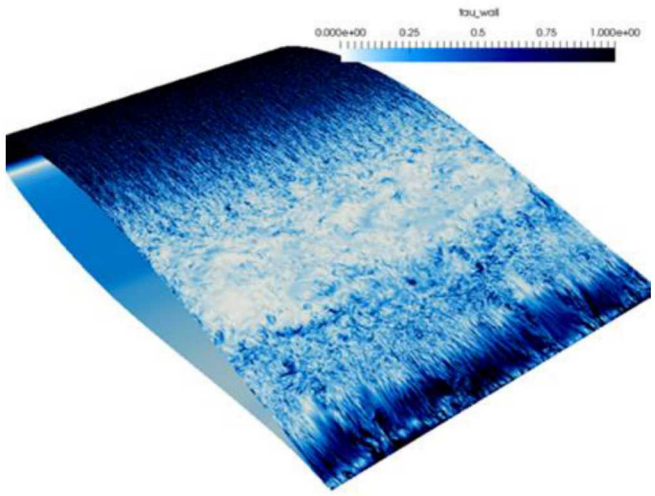


Uncertainty Quantification and High Fidelity Modeling

- Demonstrate UQ forward propagation for a wind plant high fidelity modeling case.



Barone, M., Domino, S., Bruner, C. 2018



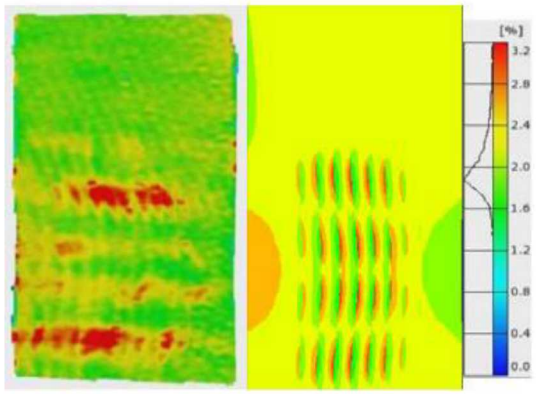
Department of Energy
Wind Energy Technology Office
Atmosphere to electrons (A2e) initiative

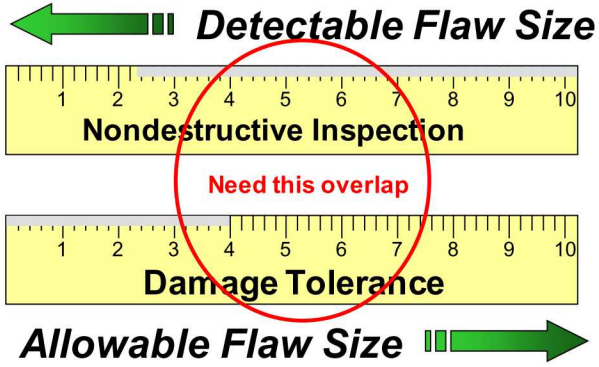
Blade Reliability

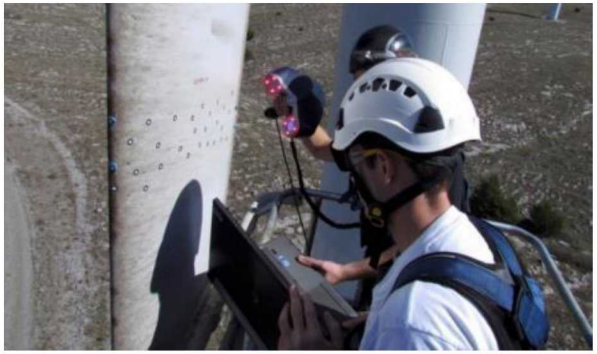
Objective: Reduce unplanned maintenance of wind blades through

- Validated damage growth models
- Improved plant and field inspections
- Optimized repairs
- Understanding of operational damage
- Lifetime value model of blades

Move blades from safe-life to damage-tolerant design (i.e. aerospace-like)







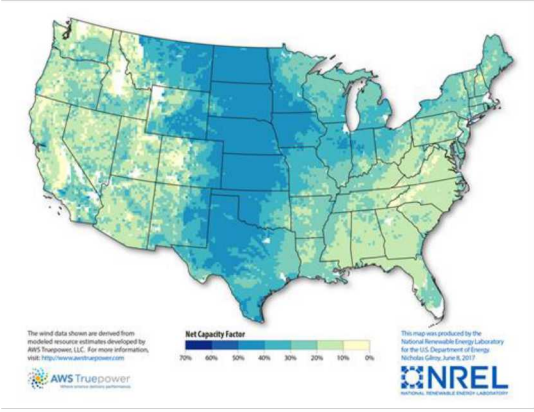
Big Adaptive Rotor

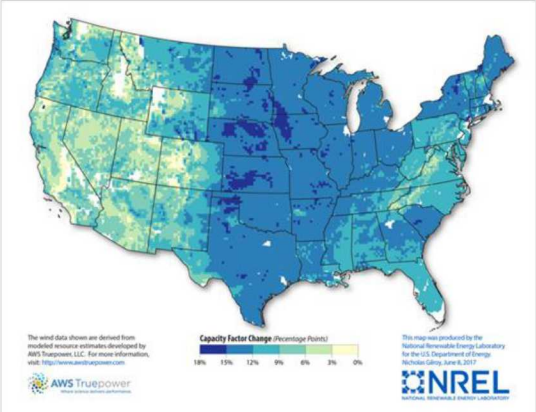
Collaboration between SNL, NREL, ORNL, LBNL and industry

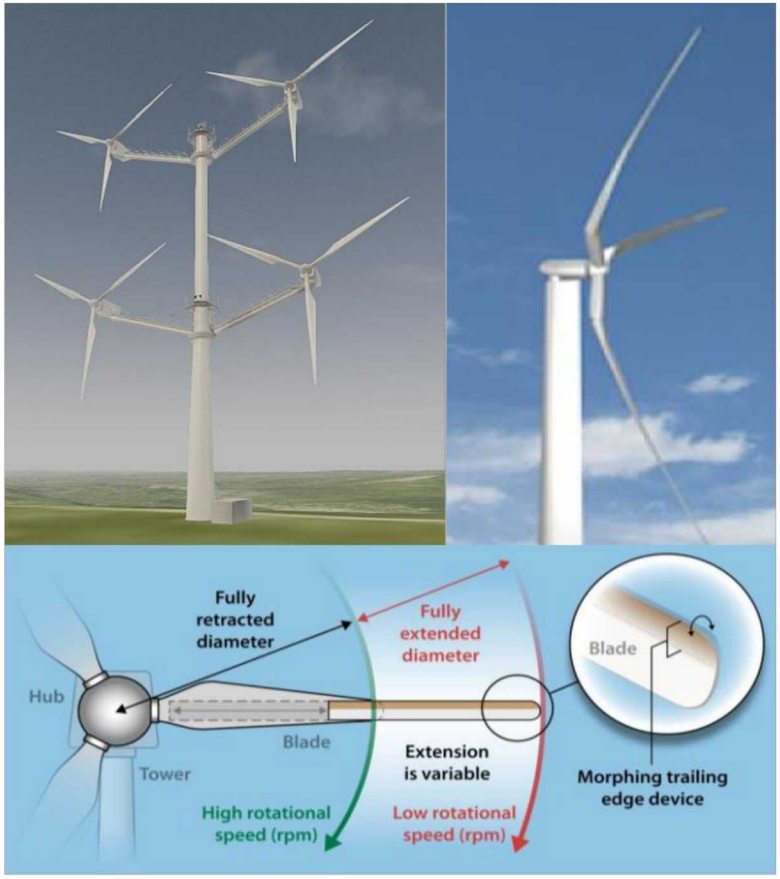
Objective:

- Investigate design conditions and criteria for large rotors
- Determine and develop key enabling technologies for high energy capture turbines

Focused on transportation, controls, materials (optimized carbon fiber), and innovative concepts

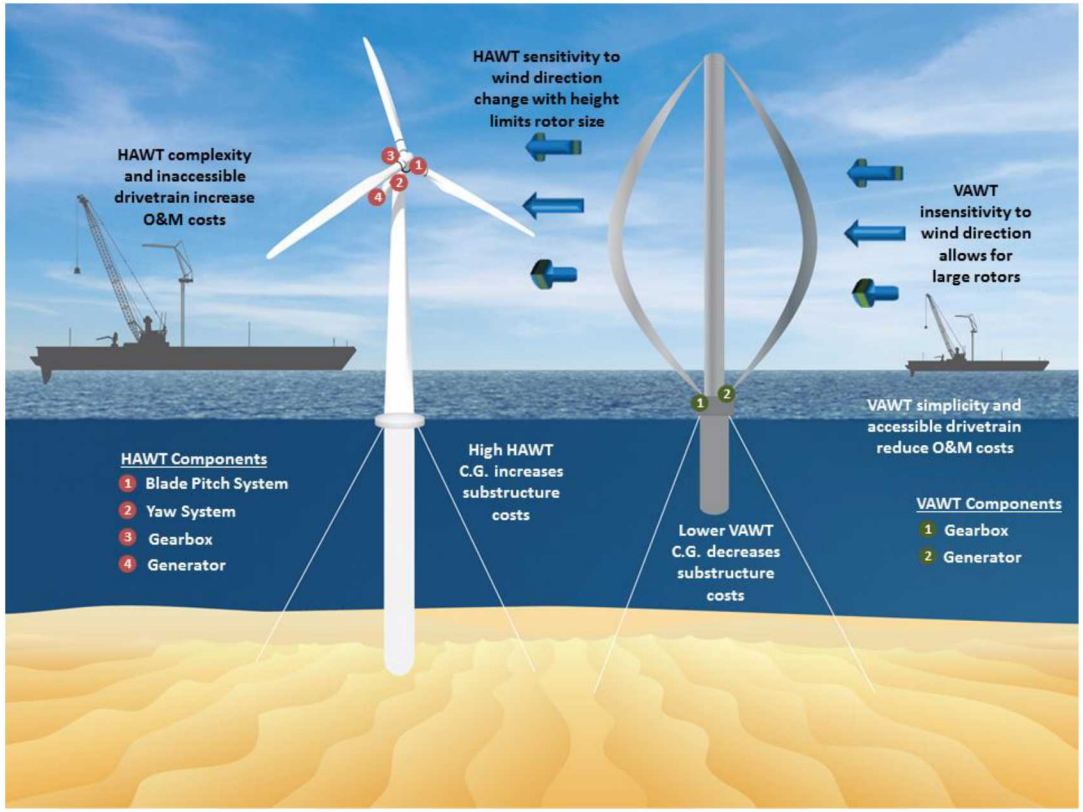






Offshore wind – New concepts and technologies

- Floating offshore wind plants have more components than land-based machines
- Turbine costs represent 65% of wind plant costs for land-based sites compared to around 20% for floating offshore sites
- Platform costs now represent the largest single contributor to LCOE
- Vertical-axis wind turbines have been studied as a potential solution for floating offshore wind energy which have several benefits, including:
  - Lower center of gravity, reducing platform costs
  - Improved efficiency over HAWTs at multi-MW scales
  - Reduced O&M costs through removal of active components and platform-level placement of drivetrain



Thank You

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