**Deepwater Offshore Wind Technology Research Requirements**

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### Offshore Wind — U.S. Rationale

**Why Go Offshore?**

- Current turbine designs use onshore practices.
- Offshore experience in shallow water is essential for offshore wind energy deployment.
- Offshore turbines must close the loop between O&M and turbine design.
- High reliability designs
- Designs for in-situ repair
- Remote condition monitoring
- Turbine self diagnostics
- Safer and faster personnel transport

### DOE Deepwater Wind Energy Workshops

**Workshop Objectives**

- Leverage experience and expertise from offshore industries such as oil and gas, marine engineers, offshore wind, oceanographers, ecoregions, and coastlines.
- Identify technology gaps to achieve a mature offshore wind industry in the United States.

### U.S. Offshore Wind Energy Resource

**DOE Offshore Wind Strategy**

- Windy onshore sites are not close to coastal load centers
- Why Go Offshore?
  - Load centers are close to the offshore wind sites
  - The electric utility grid cannot be easily set up for interstate electric transmission
  - Offshore oil
  - Experience

### Offshore Turbine Design Basis

**Define external conditions**

- Measurements – Extreme wind, wave/wind combinations, sea state, wind shear, ice, currents, tide, soil mechanics, ship collisions, turbulence, wind farm turbulence.

**Design studies – Narrow the options**

- What is the design load envelope?
- What foundations achieve the lowest cost?
- What are the design drivers?
- Code development
- Coupled platform/turbine responses
- Ocean Test Bed Validation

### Testing and Validation

- Scale model testing – Configuration tradeoff studies in wind/wave tank.
- Hybrid testing – Wave simulations can be conducted in a subscale test-bed on land under real wind conditions to measure turbine response to rare load combinations.
- Full-scale blade and drivetrain test facilities – Larger wind turbine components must be tested and verified before field deployment.
- Field testing – Full-scale test loads in real ocean environments are essential.
  - Certification
  - Code validation
  - Safety verification

### FY 2005 DOE Offshore Wind Energy Activities and Funding

- Offshore System Optimization
  - Higher speed rotors (lower aerodynamic noise constraints) will lower system weight and increase energy capture.
  - Larger turbine sizes can lower offshore balance of station and operation and maintenance costs.
  - Lower shipping and erection constraints may favor direct drive, yawing platforms, etc.
  - Greater weight penalties on floating systems will drive use of lighter materials (e.g., extended use of composites in towers, hubs, bedplates, shafts) and multi-rotor systems.
  - Windwave/hydrogen/storage energy technology convergences may spawn new energy supply models

### Summary

- U.S. offshore wind energy potential is over 1000-GW.
- U.S. offshore wind resource is complementary to the on-shore wind resource due to geographic separation.
- U.S. deepwater wind technology is necessary for full offshore wind energy deployment.
- Offshore experience in shallow water is essential for deepwater technology to move forward.
- Expanded R&D (technological and environmental) is necessary for cost-effective deepwater wind energy.
- Commercial deepwater technology will take 10–15 years to develop.