

Offshore Renewable Integration

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State of Maine

GOVERNOR'S OCEAN ENERGY TASK FORCE

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Presentation Overview

- Resources
- Off-shore Technologies
- Wind Penetration in New England
- Integration Challenges and Opportunities
- ISO New England Action Plan

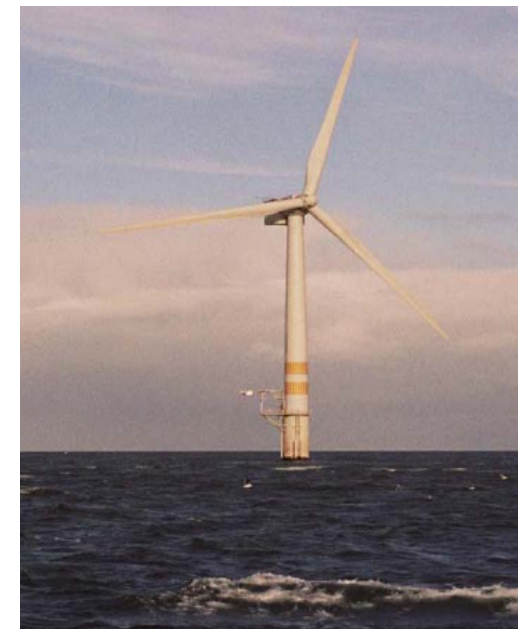
Resources

- A resource for the task force is information presented at the recent Roger Williams 7th Annual Marine Law Symposium held on October 23rd and 24th
- Conference focused upon the state of various technologies, regulatory frameworks, economic and financial issues, community concerns and grid integration
- Link to symposium's website and contact information for technology experts

<http://law.rwu.edu/sites/marineaffairs/symposia/seventhMLS.aspx>

Off-Shore Technology

- Off-Shore Wind is feasible now and in the ISO Queue:
 - This technology is in use in Europe for shallow operations (monopile foundations) +/- 60 Feet or less
 - Accurate wind data needed for investment
 - Just in beginning stages for intermediate waters (Jacketed Technology) depths to +/- 150 feet which could potentially get projects beyond the horizon. Turbines are in place in Scotland.
 - Deep Offshore technically feasible but expensive (Spar Buoy)



Off-Shore Technology

- Hydrokinetic
 - Wave
 - Current
 - In stream tidal

- Hydrokinetic:
 - Uses submerged turbines
 - Can be highly predictable -- which can help mitigate bulk power variability concerns
 - Early stages of development and testing
 - Requires additional research and development for wide scale commercial applications
 - None in the ISO Queue at this time

Off-Shore Technology

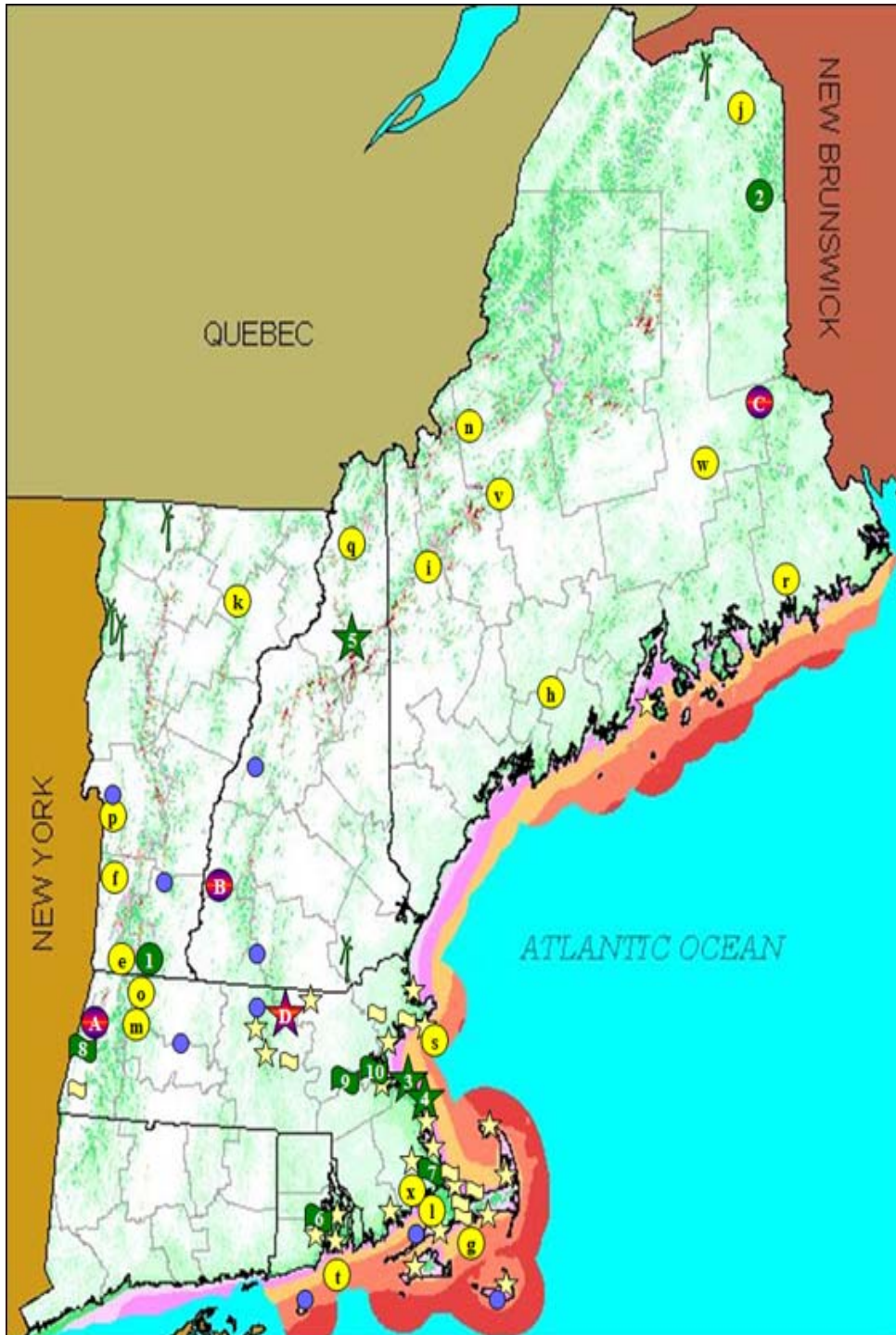
- Ocean Thermal Energy Conversion
 - Uses differences in temperature between warm ocean surface waters and cold deep ocean waters
 - Commercially unproven

Levels of Wind Penetration in New England

- Until recently only small distributed wind farms in region
 - 24 MW of Utility Scale wind is now in operations
 - 57 MW of wind expected to be added next week
 - Mars Hill project is operating and connected to New Brunswick Grid
 - Over 300 MW scheduled to be added during 2009
 - **Proposed** offshore projects exist in Massachusetts and Rhode Island
- To date there has been no significant impact to the ISO or its systems related to wind integration
- ISO objective is to be ready and able to meet challenges before they arrive

In the Queue

- 3917 MW of Wind is in the Queue
 - http://www.iso-ne.com/genrtion_resrcs/nwgen_inter/status/index.html
 - 1709 MW offshore
 - 2208 MW onshore
- Of the 3917 MW, projects totaling 852 MW have been determined by the ISO (with input from stakeholders on the Reliability Committee) to have no adverse impact on the system



Wind Map of New England

- **Operating Projects**
 - **Windfarms**
 1. [Searsburg Wind Energy Project](#) 6.6 MW
 2. [Mars Hill Wind Farm](#) 42 MW NB
 - [Lempster](#) 24 MW
 - **Community Scale**
 3. [Hull Wind 1](#) .7 MW
 4. [Hull Wind 2](#) 1.8 MW
 5. [Jericho Mountain Wind](#) 1.05 MW
 - **Customer Sited (100 kW+)**
 6. [Portsmouth Abbey](#) .7 MW
 7. [MA Maritime Academy](#) .7 MW
 8. [Jiminy Peak](#) 1.5 MW
 9. [IBEW](#) .1 MW
 10. [Forbes Park Wind Project](#) .6 MW
 - **Small Wind (<100 kW)**
 11. [Burlington Electric Department](#)
 12. [Beaulieu](#)
 13. [Manchester/Hillsborough](#)
 14. [Dynapower](#)
 15. [Butterworks Farm](#)

Source of Map:
http://www.eere.energy.gov/windandhydro/windpoweringamerica/ne_projects.asp#operating_windfarms

WIND: Integration Challenges & Opportunities

- Transmission Capacity in Areas of High Wind Capability is limited
- Who pays for the new transmission capacity
 - Texas Plan (State identifies sites and orders T.O.'s to build)
 - California Plan (Build trunk line and they will come)
 - Economic Studies Working Group
- Factors in On- and Off- Shore Wind Siting
 - Attractive Wind Source
 - Land Owner, Community, Offshore Stakeholder Support
 - Feasible Permitting and Environmentally Suitable
 - Interconnection Point
 - Offshore may have an advantage if built close to load centers
 - Must consider effects of marine environment
 - Developers often seek favorable markets

Great Wind Locations are not Necessarily Coupled with Great Transmission Corridors with Surplus Capacity

Source Levitan Phase II Wind Study for ISO New England
1 meter per second roughly 2.2 mph

Legend

Class 7 >8.8 (m/s)

Class 6 8-8.8 (m/s)

Class 5 7.5-8 (m/s)

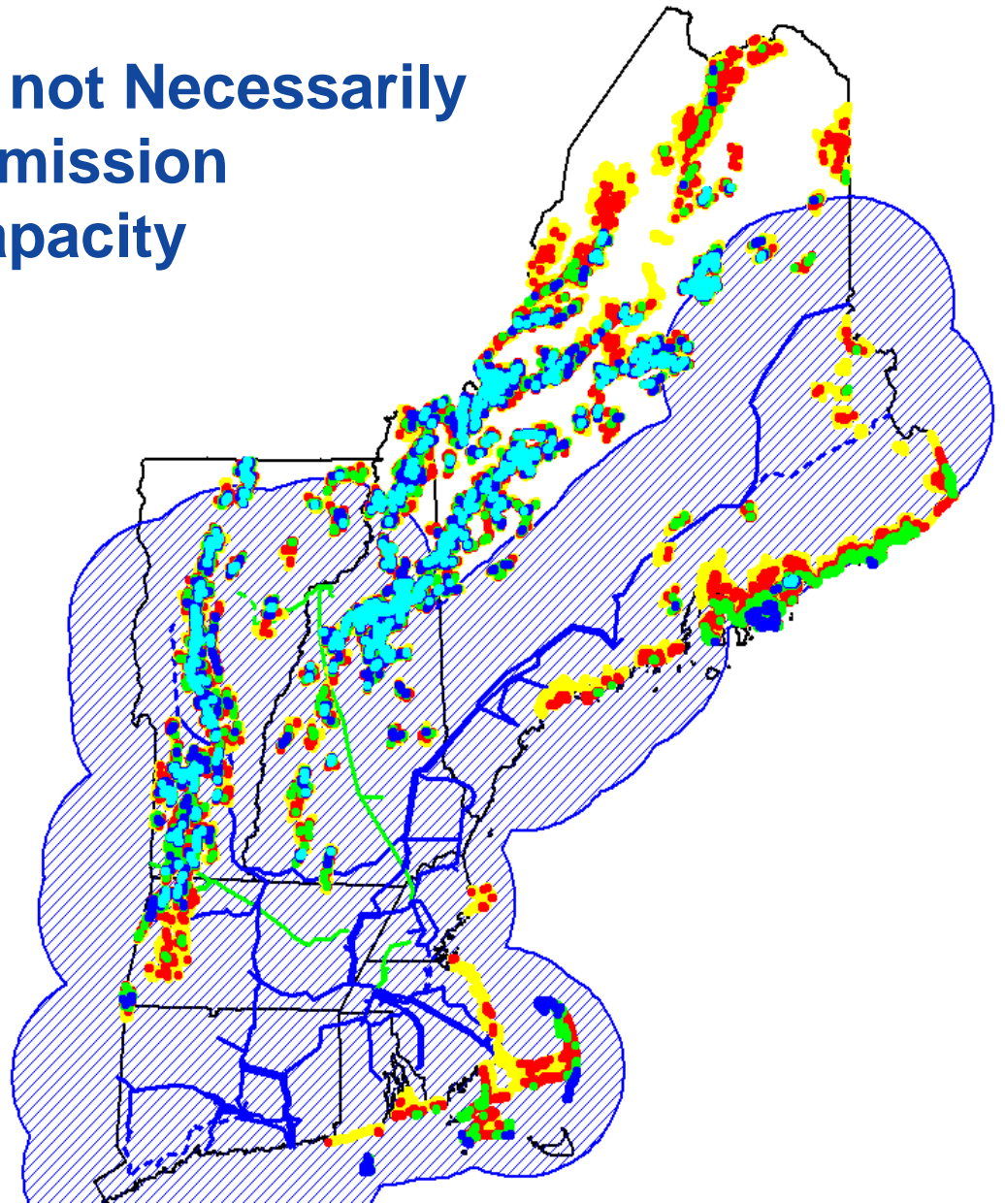
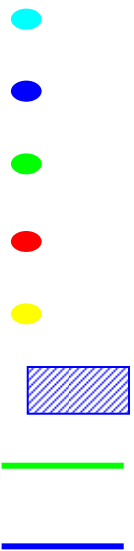
Class 4 7-7.5 (m/s)

Class 3 6.4-7 (m/s)

40 Miles

230 kV

345 kV



WIND: Integration Challenges & Opportunities

- Load Following Requirements
 - Opposing ramps of load and wind
 - Ramp Rates
 - Impacts to other resources
- Automatic Generation Control Requirements
 - Meeting Control Performance Requirements CPS1 and 2
- Reserve Requirements and Contingency Coverage Requirements for loss of wind
 - Disturbance Recovery Standards
- All of these depend on geographic diversity, level of penetration and weather
 - Distributed generation can aid in diversity of the wind resources, however scale may be an issue for offshore wind

WIND: Integration Challenges & Opportunities

- Low Voltage Ride Through
- Power Factor and ability of new technologies to control voltage
- New technologies coupled with system impact studies appear to have satisfied these concerns
- High Wind cut-out
- Neighbors with windy ambitions (NY, Maritimes)

WIND: Integration Challenges & Opportunities

- Forecasting
 - Who does it
 - Emergency monitoring tools
 - Approaching weather systems
 - Ensuring that we are forecasting accurately enough to displace more expensive resources or otherwise we have not achieved our goals
 - Effective Load Carrying Capacity
- Texas Events of 2/26/08

WIND: Integration Challenges & Opportunities

- Congestion Management
 - Competing for limited transmission
- Minimum Generation Emergencies
 - High wind, high hydro, low loads and limited transmission capacity
 - Storage
- Visibility to the System Operator
 - Real-time weather information
 - Metering and Telemetry
 - Real-time Control of Facilities (SCADA)
 - Voice Communication
 - Outage Coordination

ISO New England Action Plan

- ISO is actively engaged with developers of current and future projects to ensure successful integration of assets
- Future planning and operational studies
 - ISO Planning staff conducting economic transmission analysis
 - ISO has hired a senior renewable resource engineer to develop RFP for operational and planning study and to facilitate renewables integration
- NERC Variable Generation Task Force Report
 - Focus is primarily wind operations and planning integration
 - Scheduled for completion end of 2008 early 2009
- ISO/RTO council conducting looking at the market practices dealing with wind

What the (Near-Term) Future Holds

- Wind Integration Study
 - ISO-NE will be taking an active role
 - Operational, Markets, Planning aspects
 - What are the novel aspects
 - Offshore, Windy Neighbors, Technology advances
 - Study will include the following:
 - Wind Integration Survey
 - Interconnection requirements
 - Build New England Wind Resource Area (NEWRA) models
 - Scenario Development/Analysis
 - Scenario Simulation



The rotor is raised on the GE 1.5sle wind turbine at Jiminy Peak Ski Area in the Berkshire Mountains of western Massachusetts.

(Photo credit: Sally Wright, Renewable Energy Research Lab, UMass/PIX15160)