

Wind Integration

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Presentation Overview

- Current Levels of Penetration
- Integration Challenges and Opportunities
- Texas Event
- ISO New England Action Plan

Levels of Wind Penetration

- Currently no wind farms or individual wind units are represented in the ISO New England Energy Management System
 - Over 80 MW under construction and expected on line in 2008
- Only a few MW of Settlement Only Wind Generators are settled in ISO systems <20 MW
- To this point there has been no impact to the ISO or its systems related to wind integration
- However, we want to be ready and able to meet challenges before they arrive

In the Queue

- 1,845 MW in the Queue
 - 462 MW offshore
 - 1,383 MW onshore
- At these current levels we do not see major operational or planning issues that would inhibit system operations at the macro level

Wind Map of New England

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



- **Operating Projects**
 - **Windfarms**
 1. [Searsburg Wind Energy Project](#) 6.6 MW
 2. [Mars Hill Wind Farm](#) 42 MW NB
 - **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](#)

Integration Challenges and Opportunities

- Transmission Capacity in Areas of High Wind Capability is or may be 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)
 - New England Economic Study Process Stakeholder Group
- Siting
 - Attractive Wind Source
 - Land Owner and Community Support
 - Feasible Permitting and Environmentally Suitable
 - Interconnection Point
 - Favorable Markets

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

Legend

Class 7 >8.8 (m/s)

Class 6 8-8.8 (m/s)

Class 5 7.5-8 (m/s)

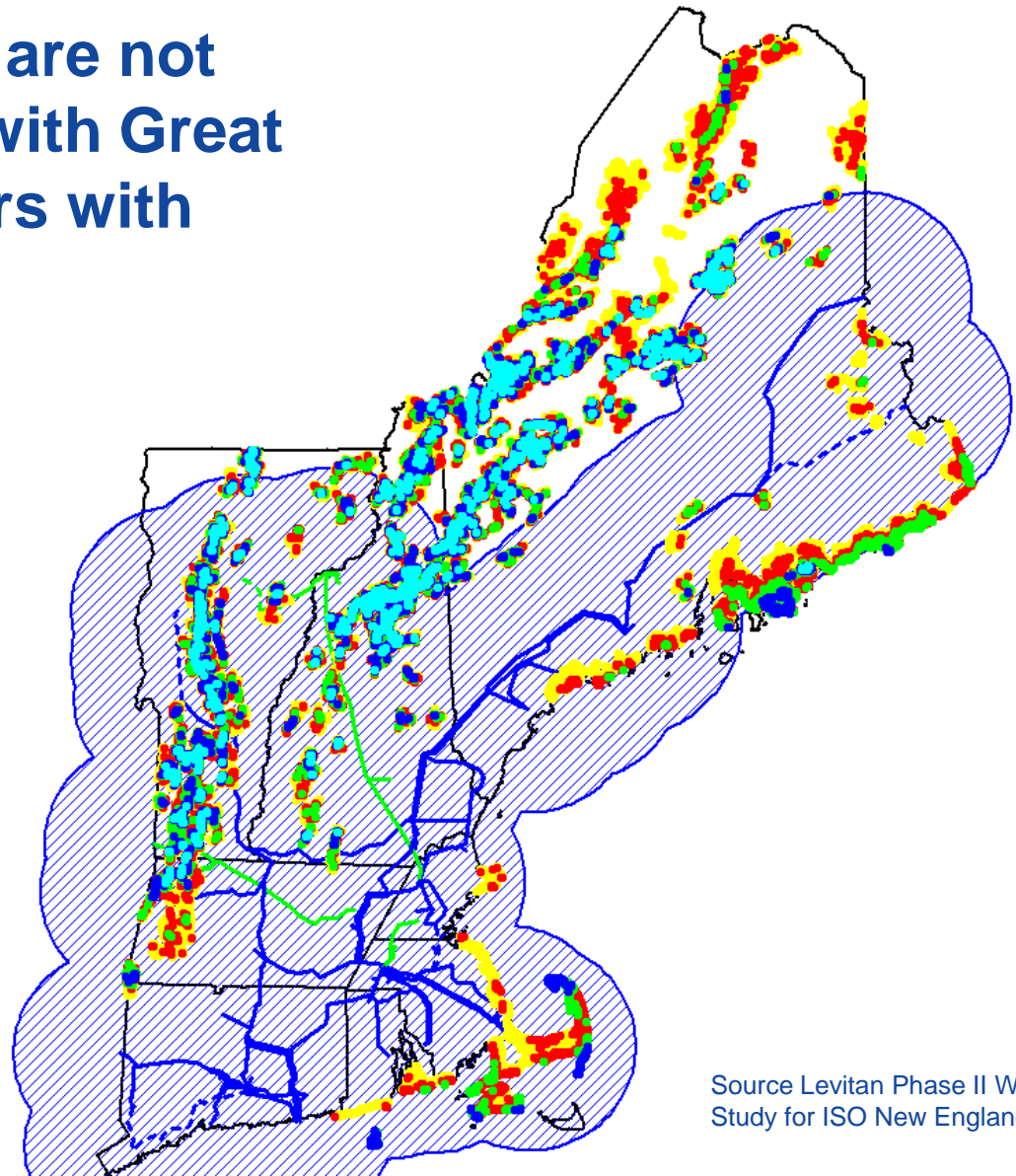
Class 4 7-7.5 (m/s)

Class 3 6.4-7 (m/s)

40 Miles

230 kV

345 kV



Source Levitan Phase II Wind Study for ISO New England

Integration Challenges and Opportunities

- Load Following Requirements
 - Ramps of load and wind may be in opposition
 - Ramp Rates
 - Impacts to other resources
- Automatic Generation Control Requirements
 - Meeting Control Performance Requirements for interchange and frequency
- 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

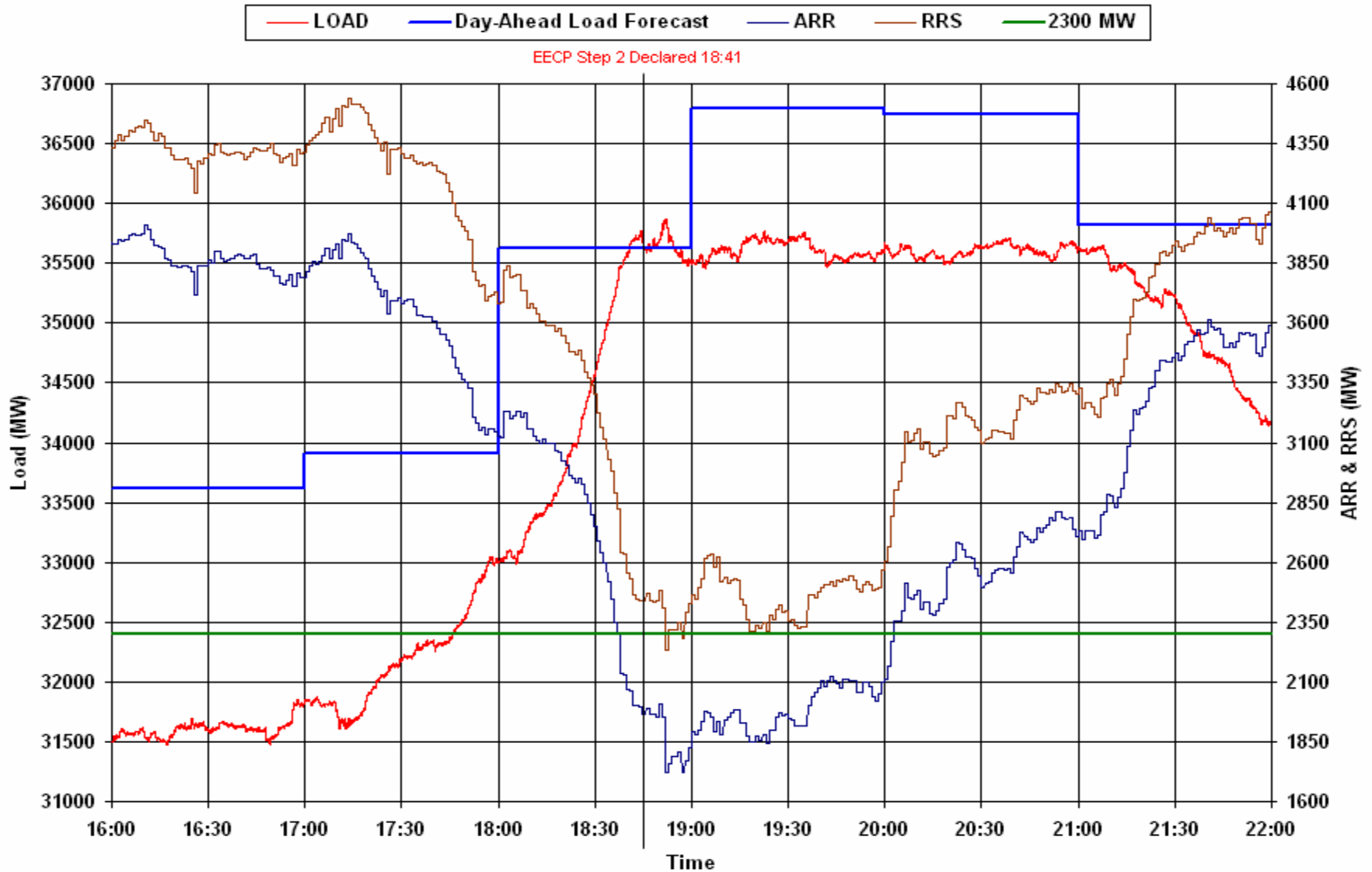
Integration Challenges and Opportunities (cont.)

- 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

Integration Challenges and Opportunities (cont.)

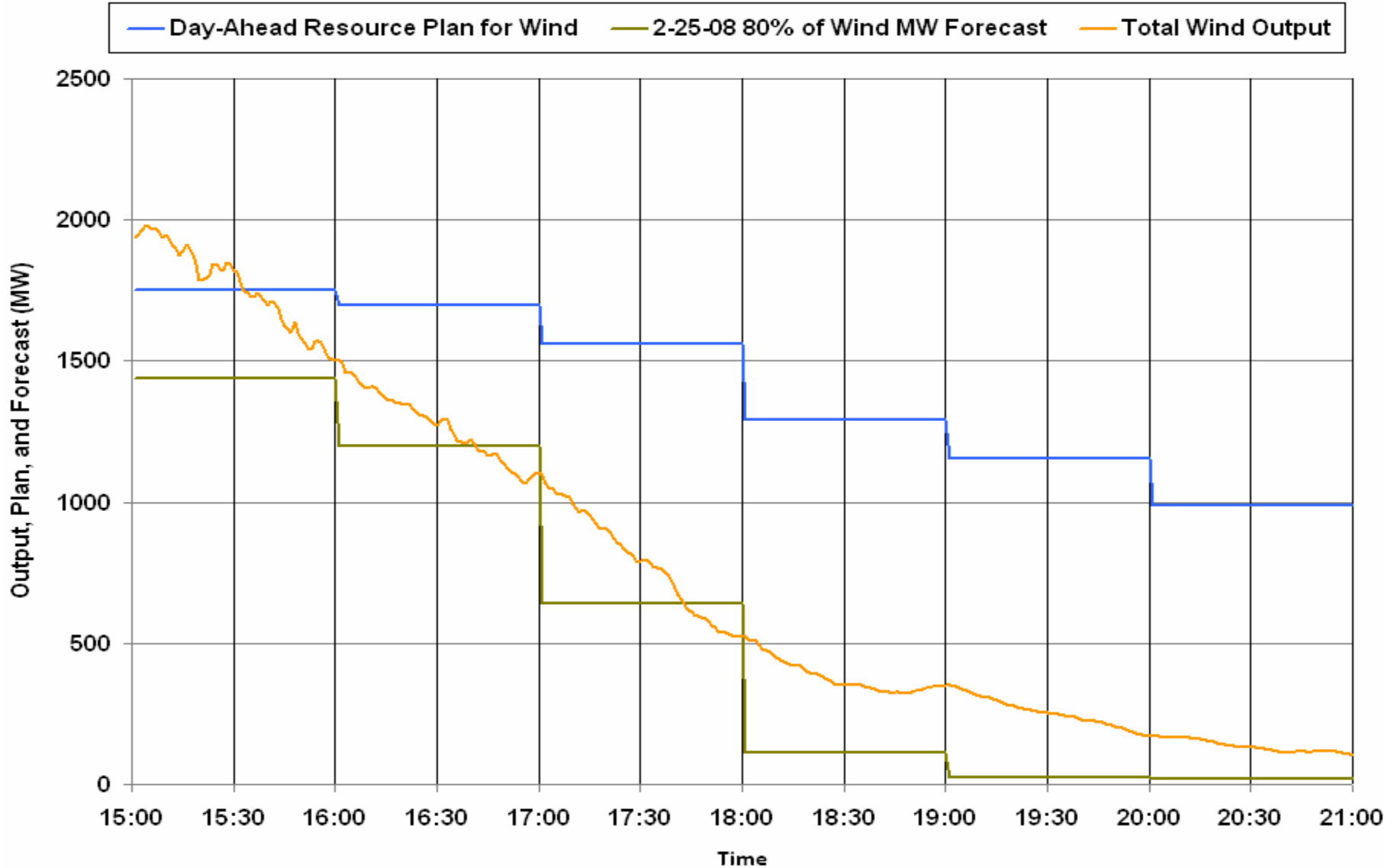
- Forecasting
 - Who does it
 - Emergency monitoring tools
 - Approaching weather systems
 - Ensuring that the forecast is accurate enough to displace more expensive resources or otherwise we have not optimized system benefits
- Texas Events of 2/26/08

Texas Loss of Wind Event on 2/26/08 (Reserve Depletion)



Texas Loss of Wind Event on 2/26/08

(Resource Plan and Actual vs. Wind Forecasting)



Integration Challenges and 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 wind projects to ensure successful integration of assets
- Future planning and operational studies
 - ISO Planning staff is developing economic analysis process under the New England Economic Study Process Stakeholder Group
 - Working with staff from University of Massachusetts Renewable Energy Lab to develop RFP for operational and planning study
 - Develop and utilize a mesoscale atmospheric model for the integration study
 - Study will focus on quantifying changes and costs to energy, AGC, reserve, and load following requirements at various penetration levels of wind
 - Develop recommendations for forecasting and operational tools as well as process changes
 - RFP expected to be completed and issued by Fall/Winter of 2008 for wind integration study
 - Detailed study expected in 2009
- 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



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)