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Clean Energy Regulatory Forum IV

Paying for System Flexibility

Jonathan Lowell

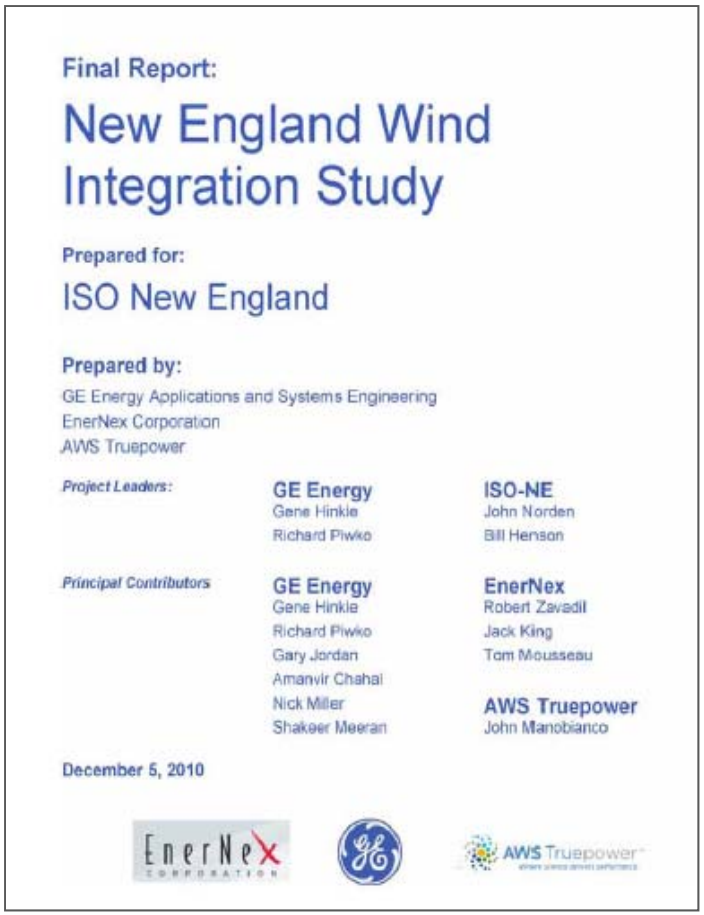
PRINCIPAL ANALYST | MARKET DEVELOPMENT

The State of Wind Power in New England

- 525 MW of wind power on system
- Abundant wind energy potential
  - Predominantly in northern areas and offshore
- Region well positioned for large-scale wind growth
  - States have adopted renewable energy policies and fossil fuel emissions limitations
  - Over 2,400 MW of wind power in the interconnection queue

New England Wind Integration Study (NEWIS)

New England-focused wind integration analysis


Final Report:

New England Wind Integration Study

Prepared for:

ISO New England

Prepared by:

GE Energy Applications and Systems Engineering
EnerNex Corporation
AWS Truepower

Project Leaders:

GE Energy
Gene Hinkle
Richard Piwko

ISO-NE
John Norden
Bill Henson

Principal Contributors

GE Energy
Gene Hinkle
Richard Piwko
Gary Jordan
Amanvir Chahal
Nick Miller
Shakeer Meeran

EnerNex
Robert Zavadil
Jack King
Tom Mousseau

AWS Truepower
John Manobianco

December 5, 2010

EnerNex CORPORATION

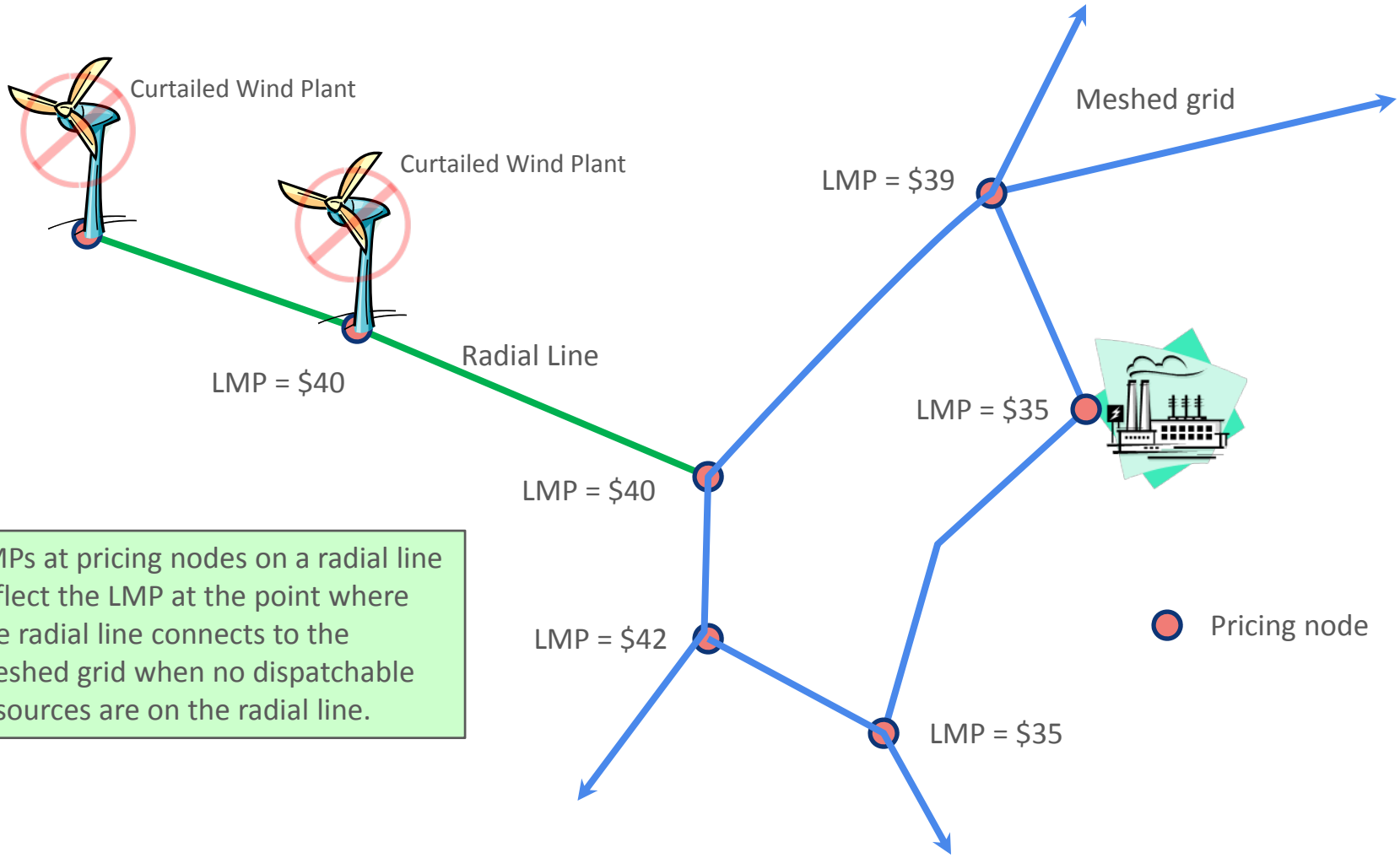
AWS Truepower

- Large-scale wind integration in New England is technically feasible
- Regional requirements:
  - Maintaining flexible resources to manage variability
  - Transmission upgrades
  - Increasing regulation service and operating reserves
  - Developing wind forecasting tools

Challenges of Wind Integration

- The ISO is unable to dispatch wind resources today.
  - Unit dispatch software is unable to send dispatch instructions.
  - Non-dispatchable resources (which includes wind) are ineligible to set price.
  - Market/operations protocol used to determine curtailment priority generally results in wind being curtailed before other resources.
  - Inability to submit negative energy offers gives competing resources little incentive to reduce output when congestion occurs.
  - System operators must rely on manual actions to ensure reliability.
- Improved short, medium, and long-term forecasting tools are needed.
- Full integration of wind resources into automated market and dispatch systems is needed.

Lack of Price Separation When Nondispatchable Wind Plants Are Manually Curtailed



LMPs at pricing nodes on a radial line reflect the LMP at the point where the radial line connects to the meshed grid when no dispatchable resources are on the radial line.

Addressing the Challenges of Wind Integration

- The ISO is developing market and infrastructure improvements:
  - Allow negative energy offers
  - Make wind resources dispatchable and eligible to set price
  - Calculate and send out a do-not-exceed (DNE) limit to each wind plant on dispatch
- The DNE limits will reflect several characteristics of each plant:
  - Economic offer curve
  - Maximum output under ideal weather conditions
  - Short-term wind output forecast
  - Transmission constraints
  - Telemetered physical status for the next dispatch interval
- A wind plant will be free to operate anywhere between 0 MW and the DNE limit

Addressing the Challenges of Wind Integration

cont.

- A centralized, regional wind power forecasting system is scheduled to be in service in early 2013.

- All wind resources will be required to provide real-time telemetry indicating current output and weather conditions.
  - Improves system operator's situational awareness
  - Enable ISO's real-time automated communication of dispatch instructions
  - Enhances the quality of the centralized forecast

- More flexible structure for hourly day-ahead energy offers and intraday reoffers is being developed.
  - Reduces the desire to self-schedule, giving system operators more flexibility to integrate renewable energy resources
  - Increases the percentage of resources dispatched economically
  - Better for efficient system operation as a whole

Addressing the Challenges of Wind Integration

cont.

- Potential increase in regulation requirements as more wind resources interconnect to the grid
  - Current hourly requirement averages ~60 MW
  - Could increase to ~300 MW if wind penetration increases to 20% of annual energy
  - New England currently has 800+ MW of regulation capable resources

- Forward Capacity Market issues under consideration
  - Pay-for-performance incentives
  - Identification of operational needs of resources to be acquired in the capacity auction

SPI
STRATEGIC PLANNING INITIATIVE

Five Challenges for Region Identified

1. Resource performance and flexibility
2. Increased reliance on natural-gas-fired capacity
3. Retirement of generators
4. **Integration of a greater level of variable resources**
5. Alignment of markets and planning needs improvement

Ongoing Strategic Transmission Analysis will support

Questions