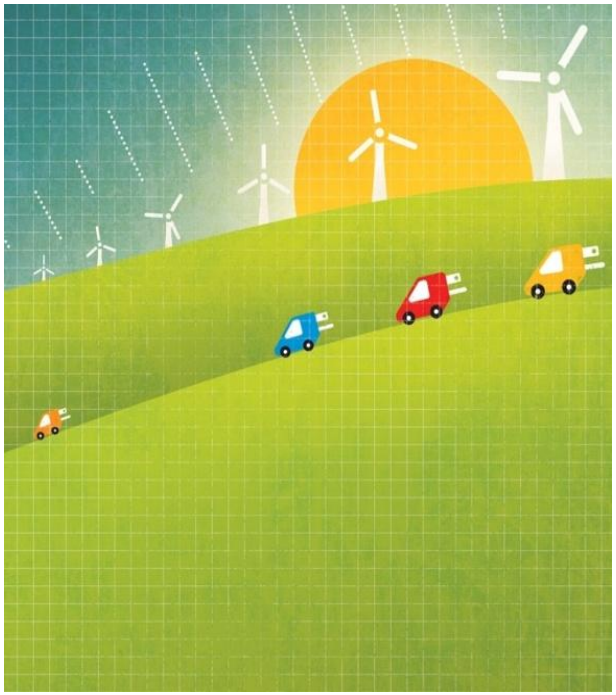
New England Wind Integration Study

NECA/CPES 18th Annual New England Energy Conference
May 18, 2011

John Norden
Director of Operations

Renewables Shaping Tomorrow's Grid Today

Public Policy Initiatives Create Incentive for Renewables



- Renewable Portfolio Standards (RPS)
- Regional Greenhouse Gas Initiative
- Environmental requirements

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New England's Wind Energy Profile

- Benefits:
  - Wind energy improves fuel diversity
  - Can help meet environmental targets
  - Can dampen fuel cost uncertainty

- Challenges:
  - Higher capital costs
  - Siting issues
  - Variable
  - Cost of transmission investment
  - Operational concerns

- New England has about 270 MW of wind on the system now

- Significant levels of wind power are proposed

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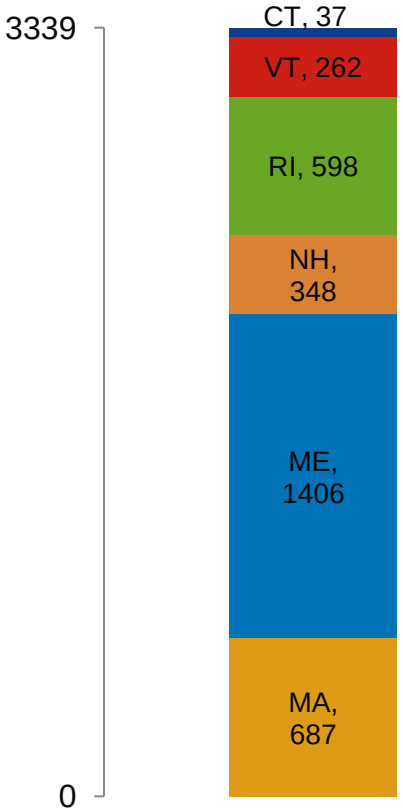
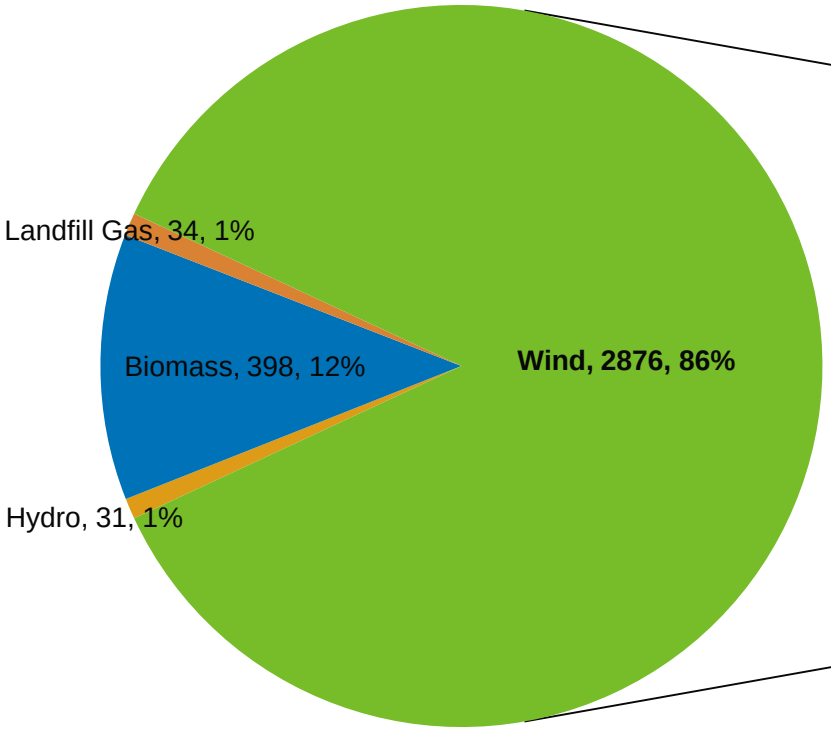
Renewables in April 2011 Queue

Vast majority of renewables proposed are wind projects in Maine

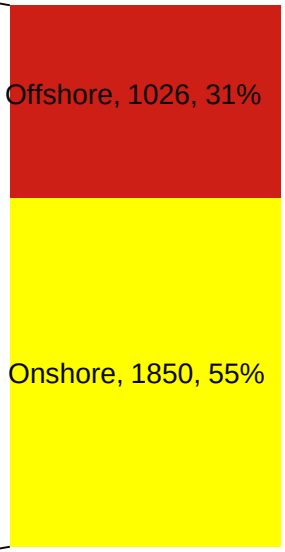
By State (MW)



By Fuel Type (MW)



Wind Breakdown (MW)



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New England's Wind Potential

- New England has abundant wind energy potential
  - Predominant wind in region is in northern areas and off-shore
  - Up to 200,000 MW theoretically possible

- Wind could be well positioned for large-scale growth in region
  - Access to areas with high demand
    - If significant transmission upgrades are made
  - Can compete in transparent markets with full suite of power market products
  - Regional renewable energy and emissions goals are in place
  - Region's resource fleet could aid in managing variability

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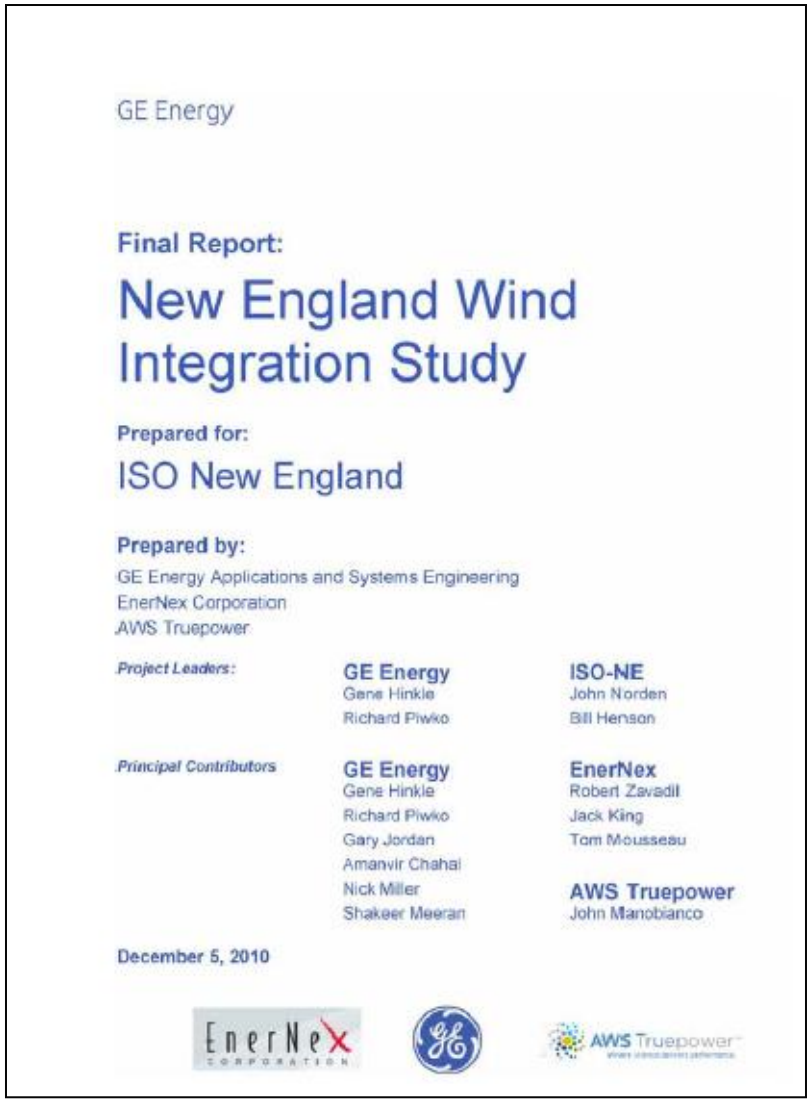
What's NEWIS?

- New England Wind Integration Study (NEWIS):
  - Comprehensive, two-year wind integration study
    - Developed a detailed on- and off-shore New England wind model
  - Snapshot of the year 2020 with hypothetical small, medium, and large wind power penetrations
  - Highlights the operational impact of each wind development scenario on New England's power system
  - Conducted by GE Energy Applications and Systems Engineering, with EnerNex and AWS Truepower



GE Energy

Final Report:

New England Wind Integration Study

Prepared for:

ISO New England

Prepared by:

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December 5, 2010

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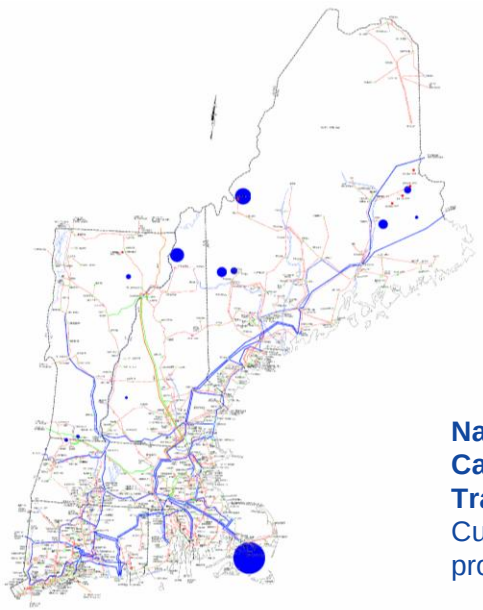
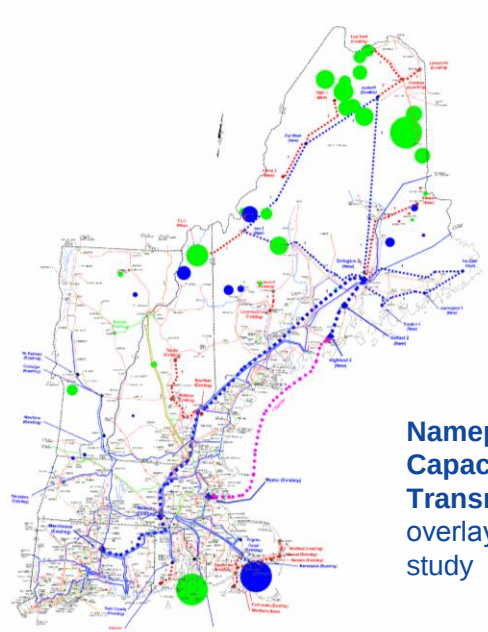
Mapping Hypothetical: Partial & Full Queue

A snapshot of several NEWIS scenarios



Nameplate: 1.14 GW
Capacity factor: 37%
Transmission: Currently planned projects are in service



Nameplate: 4.17 GW
Capacity factor: 34%
Transmission: 2 GW overlay from Governors' study

2.5%
Partial Queue

9%
Full Queue

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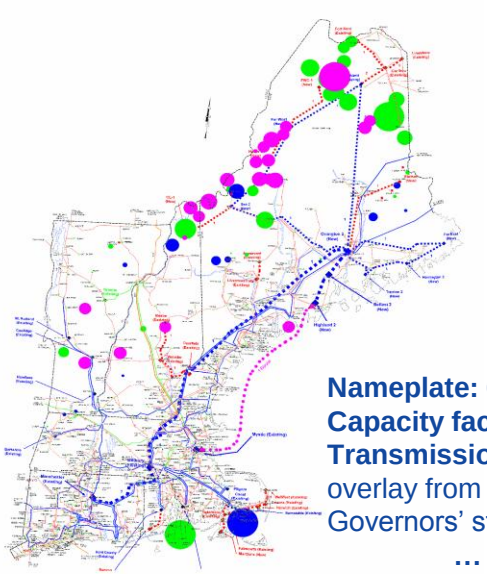
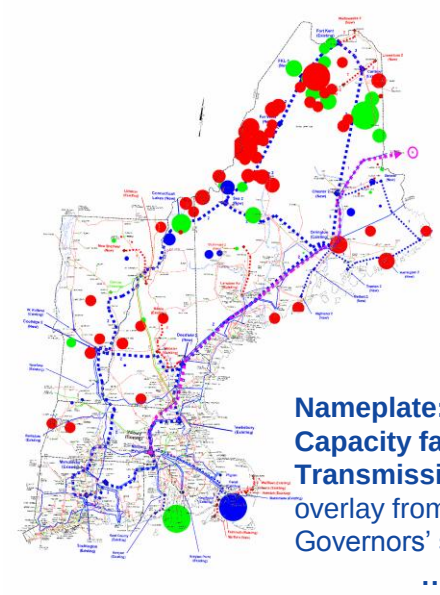
Mapping Hypothetical: On-Shore

A snapshot of several NEWIS scenarios



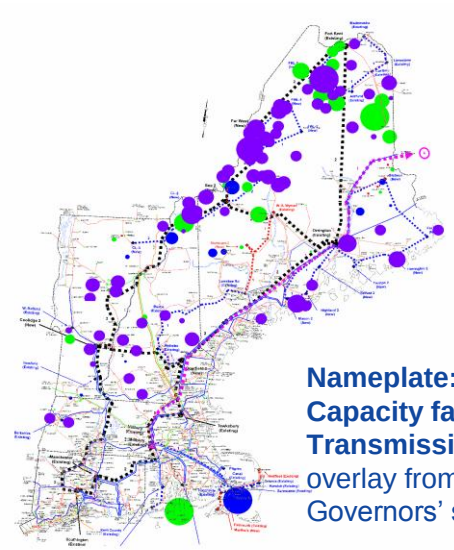
Nameplate: 6.75 GW
Capacity factor: 34%
Transmission: 2 GW overlay from Governors' study
…
Medium Scenario range: *6 to 7 GW*

14%
On-Shore



Nameplate: 9.78 GW
Capacity factor: 34%
Transmission: 4 GW overlay from Governors' study
…
High Scenario range: *8 to 10 GW*

20%
On-Shore



Nameplate: 11.8 GW
Capacity factor: 34%
Transmission: 8 GW overlay from Governors' study
…
Extra-High Scenario range*: 10 to 12 GW*

24%
On-Shore

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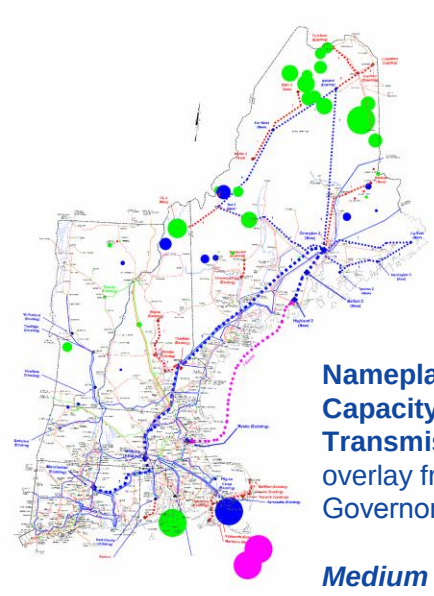
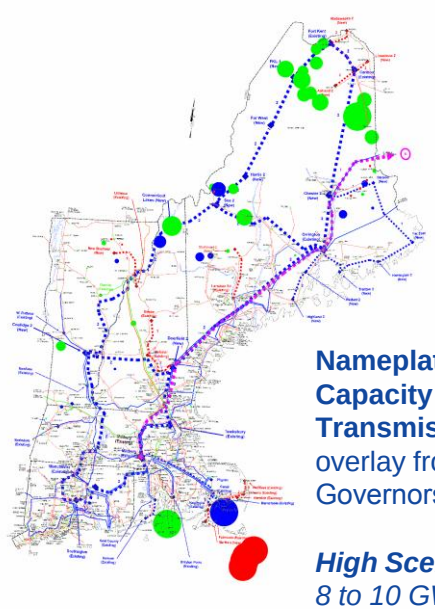
Mapping Hypothetical: Off-Shore

A snapshot of several NEWIS scenarios



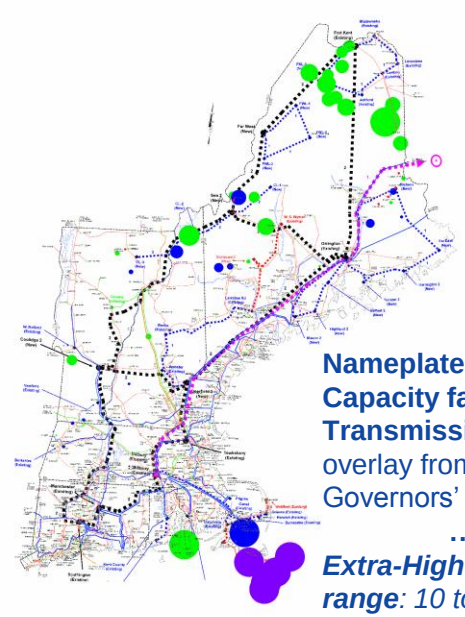
Nameplate: 6.13 GW
Capacity factor: 38%
Transmission: 2 GW overlay from Governors' study
…
Medium Scenario range: *6 to 7 GW*

14%
Off-Shore



Nameplate: 8.29 GW
Capacity factor: 40%
Transmission: 4 GW overlay from Governors' study
…
High Scenario range: *8 to 10 GW*

20%
Off-Shore



Nameplate: 9.7 GW
Capacity factor: 41%
Transmission: 8 GW overlay from Governors' study
…
Extra-High Scenario range*: 10 to 12 GW*

24%
Off-Shore

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Major Findings of NEWIS

- Large-scale wind integration in New England
  - As much as 24% is achievable under certain conditions
- When available to provide energy, wind resources could reduce fossil-fueled generation as an energy resource
  - Primarily reduce natural-gas-fired generation
  - Almost fully reduce use of oil-fired generation
- Large-scale wind integration will require:
  - Significant transmission upgrades
  - Continued availability of supply- and demand-side resources plus new resources that will be in service by 2012
  - Increases in regulation and operating reserves

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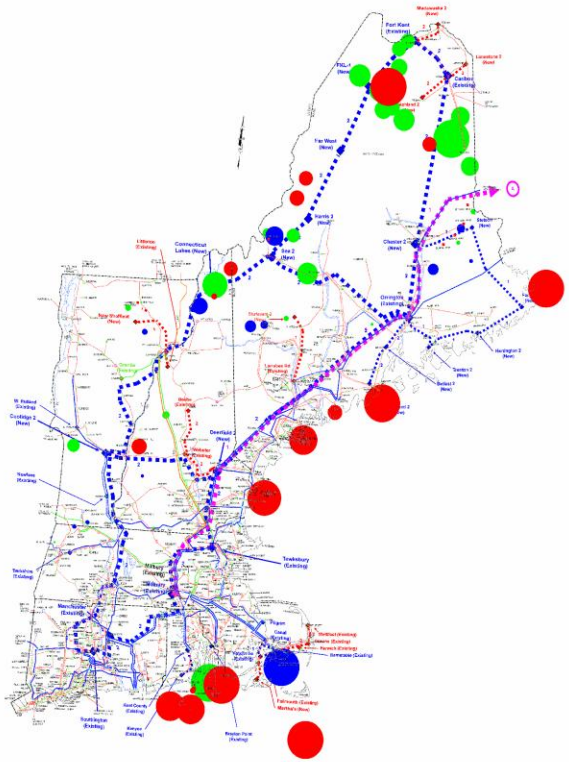
Potential Results 20% Wind Penetration

Pollutant	Approximate annual reduction	Approximate reduction vs. no wind
NOx	6,000 tons	26%
SOx	4,000 tons	6%
CO_2	12,000,000 tons	25%



20%
Balanced Scenario

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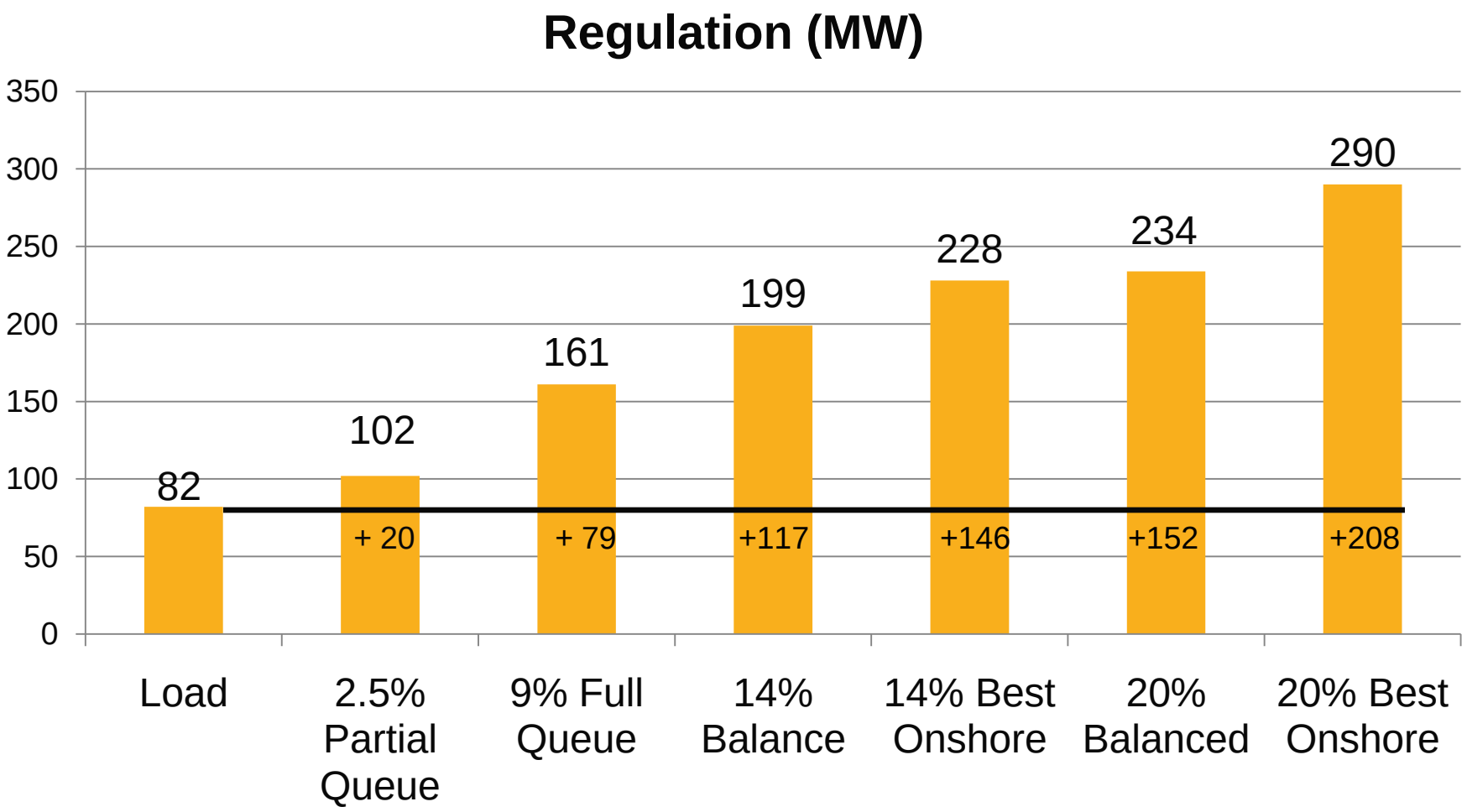
Regulation Reserves Impacts for Scenarios



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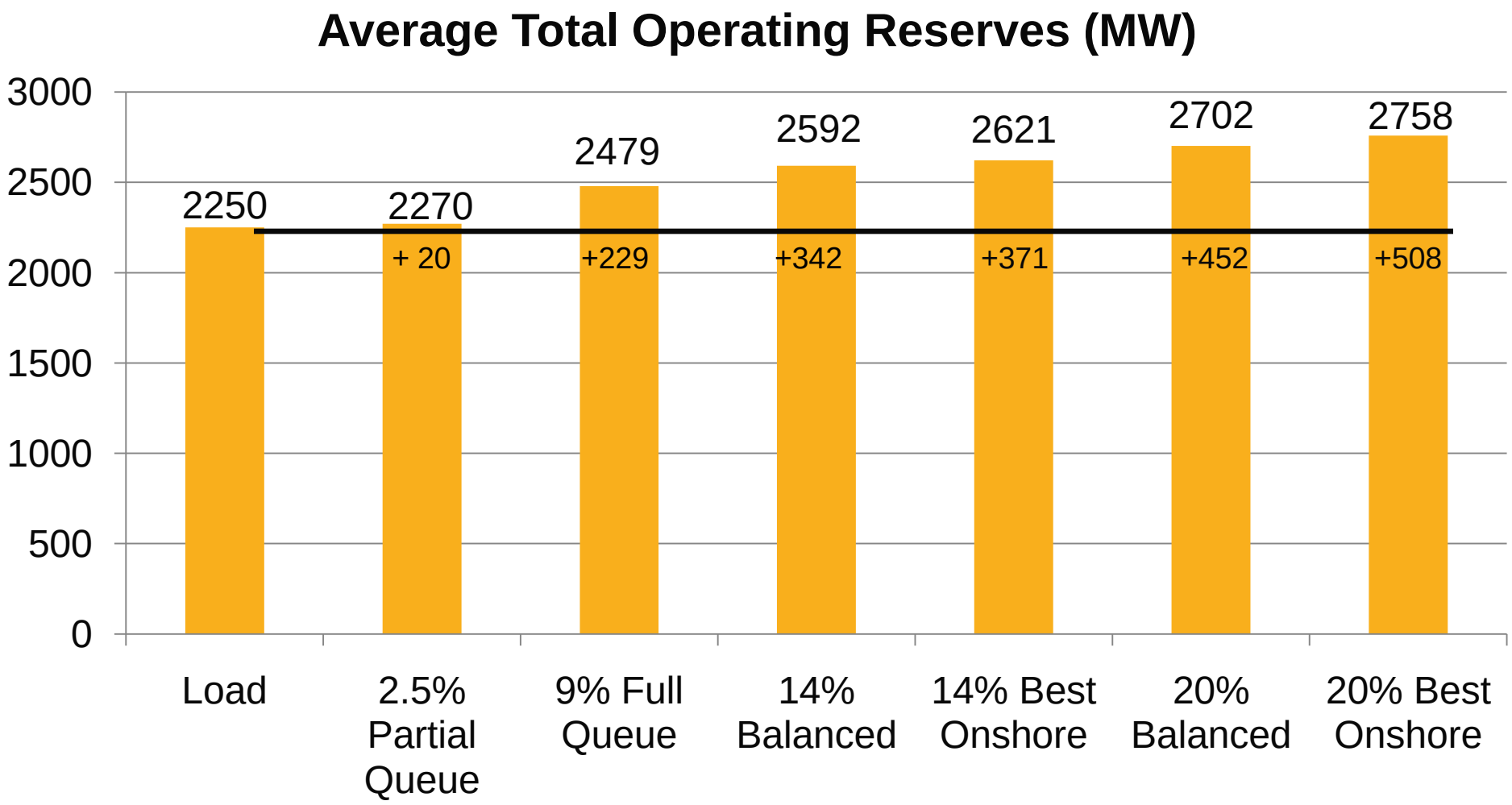
Operating Reserve Impacts for Scenarios



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Major Findings of NEWIS (continued)

- The region needs to maintain a system with flexible resources to manage variability
  - Natural gas fleet provides flexibility
  - Wind is at its lowest levels in the summer, when demand is peaking
  - Market design may need to evolve to maintain capacity required for peak demand days with low wind

- Significant capacity factors and capacity values for wind
  - Diminishes with increasing penetration or if transmission is not available to move the high-quality wind
  - Capacity factors and values are higher for off-shore than on-shore wind sites

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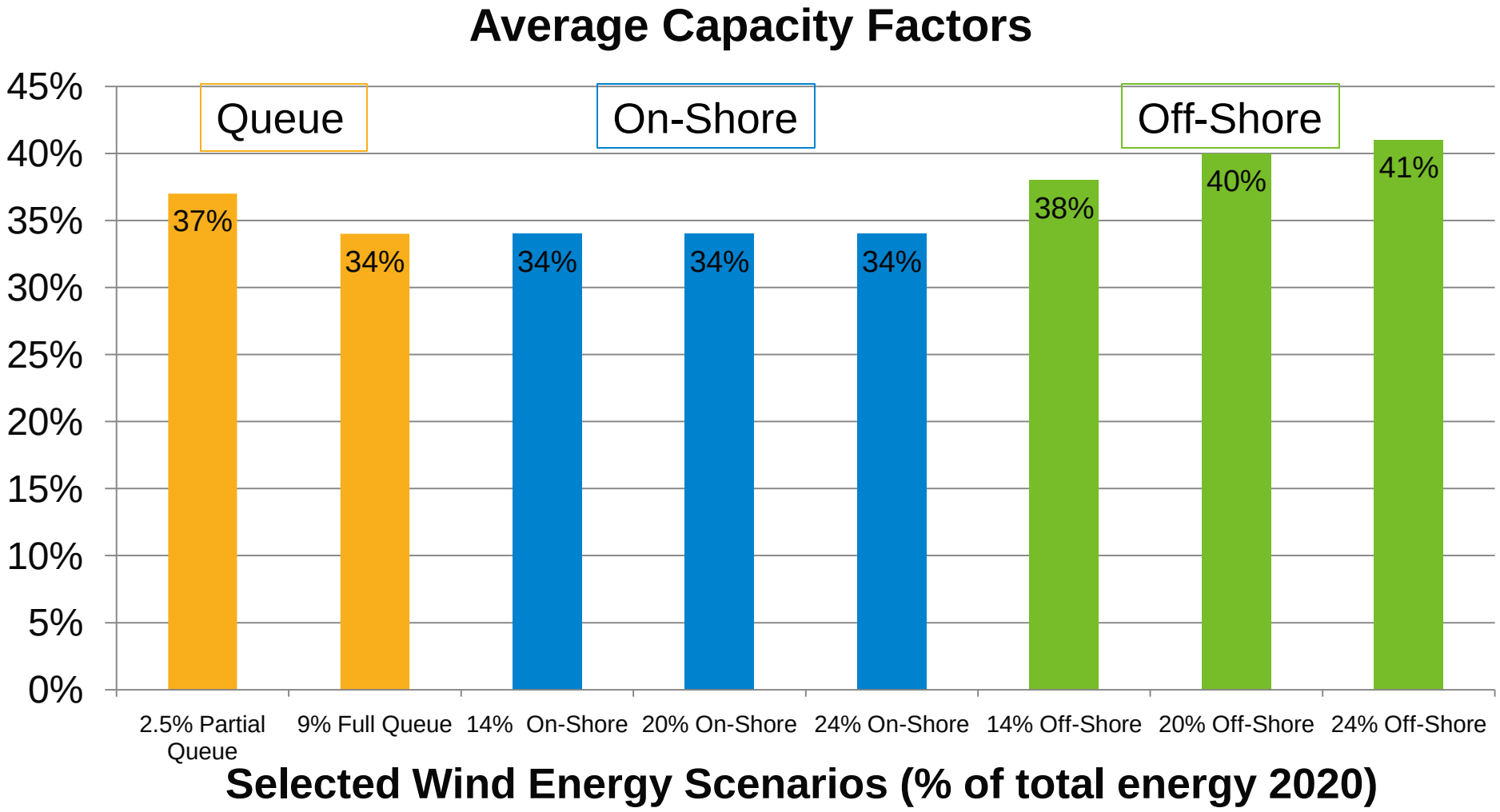
NE Wind Offers Significant Capacity Factors

Higher for off-shore than on-shore wind; off-shore is less variable



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Capacity Value of Wind

- Capacity value of wind generation:
  - Varies based on wind and load profiles and layout of wind generation
  - Varies year to year
  - Factored by wind performance during few hours when demand is highest

Scenario	3-Year Average Capacity Value (%) [% Offshore]	14% Energy 3-Year Average Capacity Value (%) [% Offshore]	20% Energy 3-Year Average Capacity Value (%) [% Offshore]
2.5 % Energy	36% [40%]		
9% Energy (Queue)	28% [20%]		
Onshore		23% [12%]	20% [8%]
Maritimes		26% [13%]	26% [9%]
Best by States		28% [15%]	26% [29%]
Best Sites		35% [47%]	34% [51%]
Offshore		34% [45%]	32% [58%]

- ISO currently estimates capacity value by using plant capacity factors during peak hours
  - Methodology benchmarked and validated against industry standard

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Major Findings of NEWIS (continued)

- Centralized wind power forecasting required
  - Will require accurate intra-day and day-ahead wind-power forecasts to ensure efficient unit commitment and market operation
  - Will require tools to forecast wind ramping so system operators can prepare for volatile wind situations by obtaining additional reserves or taking other steps

Photo courtesy of U.S. DOE/NREL Credit : Todd Spink

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