New England 2030 Power System Study: Preliminary Maps and Cost Estimates for Potential Transmission

August 14, 2009 Planning Advisory Committee



Potential Transmission

- ISO developed sixteen <u>conceptual</u> transmission configurations:
 - Thirteen scenarios to connect wind in New England, and
 - Three scenarios to expand ties to neighboring regions
 - Transmission scenarios developed as robust, workable solutions with cost estimates based on actual project experience
 - More detailed transmission studies will be required if the region pursues specific projects
 - New voltage classes will be needed for higher wind penetration scenarios (345 kV is the backbone of the existing system)



Preliminary Maps and Cost Estimates for Potential Transmission

- List of Maps (number of maps):
 - Base system map (1)
 - Wind scenarios and potential transmission (13)
 - 2,000 MW wind scenario and potential transmission (2)
 - 2,000 MW offshore-only wind scenario and potential transmission (2)
 - 4,000 MW wind scenario and potential transmission (2)
 - 4,000 MW offshore-only wind scenario and potential transmission (2)
 - 5,500 MW wind scenario (4,000 MW offshore and 1,500 MW onshore) (1)
 - 8,000 MW wind scenario and potential transmission (2)
 - 12,000 MW wind scenario and potential transmission (2)
 - Interconnection scenarios (3)
 - 1,500 MW New Brunswick interconnection (1)
 - 1,500 MW Québec interconnection (1)
 - 10,000 MW New York interconnection (1)
- Preliminary Transmission Cost Estimates



The Challenge: Connecting Wind Energy to Load Centers

- Region's population and electricity demand are substantially concentrated in southern New England
- Potential wind resources do not substantially overlap high population and high energy demand areas
- Therefore, new "backbone" transmission will be required to connect potential wind resources to load centers in **New England**

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Base System Map

 2019 Base Transmission System Prior to Potential Transmission System Expansions



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2,000 MW Wind Scenario and Potential Transmission

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2,000 MW Offshore Wind Scenario and Potential Transmission

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4,000 MW Wind Scenario and Potential **Transmission**



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4,000 MW Offshore Wind Scenario and **Potential Transmission**

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Transmission for 5,500 MW of Wind

- Potential transmission to connect:
 - 4,000 MW of offshore wind, and
 - 1,500 MW of onshore wind



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8,000 MW Wind Scenario and Potential Transmission

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12,000 MW Wind Case and Potential **Transmission**

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Other Transmission Interconnections

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Cost Estimate Range Development Methodology



- All One-Line Proposals Reviewed By ISO-NE Staff 1.
- 2. By Voltage / By Circuit Configuration Type
- By Voltage / By Substation Element Type 3.

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- By NE Cost Zone / From Recent NE Experience 4.
- 5. Calculation Produces Order-Of-Magnitude 2009 Dollars
- Mid-Range Cost Estimate Decreased By 25% 6.
- 7. Mid-Range Cost Estimate Increased By 25%.

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Cost Estimate Range Development – Example

Step 1

Install +/-450kV, 1500MW HVDC From US / CN Border To Central Massachusetts



<u>Step 2</u>

A. Transmission:

1. 400 Mi Lattice Tower Line Traversing All 3 N.E. Cost Zones Using ROW Parallel To Other Existing T-Line ROWs

2A. Z1: 110 Mi @ \$3.5M / Mi 2B. Z2: 235 Mi @ \$4.5M / Mi 2C. Z3: 55 Mi @ \$5.5M / Mi

B. Substation:

1. One +/-450kV, 1500MW HVDC Converter Terminal, Complete With Connection To Existing 345kV Substation (Not Requiring Reinforcements)

2. Terminal Cost @ \$270M (Or ~\$180 / KW Installed And Interconnected)

<u>Step 3</u>

_ine	A. Transmission:	<u>Step 4</u>	
st el	110 X \$3.5 = \$385.0M 235 X \$4.5 = \$1057.5M 55 X \$5.5 = \$302.5M	A. Mid-Range Estimate:	
ROWs		<u>Round \$2015M = ~\$2.0B</u>	
/ Mi / Mi	T-Subtotal = \$1745M	B. Low-Range Estimate:	
Mi	B. Substation:	0.75 X \$2.0B = ~\$1.5B <u>C. High-Range Estimate</u> :	
W al,	1 X \$270 = \$270.0M		
	S-Subtotal = \$270M	1.25 X \$2.0M = ~\$2.5B_	
on ation ments)	<u>C. Mid-Range ("Target")</u> <u>Estimate</u> :	Ţ	
)M And	T-Subtotal = \$1745M S-Subtotal = \$270M	Order-Of-Magnitude Cost Estimate Range	
	T&S Total = \$2015M	Is \$1.5B - \$2.5B, Stated In 2009 \$	

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Preliminary Transmission Cost Estimates

	Description	Approx. circuit miles of new transmission	Preliminary order-of-magnitude cost estimate range by voltage class (2009 dollars)	Mid-range cost estimate
1	2,000 MW On and Offshore Wind	1,785	345 kV/HVDC: \$4.7B to \$7.9B	\$6.4B
2	2,000 MW Offshore Wind	1,015	345 kV/HVDC: \$3.6B to \$6.0B	\$4.8B
3	4,000 MW On and Offshore Wind	3,615	345 kV: \$8.0B to \$13.2B 500 kV: \$10.8B to \$17.9B	\$10.7B \$14.3B
4	4,000 MW Offshore Wind	1,430	345 kV/HVDC: \$4.7B to \$7.6B	\$6.1B
5	8,000 MW On and Offshore Wind	4,320	500 kV: \$13.4B to \$22.4B 765 kV: \$17.3B to \$28.9B	\$17.9B \$23.0B
6	12,000 MW On and Offshore Wind	4,320	500 kV: \$14.5B to \$24.2B 765 kV: \$18.9B to 31.5B	\$19.3B \$25.2B
7	1,500 MW New Brunswick Interconnection*	400	+/-450 kV HVDC: \$1.5B to \$2.5B	\$2.0B
8	1,500 MW Québec Interconnection*	280	+/-450 kV HVDC: \$1.1B to \$1.9B	\$1.6B
9	10,000 MW New York Interconnection**	1,020	500 kV: \$4.7B to \$7.7B 765 kV: \$6.8B to \$11.2B	\$6.3B \$8.9B

Source: ISO New England and Energy Initiatives Group

* Estimate does not include facilities in Québec and New Brunswick; only includes cost of potential transmission in New England.

** Estimate does not include New England's share of the cost of building transmission from the Midwest to the New York-New England border; only includes cost of integrating energy from the NY-NE border to load centers in New England.

