NEPOOL SCENARIO ANALYSIS PROPOSAL 2016

Implications of Public Policy on ISO-NE Market Design, Reliability, Resource Metrics, Costs, Emissions, System Operability and Revenues of New Generation

Below is NEPOOL's proposal supporting its request for a 2016 Economic Study (as defined in Attachment K of Section II of the ISO New England Inc. Transmission, Markets and Services Tariff), including the purpose, base assumptions, scenarios, deliverables and key public policies to be included in the study.

Purpose:

The goal of the proposed NEPOOL Economic Study request is to provide NEPOOL Participants and regional power market stakeholders information, analyses and observations regarding:

(i) the potential effects on the ISO-New England wholesale electricity markets of implementing public policies in the New England states;

(ii) projected wholesale energy market revenues, and the contribution of those revenues to the fixed costs of generic new generation; and

(iii) the total wholesale electricity cost of supplying load, emissions in New England, and system operability under alternative scenarios.

Base Assumptions:

The Base Assumptions to be included in all Scenarios unless otherwise noted are:

- Existing resources will be the generation fleet and demand response and energy efficiency ("EE") resources as of FCA #10, plus: (i) any additional generation that is operating or under construction but has not cleared in an FCA as of April 1, 2016, and (ii) any generation with an approved I.3.9 and that is still in the interconnection queue as of April 1, 2016. Individual cases will model amounts of capacity and energy-only resources consistent with their respective designs, unless otherwise noted.

- Retirement cases will retire oldest half in MW of the conventional oil and coal-fired steam units by 2025 and next oldest half in MW by 2030 (including dual fuel units).

- All Scenarios will model 2025 and 2030.

- The transmission topology will be the one used in FCA #10, plus upgrades associated with resources that cleared in FCA #10 and any Proposed or Planned reliability projects on ISO's March 2016 RSP Project List.

- The Net Installed Capacity Requirement ("NICR") will be determined as load plus a reserve margin of 14%. NICR may be exceeded to meet renewable/clean energy goals.

- EE, solar photovoltaic ("PV") and load projections will be based on 2016 CELT Forecast, but remove EE discount factors and use the FCA 10 methodology for Behind-the-Meter Solar PV adjustment and extrapolation of the CELT forecast out to 2030. There will be further discussion with the ISO and the PAC on development of any material load sensitivities.

- The ISO will assume prices for RGGI allowances and prices for other environmental emission allowances. Specific assumptions of prices will be developed through further discussion with the ISO and the PAC and determine if there is a need to create sensitivities for high and low emissions prices.

- When adding natural gas combined cycle ("NGCC") generation, the location will first be assumed to be at the location of retired units and then at the Hub. When adding renewable/clean energy resources, their locations will be at locations consistent with resources in the current interconnection queue as of April 1, 2016, with the same relative proportion of MW at those locations (i.e., first include generation in the current queue and then add generation, if needed, proportionally based on current locations of generation in the queue); except that Offshore wind resources will be added at the ISO interconnection points closest to federally-designated Wind Energy Areas.

- Fuel price forecasts will come from the EIA data for New England. The impact of alternative fuel prices can be determined exogenously unless they affect the dispatch order of resources. Use high and low fuel price sensitivities to determine effect on dispatch order. After initial runs are done, determine whether any fine tuning of the EIA prices should be done to recognize seasonal price or basis differentials. There will be further discussion with the ISO and the PAC on how to model imports.

- All supply resources to be added will be assumed to have capacity value, except one scenario (to be determined which one) will contain a sensitivity of supply resources being energy-only.

Scenarios:

The Scenarios to be included are:

1. **Generation Fleet Meeting Existing State Renewable Portfolio Standards ("RPS") and Steam Units Retired and Replaced with NGCC units:** Use the Base Assumptions, including the retirement assumption. Assume that targeted energy requirement for the New England states' RPS goals as of April 1, 2016 will be met by physical renewable/clean energy resources. Any retirement replacement and any supply growth above RPS will be met by new NGCC units.

2. **Generation Fleet Meeting Existing RPS and All Future Needs Met with New Renewable/Clean Energy Resources:** Same as Scenario 1, except assume all needed capacity will be met by renewable/clean energy resources. The mix of renewable/clean energy resources will be determined in the PAC scoping process.

3. **Generation Fleet Meeting Existing RPS Plus Additional Renewable/Clean Energy Resources:** Same as Scenario 2 except include additional MW by 2025 and 2030 of new renewable/clean energy resources above the existing RPS requirements. Specifics of this "RPS-Plus" Scenario 3 are included Appendix 1 to the Proposal and will be further developed through further discussion with the ISO and the PAC.

4. **Generation Fleet Meeting Existing RPS in part through Alternative Compliance Payments with NGCC Additions, and with No Retirements:** Use Scenario 1, except assume: (a) RPS requirements are met first physically with renewable/clean energy resources that are interconnected to the system, under construction or have an approved I.3.9 as of April 1, 2016, and then through alternative compliance payments for any RPS requirements not physically met, (b) any new generation resources added to meet NICR will be NGCC units, and (c) no retirements.

5. **Existing Fleet Meeting Existing RPS in part through Alternative Compliance Payments and Retirement Replacement with NGCC Additions:** Same as Scenario 4, except use retirement assumption and replace retired units as needed to meet NICR with NGCC generation.

Deliverables:

The scenarios will be designed to provide information, analyses and observations regarding the impacts of public policies on five major areas of concern to policy-makers, market participants, and consumers, including the following deliverables (with ISO using outside consultant(s) as necessary):

Reliability	Resource Metrics	Wholesale Power Costs	Emissions
1. Resource mix changes and/or general transmission additions needed to maintain reliability The study will not provide specific transmission planning solutions, but will identify transmission capacity needed between areas and provide high-level transmission cost estimates.	1. Metrics provided in Economic Studies, including: • Production Costs • Load Serving Entity Energy Expenses • Congestion • Interface Flow Duration Curves • Generation Energy Production by Fuel Type • Air Emissions	1. For each scenario, total wholesale power costs in $/MWh	1. For each scenario, the total emissions of NOx, Sox, mercury and CO2 compared environmental targets/requirements
	2. Projected wholesale energy market revenues, and the contribution of those revenues to the fixed costs of generic new generation]	2. The cost components, including capacity, energy, reserves, and high-level transmission costs of each scenario	
	4. The percent of total energy provided by resource type and		

	capacity factor		
	5. The fuel that sets the marginal clearing price 6. Estimated FCA clearing prices for each scenario		

There is one other major deliverable of the study. The study will provide information and analysis on the operability of the system under various scenarios and sensitivities. NEPOOL will provide additional input into specific areas of consideration for the operability part of the study (e.g., how each scenario affects natural gas usage in New England and the implications of that). This operability analysis will likely come in a second phase of the study, depending on its difficulty and how long it will take.

Public Policies to Be Included in the Scenarios

- RPS
- Energy Efficiency programs
- Solar programs
- State long-term renewable/clean energy procurements
- Climate Change - RGGI pricing
- Potentially others based on further discussion with the ISO, NEPOOL and the PAC

Appendix 1 (Specifics of Scenario 3)

Scenario 3 Assumptions

The mix of clean energy resource additions be used in Scenario 3 is:

Clean Energy Resource	**Target for 2025**	**Target for 2030**
Energy Efficiency	All states to 3 percent annual savings	All states to 3.5 percent annual savings
Demand Response	Add 1,000 MW DR	Add 500 MW more
Hydro Imports	Add 1,500 MW	Add 500 MW more
Solar PV (includes both utility-scale and DG)	Total NE PV should be 8,000 MW (95% utility-scale, 5% DG)	Total NE PV should be 12,000 MW (95% utility-scale, 5% DG)
Onshore Wind	Total for NE should be 4,250 MW	Total for NE should be 4,800 MW
Offshore Wind	Add 1,000 MW	Add 500 MW more
Storage	Add 1,200 MW	Add 1,300 MW more

Annual energy efficiency savings in each New England state should reach 3 percent by 2025 and 3.5 percent by 2030. An additional 1,000 MW of active demand response resources should be added by 2025 and another 500 MW of active DR by 2030. New hydro imports of 1,500 MW should be added by 2025 and another 500 MW of new hydro by 2030, with dispatch assumed to be at 80%. Total New England-wide solar PV installations (including both utility-scale and distributed PV) should reach 8,000 MW by 2025 and 12,000 MW by 2030. 95 percent of these installations should be utility PV while 5 percent should be distributed generation. Onshore wind totals in New England should total 4,250 MW by 2025 and 4,800 MW by 2030. In addition, 1,000 MW of offshore wind should be added by 2025, with another 500 MW added by 2030. Energy storage resources should also be added so that there are 1,200 MW of storage on the system in 2025 and another 1,300 MW by 2030. For energy storage, assume a 4-hour delivery for 2025 and an 8-hour delivery for 2030; also assume recharge time of 1-4 hours for 2025 and 2-8 hours for 2030.

The scenario should include an assumption about the increased deployment of electric vehicles. In order to take some of the burden of emission reductions off of the electric sector, it would be appropriate to assume that a portion of the light duty vehicle fleet is replaced with electric vehicles. Based on modeling previously done, 2.5 million EVs by 2025 and 4.2 million by 2030 should be an appropriate estimate. The distribution of EVs can be: 44 percent in Massachusetts, 23 percent in Connecticut, 12 percent in Maine, 11 percent in New Hampshire, 6 percent in Rhode Island, and 5 percent in Vermont. These vehicles should act as a load modifier only and should not be assumed to provide any storage support at this time.

Some believe these assumptions are reasonable in order to evaluate compliance with long-term climate protection goals, such as the recent commitment by all six New England governors to achieve carbon reductions of 35-45 percent below 1990 levels by 2030; however, these assumptions can be modified

through further discussion with the ISO and the Planning Advisory Committee if they are not well-suited to the model being used in this study.

Scenario 3 additional assumptions

Make two adjustments to the Base Assumptions for Scenario 3:

First, the load forecasts should reflect each state meeting its current energy efficiency and solar PV goals.

Second, for location of new renewable/clean energy resources let the model build renewable resources based on lowest cost availability, subject to transmission constraints that allow that energy to be deliverable to load.