**AGENDA**

Meeting No. 18  
NPCC Governmental/Regulatory Affairs Advisory Group  

*Omni Mont-Royal Montreal*  
1050 rue Sherbrooke ouest  
Montreal, QC H3A 2R6 Canada

Salon Été Conference Room  
December 6, 2016  
2:00 pm – 5:00 pm

**Teleconference Information:**  
US: (415) 655-0003 - Canada: (416) 915-6530  
Attendee Access Code: 29145813

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Est. Time</th>
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</table>
| 1.   | Convene Meeting  
Introductions  
Anti-Trust Compliance Guidelines  
Roster Update | 2:00 - 2:15 |
| 2.   | Chair Remarks  
Carolyn O’Connor  
Chair | 2:15 - 2:30 |
| 3.   | New York State Resource Planning Analysis (Clean Energy Standard)  
John Buechler  
Executive Regulatory Policy Advisor  
New York ISO | 2:30 – 3:15 |
Eric Johnson  
Director, External Affairs  
ISO New England | 3:15 – 4:00 |
| 5.   | NPCC Clean Power Plan Analysis  
Michael Lombardi  
Manager, System Studies  
NPCC | 4:00 – 4:45 |
| 6.   | Next Meeting(s)  
All | 4:45 – 5:00 |
Northeast Power Coordinating Council, Inc. (NPCC)

Antitrust Compliance Guidelines

It is NPCC’s policy and practice to obey the antitrust laws and to avoid all conduct that unreasonably restrains competition. The antitrust laws make it important that meeting participants avoid discussion of topics that could result in charges of anti-competitive behavior, including: restraint of trade and conspiracies to monopolize, unfair or deceptive business acts or practices, price discrimination, division of markets, allocation of production, imposition of boycotts, exclusive dealing arrangements, and any other activity that unreasonably restrains competition.

It is the responsibility of every NPCC participant and employee who may in any way affect NPCC’s compliance with the antitrust laws to carry out this commitment.

Participants in NPCC activities (including those participating in its committees, task forces and subgroups) should refrain from discussing the following throughout any meeting or during any breaks (including NPCC meetings, conference calls and informal discussions):

- Industry-related topics considered sensitive or market intelligence in nature that are outside of their committee’s scope or assignment, or the published agenda for the meeting;
- Their company’s prices for products or services, or prices charged by their competitors;
- Costs, discounts, terms of sale, profit margins or anything else that might affect prices;
- The resale prices their customers should charge for products they sell them;
- Allocating markets, customers, territories or products with their competitors;
- Limiting production;
- Whether or not to deal with any company; and
- Any competitively sensitive information concerning their company or a competitor.

Any decisions or actions by NPCC as a result of such meetings will only be taken in the interest of promoting and maintaining the reliability and adequacy of the bulk power system.

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Background and Assumptions
New York State Department of Public Service initiated a State Resource Planning (SRP) study to examine the effects of various public policies on the State’s bulk power system.

**Study Goals:**
- Evaluate the mix of resources (generation, transmission, and DER) that will need to be deployed by 2030 to meet various public policies and regulations while maintaining reliability.
- Two initial policy drivers: EPA Clean Power Plan and New York State Energy Plan
- CES mandate “50 by 30” requiring 50% of electric energy by 2030 be produced by renewable resources added as a subsequent policy driver
- Identify bulk power system and other upgrades that would be required to maintain a reliable bulk power system

**Study Participants:**
- NYDPS, NYSERDA, NYDEC, NYISO, NYDOS (UIU) and NYTOs

**Consultants:**
- GE – Transfer Analysis (TARA), Resource Adequacy (GE MARS), Production Cost (GE MAPS)
- ICF – Capacity Resource Mix (IPM)
## Scenarios Studied

<table>
<thead>
<tr>
<th>Base Case</th>
<th>Clean Energy Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Base Case (Business As Usual)</strong>&lt;br&gt;WNY and AC Proceeding Transmission Project Out</td>
<td>CES Policy Case&lt;br&gt;WNY and AC Proceeding Transmission Project In</td>
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<td><strong>Sensitivities</strong>&lt;br&gt;&lt;br&gt;BCS1 – Indian Point retires in 2019</td>
<td>CES S1 – WNY and AC Transmission projects out</td>
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<tr>
<td>BCS2 – High Load, High Gas Prices</td>
<td>CES S2 – Indian Point retires in 2019</td>
</tr>
<tr>
<td>BCS3 – No Minimum Oil Burn Requirement</td>
<td>CES S3 – Zone D loss of significant load</td>
</tr>
<tr>
<td>BCS4 – WNY and AC Transmission projects in</td>
<td>CES S4 – Incremental HQ Imports (1,000 MW HVDC line to Zone J)</td>
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<tr>
<td>BCS5 – IP retires and WNY and AC Transmission projects in</td>
<td>CES S5 – Clean Power Plan Compliance</td>
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<tr>
<td></td>
<td>CES S6 – Reduction of load in adjoining control areas</td>
</tr>
<tr>
<td></td>
<td>CES S7 – High Load (Alternate Policy Scenario)</td>
</tr>
</tbody>
</table>
Methodology

The studies will be performed in three steps for each identified scenario

1. Initial Modeling
   a. Develop Capacity Resource Mixes using IPM
   b. Transfer Analysis using TARA
   c. Resource Adequacy using GE MARS

2. Address Resource Adequacy violations if any are identified
   a. Examine Potential Options – Generation Shifts, Transmission Upgrades, and Combinations of the two
   b. Run GE MARS to determine which solutions solve the violation
   c. Select the least cost viable solution

3. Production Simulation
   a. Model the Final Reliable System in GE MAPS
   b. Generate System Data (Wholesale Energy Prices, Emissions, Production, etc.)
Assumptions

Base Case

- **Modeling Regions**: NYISO, ISO-NE, PJM, other U.S. regions, and Canadian provinces
- **Statewide and Local Capacity Reserve Requirements**: Utilize 2016-2017 IRM approved by NYSRC and corresponding LCRs
- **Capacity Market Parameters**: Utilized 2015/2016 Demand Curves
- **Gas Price Forecast**: Use AEO’s 2015 High Resource Case commodity prices
- **Load Forecast**: Use 2015 Gold Book forecast for 2015 through 2025 and extrapolate through 2030 using the growth rate from the last two years of this forecast
- **Load Duration Curve**: Utilize 2006 load shape for production models (IPM/MAPS) and 2002/2006/2007 multiple load shape model for reliability models (MARS)-consistent with CARIS & RNA assumptions.
- **Firm Additions and Retirements** – New builds, return to service and retirements based on latest known information
- **Nuclear Units**: All units remain in-service until license expiration, then assumed retired
- **Other Assumptions**:
  - Solar, wind and EE will grow at existing rates
  - RGGI cap for CO2 emissions to be extended at 2020 level
  - External systems will be modeled to preserve reserve margins
Assumptions

Clean Energy Standard

All CES Case assumptions are the same as the Base Case, with the following exceptions:

• Load Forecast:
  • CES Policy Case peak load is 2,507 MW lower than the Base Case in 2030
  • CES Policy Case energy load is 13,346 GWh lower than the Base Case by 2030

• Other Assumptions:
  • Renewable generation additions by zone
    • 15,500 MW of renewable capacity added to NY in the CES Policy Case
    • 18,400 MW of renewable capacity added to NY in the CES High Load Case
  • Western New York and AC Transmission projects in-service
NYISO Load Forecasts

2030 Energy (GWh) and Coincident Peak (MW)

<table>
<thead>
<tr>
<th>Case</th>
<th>Energy (GWh)</th>
<th>Coincident Peak (MW)</th>
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<td>Base Case</td>
<td>163,362</td>
<td>37,113</td>
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<td>CES Policy Case</td>
<td>150,016</td>
<td>34,606</td>
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<tr>
<td>CES High Load</td>
<td>172,402</td>
<td>40,581</td>
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NY State Resource Planning Analysis

DRAFT – For Discussion Only

October 25th 2016
Natural Gas Price Forecast

Annual Average Delivered Price By Zone (Nominal $/mmBtu)

- Henry Hub
- A-E (Tetco M3)
- F (TGP Z6)
- G-I (Iroquois Z2)
- J-K (Transco Z 6 NY)

Delivered Natural Gas Price (Nominal $/mmBtu)

<table>
<thead>
<tr>
<th>Year</th>
<th>Henry Hub</th>
<th>A-E (Tetco M3)</th>
<th>F (TGP Z6)</th>
<th>G-I (Iroquois Z2)</th>
<th>J-K (Transco Z 6 NY)</th>
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Natural Gas Price Forecast

Annual Average Delivered Price By Zone (2013 $/mmBtu)

Delivered Natural Gas Price (2013 $/mmBtu)

<table>
<thead>
<tr>
<th>Year</th>
<th>A-E Tetco M3</th>
<th>F TGP Z6</th>
<th>G-I Iroquois Z2</th>
<th>J-K Transco Z6 NY</th>
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<td>Basis by Zone (2013 $/mmBtu)</td>
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</table>

NY State Resource Planning Analysis

October 25th 2016
Natural Gas Price Forecast

2030 Weekly Delivered Price By Zone (Nominal $/mmBtu)

- A-E (Tetco M3)
- F (TGP Z6)
- G-I (Iroquois Z2)
- J-K (Transco Z 6 NY)

Weeks
Summary Of Preliminary Results

• For the CES Policy Case, resource adequacy criteria (LOLE) are met
• For CES Policy and Base Case sensitivities where LOLE violations occurred generation shifts, transmission upgrades and combined solutions were examined. Where available, generation solutions were found to be the least cost option for meeting resource adequacy.
• The EPA’s proposed CPP targets for New York are met under the CES Policy Case and CES sensitivities
• Increases in exports and decreases in imports with PJM, Ontario, and ISO-NE occur under CES cases
• Lower LBMPs under CES compared to the Base Case
• Increased overloads on the 115 and 138 kV network under the CES compared to the Base Case Sensitivity 4 – Transmission projects in service
• In the CES Policy Case, NYCA generates and imports sufficient renewable energy to provide 50% of energy consumption by 2030.
• When accounting for renewable generation consumed in New York, exports may reduce the amount of renewables from the 50% target to 46% by 2030.
Capacity Additions and Retirements
Capacity Additions and Retirements

Firm and Economic Additions and Retirements by Modeled Control Area by 2030

<table>
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<tr>
<th>Modeled Control Area</th>
<th>Additions</th>
<th>Retirements</th>
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<td>PJM</td>
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<td>BCS4 - WNY and AC Proceeding Upgrades</td>
<td>Additions</td>
<td>Retirements</td>
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<td>CES Policy Case</td>
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<tr>
<td>PJM</td>
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</tbody>
</table>
Capacity Additions and Retirements

Base Case NYCA Firm and Economic Capacity Additions and Retirements by Type and Zone by 2030

- Steam Coal
- Nuclear
- Simple Cycle
- Wind
- Distributed Solar
- Biomass / Other Renewable
- Hydro
- Combined Cycle
- ECONOMIC
- FIRM
Capacity Additions and Retirements

CES Policy Case NYCA Firm and Economic Capacity Additions and Retirements by Type and Zone by 2030

- Steam Coal
- Nuclear
- Simple Cycle
- Wind
- Distributed Solar
- Utility Scale Solar
- Biomass / Other Renewable
- Hydro
- Combined Cycle
- ECONOMIC
- FIRM
Reliability
Resource Adequacy – Initial Build

NYCA Loss of Load Expectation (Days / Year)

2024  2030  — NYCA LOLE Criteria 0.100 Days/Year
BCS4 – WNY and AC Proceeding Upgrades

NYCA Loss Of Load Expectation (Days/Year)

Solutions Evaluated

Capacity Solution
Shift 1 GT from Zone G to Zone J

Transmission Solution
Relax Dunwoodie South
BCS5 – IP Retired WNY and AC Proceeding

**NYCA Loss Of Load Expectation (Days/Year)**

**Solutions Evaluated**

**Capacity Solution**

- Shift 8 GT from Zone G to Zone H
- Shift 2 GT from Zone G to Zone J

**Transmission Solution**

- Relax UPNY-ConEd and Dunwoodie South
CES S2 – Indian Point Retired

NYCA Loss Of Load Expectation (Days/Year)

2024 2030 — NYCA LOLE Criteria

Solutions Evaluated

Capacity Solution

No Capacity Built in IPM

Transmission Solution

Relax UPNY-ConEd (600 MW HVDC from Pleasant Valley to Sprainbrook)
CES S7 – High Load

NYCA Loss Of Load Expectation (Days/Year)

Solutions Evaluated

**Capacity Solution**
Shift 1 GT from Zone E to Zone I, 3 GT and 1 CC from Zone E to Zone J, 2 GT from Zone E to Zone K

**Transmission Solution**
Relax Marcy South, UPNY-ConEd, UPNY-SENY, Dunwoodie South, and Y49/Y50

**Combined Solution 1**
Relax UPNY-ConEd, Shift 3 GT from Zone E to Zone J, and 2 GT from Zone E to Zone K

**Combined Solution 2**
Relax UPNY-ConEd and Y49/Y50, Shift 4 GT from Zone E to Zone J

**Combined Solution 3**
Relax UPNY-ConEd and Dunwoodie South, Shift 3 GT from Zone E to Zone K

**Combined Solution 4**
Relax UPNY-ConEd, Dunwoodie South, and Y49/Y50, Shift 2 GT from Zone E to Zone J, and 1 GT from Zone E to Zone K
Generation, Emissions, and Spot Prices
Generation

2030 NYCA Total Generation + Net Imports (GWh)

- BCS4 - WNY and AC Proceeding Upgrades
- BCS5 - IP Retirement, WNY and AC Upgrades
- CES Policy Case
- CES S2 - IP Retirement
- CES S7 - High Load

NY State Resource Planning Analysis

DRAFT – For Discussion Only

October 25th 2016
## 2030 NYCA Imports and Exports by Interface (GWh)

<table>
<thead>
<tr>
<th>Interface</th>
<th>Imports (GWh)</th>
<th>Exports (GWh)</th>
<th>Net Imports (GWh)</th>
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<tr>
<td></td>
<td>Base Case S4</td>
<td>CES Policy Case</td>
<td>Base Case S4</td>
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<tr>
<td>PJM West</td>
<td>731</td>
<td>153</td>
<td>3,009</td>
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<td>PJM East</td>
<td>2,833</td>
<td>1,574</td>
<td>1,048</td>
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<td>Ontario</td>
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<td>Quebec (Chat.)</td>
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<td>Northport Norwalk Cable</td>
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<td><strong>NYCA Total</strong></td>
<td><strong>25,520</strong></td>
<td><strong>17,917</strong></td>
<td><strong>8,684</strong></td>
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</table>
### 2030 NYCA Generation by Type (GWh)

#### Generation

- **Wind**
- **Solar**
- **Biomass / Other Renewable**
- **Hydro and PSH**
- **Simple Cycle**
- **Combined Cycle**
- **Simple Cycle**
- **Combined Cycle**
- **Oil / Gas Steam**
- **Oil / Gas Steam**
- **Coal Steam**
- **Nuclear**

<table>
<thead>
<tr>
<th>Case</th>
<th>BCS4 - WNY and AC Proceeding Upgrades</th>
<th>BCS5 - IP Retirement, WNY and AC Upgrades</th>
<th>CES Policy Case</th>
<th>CES S2 - IP Retirement</th>
<th>CES S7 - High Load</th>
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<tr>
<td>Generation (GWh)</td>
<td>120,000</td>
<td>140,000</td>
<td>160,000</td>
<td>180,000</td>
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Renewable Generation

2030 NYCA Renewable Generation and HQ Imports (GWh)

- **BCS4 - WNY and AC Proceeding Upgrades**: 47,126 GWh
- **BCS5 - IP Retirement, WNY and AC Upgrades**: 46,572 GWh
- **CES Policy Case**: 75,652 GWh
- **CES S2 - IP Retirement**: 75,650 GWh
- **CES S7 - High Load**: 86,845 GWh

Breakdown by source:
- **Hydro**
- **Biomass /Other Renewables**
- **Solar**
- **Wind**

NY State Resource Planning Analysis
2030 CES Policy Case NYCA Generation By Type by Zone

<table>
<thead>
<tr>
<th>Type</th>
<th>Zones A-F</th>
<th>Zones GHI</th>
<th>Zone J - New York City</th>
<th>Zone K - Long Island</th>
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<tbody>
<tr>
<td>Wind</td>
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<td>Nuclear</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
CO$_2$ Emissions

2030 NYCA CO$_2$ Emissions (Million Short Tons)

** Units physically located in NJ, but electrically connected to NY
Locational Prices

2030 NYCA LBMP by Zone and NYCA Average

- Base Case
- BCS4 - WNY and AC Upgrades
- BCS5 - IP Retirement, WNY and AC Upgrades
- CES Policy Case
- CES S2 - IP Retirement
- CES S7 - High Load
115 and 138 kV Overloads
115 and 138 kV Line Overloads

Number of Circuits Overloaded by Sending Area in 2030

- **BCS4 - WNY and AC Proceeding Upgrades**
- **CES Policy Case**
- **CES S7 - High Load**

The diagram shows the number of circuits overloaded at least one hour for different zones in 2030, categorized by various load scenarios.
115 and 138 kV Line Overloads

Incremental Number of Circuits Overloaded in 2030 Relative to Base Case Sensitivity 4

CHANGE IN NUMBER OF CIRCUITS OVERLOADED AT LEAST ONE HOUR

ZONE A - WEST
ZONE B - GENESSEE
ZONE C - CENTRAL
ZONE D - NORTH
ZONE E - MOHawk VALLEY
ZONE F - CAPITAL
ZONE G - HUDSON VALLEY
ZONE H - MILLWOOD
ZONE I - DUNWOODIE
ZONE J - NEW YORK CITY
ZONE K - LONG ISLAND

CES Policy Case
CES Policy Case Sensitivity 7
Next Steps

• Collect stakeholder comments on today’s presentation
  Comments can be sent to Leka Gjonaj at Leka.Gjonaj@dps.ny.gov
• Complete current scope of work with Interim Report first quarter 2017
• Collect stakeholder comments on Interim Report
• Additional Analysis Under Consideration
Potential Additional Analysis

- Further evaluate the drivers for increased exports to PJM, Ontario, and ISO-NE under the CES cases.
- Assess whether there are Transmission Security issues in the CES cases.
- Analyze the extent of renewable resource bottling, if any, due to 115 and 138 kV overloads and determine what upgrades may be necessary.
- Economic generator retirements in New York State are minimal, despite increasing capacity surplus under CES and aging generator fleet. Further evaluate impact on reliability with higher generation retirements.
- Examine the impacts to New York if neighboring regions adopt similar renewable goals.
- Examine the implications of using fixed demand curves, IRMs and LCRs and the need to adjust them.
The Challenge of Ensuring System Reliability Through Wholesale Markets as the Resource Mix Evolves

NPCC Governmental/Regulatory Affairs Advisory Group

Eric Johnson

DIRECTOR, EXTERNAL AFFAIRS
Natural Gas Is Currently the Dominant Fuel Source for New Generating Capacity in New England

Cumulative New Generating Capacity in New England (MW)

- Natural Gas
- Fuel Cell
- Hydro
- Solar
- Biomass
- Nuclear
- Wind
- Oil

Note: New generating capacity for years 2016 – 2019 includes resources clearing in recent Forward Capacity Auctions.
New England Has Seen Dramatic Changes in the Energy Mix

Percent of Total **Electric Energy** Production by Fuel Type
(2000 vs. 2015)

- **Nuclear**: 31% in 2000, 30% in 2015
- **Oil**: 22% in 2000, 2% in 2015
- **Coal**: 18% in 2000, 4% in 2015
- **Natural Gas**: 15% in 2000, 49% in 2015
- **Hydro and Other Renewables**: 13% in 2000, 15% in 2015
- **Pumped Storage**: 2% in 2000, 1% in 2015

Source: ISO New England [Net Energy and Peak Load by Source](#)
Other renewables include landfill gas, biomass, other biomass gas, wind, solar, municipal solid waste, and miscellaneous fuels
State Policy Requirements Drive Proposals for Renewable Energy

State Renewable Portfolio Standard (RPS)* for Class I or New Renewable Energy by 2020

* State Renewable Portfolio Standards (RPS) promote the development of renewable energy resources by requiring electricity providers (electric distribution companies and competitive suppliers) to serve a minimum percentage of their retail load using renewable energy. Vermont’s new Renewable Energy Standard has a ‘total renewable energy’ requirement (reflected above), which recognizes large-scale hydro and all other classes of new and existing renewable energy.
Renewable and EE Resources Are Trending Up

- **Wind (MW)**
  - Existing: 800
  - Proposed: 4,800

- **Solar (MW)**
  - PV thru 2015: 1,300
  - PV in 2025: 3,300

- **Energy Efficiency (MW)**
  - EE thru 2015: 1,700
  - EE in 2025: 3,800

Nameplate capacity of existing wind resources and proposals in the ISO-NE Generator Interconnection Queue; megawatts (MW) as of September 2016.

*Final 2016 ISO-NE PV Forecast, AC nameplate capacity from PV resources participating in the region’s wholesale electricity markets, as well as those connected “behind the meter.”*

*2016 CELT Report, EE through 2015 includes EE resources participating in the Forward Capacity Market (FCM). EE in 2025 includes an ISO-NE forecast of incremental EE beyond the FCM.*
Additional Infrastructure Will Be Needed to Replace Retiring Resources and Meet Renewable Energy Goals

All Proposed Generation

Developers are proposing to build nearly 12,400 MW of generation, including approx. 6,400 MW of gas-fired generation and more than 4,900 MW of wind.

- Natural gas 52%
- Wind 40%
- Other 8%

Wind Proposals

- ME 3,545 MW
- Offshore wind MA 1,254 MW
- VT 30 MW
- NH 79 MW
- MA 10 MW

Source: ISO Generator Interconnection Queue (November 2016); FERC Jurisdictional Proposals
New England States and Developers Are Proposing to Add Significant Clean Energy to the Region

- As of **November 2016**, 15 elective transmission projects are proposed in the ISO Interconnection Queue totaling more than **9,000 MW** of potential transfer capability
  - Primarily large-scale **hydro** from eastern Canada and **wind** from northern New England
    - Note: CT/MA/RI RFP selected mostly in-region projects to move forward
- These projects seek to address policy goals, not reliability needs and are not economic in the wholesale market (because their environmental attributes are not valued)
- Contracting for clean energy outside of the wholesale markets may affect price formation and investment incentives; market-design adjustments may be needed
Electric Grid of the Future Will Look Very Different

We are moving toward a “hybrid” grid with grid-connected and distributed resources, and a continued shift toward natural gas and renewable energy.
New England Has Two Overarching Policy Goals – Are They Compatible?

1. Achieving reliability through **competitive wholesale markets**, and

2. Achieving **reductions in carbon emissions**
An Initiative Is Underway to Integrate Markets and Public Policy (IMAPP)

• In August, NEPOOL launched a stakeholder process with the goal of identifying potential adjustment(s) to the wholesale electricity market(s) to accommodate and achieve the New England states' public policy objectives

• The region’s competitive wholesale electricity markets are designed to maintain reliability through the selection of the most economically efficient set of resources

• The states have environmental and renewable energy goals that are beyond the objectives of the wholesale electricity markets
Three General Categories of Proposals Have Emerged from IMAPP Discussion

• Carbon Pricing
• Forward Clean Energy Market (FCEM)
• Two-Tiered Forward Capacity Market (FCM)
Pricing Carbon in the Energy Market

• Proposal calls for ISO’s Day-Ahead and Real-Time dispatch and pricing to use resource-specific offer adders that reflect each generator’s carbon emissions and a tariff-based carbon cost (per ton CO₂)

• In theory, this would provide incentives to invest in low- or non-carbon-emitting resources and to retire high-carbon-emitting resources

• Some state representatives are concerned that this would raise costs and not necessarily stimulate new renewables

• Similar in effect to the successful 30-year experience with SO₂ and NOx emissions pricing in New England and nationally; complements existing Regional Greenhouse Gas Initiative
Forward Clean Energy Market

- This type of proposal calls for the procurement of forward commitments to deliver clean energy through a competitive auction administered by the ISO.
- Provides new revenue and incentives for production and investment from qualified clean energy resources.
- Quantity purchased set to meet state emission goals, and cost allocated to states’ load.
- FCEM could be a complement to other concepts, such as carbon pricing in the energy and FCM two-tiered pricing.
Two-Tiered Forward Capacity Market

• This proposal attempts to undo the effect of state subsidies to select low-carbon resources in the FCM, paying different capacity prices to resources with and without subsidies.

• The auction would be modified to occur in two stages:
  – In one stage, all resources would be subject to offer-price mitigation, including resources supported by out-of-market revenues.
    • Mitigation would “add back” to a resource’s offer price the value of its out-of-market revenues; this would push up its offer price, and, as a consequence, the resource might not clear in the auction.
  – In a second stage, any resource supported by out-of-market revenues that did not clear in the first stage would enter the auction as a price-taker.
IMAPP: Looking Ahead

• NEPOOL’s initial goal was to develop a “framework document” by December 2 to provide guidance to the ISO regarding potential changes to the wholesale power markets.

• Earlier this fall, NEPOOL adjusted the schedule to provide more time to consider and work through proposals.

• Between now and the next meeting, on January 25, 2017, participants are encouraged to refine, combine, and augment their proposals; the ISO and the states plan to provide feedback on proposals at the January meeting.

• Additional refinements will be made based on feedback and presented at a February 16, 2017 meeting.

Note: For information on the individual proposals, visit the NEPOOL website or the ISO’s Wholesale Markets and State Public Policy Initiative webpage.
Questions
NPCC EPA Clean Power Plan Analysis

NPCC Governmental/Regulatory Affairs Advisory Group

December 6, 2016
NPCC is performing a study of possible effects EPA Clean Power Plan (CPP) compliance, including consideration of Regional Greenhouse Gas Initiative (RGGI) and state initiatives in New England and New York.

The study assumes the CPP is enacted and examines its possible impacts on essential reliability services, i.e.:
- Frequency
- Voltage
- ramping
The study is being performed in two stages

The first phase of this study has been completed (Phase I)

- Assessed the ability of the New York and New England power system to handle high-voltage transmission forced outages or contingencies
- Assessment compared the results of the 2022 Base case (CPP not enacted) scenarios with the CPP scenarios
2022 Base Case:

- Generation dispatch patterns match what is shown in the FERC 715 filing power flow cases for 2022 for:
  - summer peak
  - winter peak
  - spring light load

- Generation dispatch exception -- generation units that are highly likely to be retired from service prior to 2022 were removed from the base case
2022 CPP Case:
- Assumed that the CPP is enacted, which may require reductions in CO2 emitting resources such as coal and gas steam turbines
- Assumed that the state CPP goals for total CO2 mass emissions will be met for specific years in the EPA schedule

Analysis
- Contingencies, or forced outages, were simulated for both the 2022 Base and CPP cases (summer peak, winter peak, and spring light load conditions)
Analysis (continued)

- Considered outage of single transmission lines or transformers (N-1) at 100 kV and above
  - About 1,000 contingencies were simulated for each case.
  - Instances where the CPP generation dispatch could result in additional stress to the system, beyond that produced by the base case generation dispatch, were of particular interest

- A macro-level metric for comparing the Base and CPP cases is the Aggregate MVA Contingency Overload (AMVACO)
  - AMVACO raw number depends both on the number of contingencies considered and the number of line ratings monitored and requires context for meaning
  - However, by comparing the AMVACO in each base case to its corresponding CPP case, a general conclusion may be drawn about how the CPP could impact transmission congestion and operational reliability
Spring Light Load

- Severity and number of overloads generally increases with the CPP generation mix, but AMVACO in New England and across the region improves.

- CPP case also has more contingencies that result in failed load flow solutions, which can be related to voltage problems.

Base case

- 54 contingencies cause at least one thermal branch violation.
- 10 contingencies with at least one high or low bus voltage violation (with some overlap of contingencies that cause both).

CPP cases

- 47 contingencies cause at least one thermal branch violation.
- 13 contingencies cause at least one high or low bus voltage violation.
### Spring Light Load Contingency Metric Comparison

<table>
<thead>
<tr>
<th></th>
<th>Base Case</th>
<th>CPP Case</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AMVACO</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NY</td>
<td>1,110</td>
<td>1,303</td>
</tr>
<tr>
<td>NE</td>
<td>1,034</td>
<td>792</td>
</tr>
<tr>
<td>Total</td>
<td>2,144</td>
<td>2,095</td>
</tr>
<tr>
<td><strong># of Contingency Overloaded Elements</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NY</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>NE</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Total</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td><strong>Worst Contingency Overload (%)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NY</td>
<td>138%</td>
<td>145%</td>
</tr>
<tr>
<td>NE</td>
<td>212%</td>
<td>220%</td>
</tr>
<tr>
<td>Total</td>
<td>212%</td>
<td>220%</td>
</tr>
<tr>
<td><strong># of Buses with Low Voltage Violations</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NY</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>NE</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td><strong>Lowest Contingency Bus Voltage (pu)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NY</td>
<td>0.87</td>
<td>0.87</td>
</tr>
<tr>
<td>NE</td>
<td>0.86</td>
<td>0.86</td>
</tr>
<tr>
<td>Total</td>
<td>0.86</td>
<td>0.86</td>
</tr>
</tbody>
</table>
NPCC EPA Clean Power Plan Analysis – Phase I

- **Winter Peak**
  - Severity and number of overloads generally decreases with the CPP mix, but the impacts are not uniform across the NPCC area
  - CPP mix generally improves performance in New England but degrades it in New York
  - Winter CPP cases show an increase in the number of contingencies for which the power flow solution fails

- **Base case**
  - 16 contingencies with at least one thermal overload
  - 11 contingencies with at least one high or low voltage bus violation

- **CPP case**
  - 43 contingencies with at least one thermal overload
  - 8 contingencies with at least one high or low voltage bus violation
### Winter Peak

**Winter Peak Load Contingency Metric Comparison**

<table>
<thead>
<tr>
<th></th>
<th>Base Case</th>
<th>CPP Case</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AMVACO</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NY</td>
<td>189</td>
<td>691</td>
</tr>
<tr>
<td>NE</td>
<td>772</td>
<td>166</td>
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<tr>
<td>Total</td>
<td>961</td>
<td>857</td>
</tr>
<tr>
<td><strong># of Contingency Overloaded Elements</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NY</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>NE</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td><strong>Worst Contingency Overload (%)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NY</td>
<td>129%</td>
<td>144%</td>
</tr>
<tr>
<td>NE</td>
<td>164%</td>
<td>125%</td>
</tr>
<tr>
<td>Total</td>
<td>164%</td>
<td>144%</td>
</tr>
<tr>
<td><strong># of Buses with Low Voltage Violations</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NY</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>NE</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td><strong>Lowest Contingency Bus Voltage (pu)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NY</td>
<td>0.87</td>
<td>0.87</td>
</tr>
<tr>
<td>NE</td>
<td>0.86</td>
<td>0.86</td>
</tr>
<tr>
<td>Total</td>
<td>0.86</td>
<td>0.86</td>
</tr>
</tbody>
</table>
**Summer Peak**

- **CPP generation mix improves AMVACO in New York by a slight amount (despite more overloaded elements in the CPP results) and by a significant amount in New England**
- **Fewer contingencies in the CPP case that result in failed load flow solutions**
- **Seemed to be significant improvement in the thermal overloads with the CPP generation mix. However, the number and severity of low voltage violations increased, specifically in New York**

**Base case**
- 275 contingencies cause at least one thermal branch violation
- 10 contingencies have at least one high or low bus voltage violation

**CPP case**
- 66 contingencies cause at least one thermal branch violation
- 10 contingencies cause at least one high or low bus voltage violation
**Summer Peak**

### Summer Peak Load Contingency Metric Comparison

<table>
<thead>
<tr>
<th></th>
<th>Base Case</th>
<th>CPP Case</th>
</tr>
</thead>
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<tr>
<td><strong>AMVACO</strong></td>
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<td></td>
</tr>
<tr>
<td>NY</td>
<td>4842</td>
<td>4606</td>
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<tr>
<td>NE</td>
<td>3458</td>
<td>534</td>
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<td><strong>Total</strong></td>
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<td>5140</td>
</tr>
<tr>
<td><strong># of Contingency Overloaded Elements</strong></td>
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<td></td>
</tr>
<tr>
<td>NY</td>
<td>28</td>
<td>44</td>
</tr>
<tr>
<td>NE</td>
<td>13</td>
<td>9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>41</td>
<td>53</td>
</tr>
<tr>
<td><strong>Worst Contingency Overload (%)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NY</td>
<td>177%</td>
<td>177%</td>
</tr>
<tr>
<td>NE</td>
<td>230%</td>
<td>194%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>230%</td>
<td>194%</td>
</tr>
<tr>
<td><strong># of Buses with Low Voltage Violations</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NY</td>
<td>10</td>
<td>17</td>
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<tr>
<td>NE</td>
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<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
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<td>21</td>
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<tr>
<td><strong>Lowest Contingency Bus Voltage (pu)</strong></td>
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<tr>
<td>NY</td>
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<td>0.75</td>
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<tr>
<td>NE</td>
<td>0.87</td>
<td>0.87</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>0.87</td>
<td>0.75</td>
</tr>
</tbody>
</table>
Phase I Conclusion:

- The Phase I study provided an initial look at potential vulnerabilities that could be seen on the New York and New England bulk power system with enactment of the CPP
- The possible de-commitment or retirement of some generation resources could lead to higher contingency overloads in some parts of the system, though it could also provide relief in other parts of the system
Phase II

- Expands upon Phase I (2022 case) by creating a 2030 power flow case for a post-CPP environment
- Incorporates New York and New England state renewable portfolio standards (RPS), as some of these may be more constraining than CPP or RGGI
NPCC EPA Clean Power Plan Analysis – Phase II

- **Phase II**
  - Examines if minor changes in the generation dispatch can improve the operational reliability of the CPP cases, without adversely impacting the state CPP goals
  - Examines changes in system voltages (PV curves) as generation is shifted from the base mix of resources to the potential CPP mix
  - Compares the transient stability performance of the base and CPP cases during major outages and examines system conditions in 2030, when the state CPP target rates reach their lowest levels
**NPCC EPA Clean Power Plan Analysis – Phase II**

- **Phase II - Frequency Study**
  - Transient stability analysis will be performed on up to three faults on the worst-case 2030 conditions
  - Frequency response of the base case and the CPP case will be compared to assess the impact of increased renewable penetration

- **Phase II - Voltage Study**
  - N-1 contingencies on the high voltage grid (>100 kV) will be analyzed on the 2030 base case and CPP case. Voltage performance under contingency will be compared between the two sets of cases
  - P-V curves will be traced for transfers of power from units that could be retired under CPP to other resources
Phase II - Ramping Study

- Analyze if expected generator ramping capability is suitable to transition from off-peak to peak hours and back over the course of a typical daily load curve projected for 2030, net of expected renewable production (i.e. “duck curve”)
- This analysis will be formulated algebraically and primarily outside of the power flow environment

Phase II Completion Target: December 2016
Questions?