Transmission Planning for the Clean Energy Transition

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Presentation Overview

- Review of September PAC Presentation
- Tradeoffs: Reliability and Flexibility vs. Transmission Cost
- Pilot Study Proposal
- Feedback & Next Steps

REVIEW OF SEPTEMBER PAC PRESENTATION

New Challenges in Transmission Planning

- By 2030, New England's power system is expected to have much higher levels of clean energy integration than today
  - Approximately 7,800 MW of distributed photovoltaic (PV) resources
  - 3,100 MW of offshore wind with contracts signed or under negotiation
  - New HVDC interconnection to Quebec
  - Increased development of battery energy storage
- These trends will require changes in New England's transmission planning studies
  - Different system conditions to be studied
  - New approaches to data collection
- Topic introduced in a September 24, 2020 PAC presentation
  - Since September, this effort has been renamed to avoid confusion with the "Future Grid" efforts underway at NEPOOL committees

Trends Requiring New Study Approaches

- Decreasing net load in mid-day periods
- Potential for distributed energy resources (DER) to trip due to transmission system faults
- Stability performance with higher levels of DER
- Variability of wind generation, especially offshore wind
- Low-inertia conditions due to increased replacement of synchronous generators by power electronics

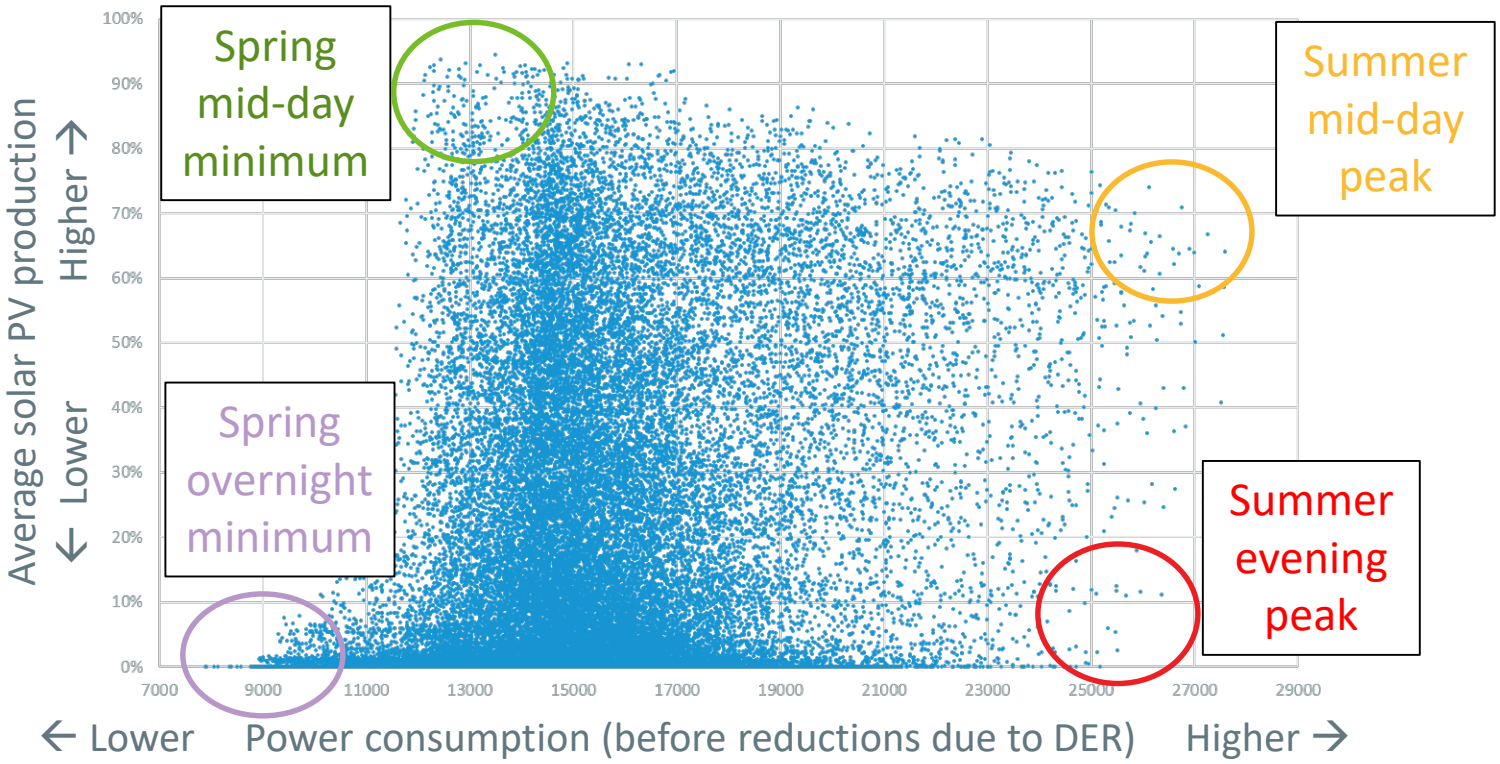
Feedback from September PAC Presentation

- Many stakeholders provided comments during and after the September PAC presentation
- Feedback related to study conditions
  - How likely are the proposed study conditions to actually occur?
  - Can operational measures ensure reliability in these conditions?
- Feedback related to DER and storage policies
  - Would the implementation of voltage and/or frequency control on DERs mitigate any reliability concerns?
  - Is synthetic inertia on power-electronic-based generation helpful?
  - Could better rules around behavior of storage assets address peak and minimum load conditions?
  - How can System Planning, Operations, and Markets better coordinate to address concerns related to transmission system reliability?

TRADEOFFS: RELIABILITY AND FLEXIBILITY VS. TRANSMISSION COST

Probability and Frequency of Study Conditions

Recall from the September PAC presentation: each blue dot represents a single hour experienced between 2012 and 2018. We have proposed to study the "corners," at the intersection of high/low load and high/low solar output.



Infrequent, But Not Improbable, Conditions

Example: Spring Daytime Minimum
(proposed assumption: 12000 MW, 90% PV)

Date	Power Consumption (before reductions from PV)	PV Output (% of nameplate capacity)
April 20, 2014	12405 MW	89%
April 19, 2015	12375 MW	86%
April 17, 2016	12300 MW	90%
April 24, 2016	12304 MW	93%
April 23, 2017	12296 MW	92%
April 21, 2018	12256 MW	85%
April 22, 2018	12233 MW	93%
May 11, 2019	12292 MW	88%
May 18, 2019	12477 MW	86%

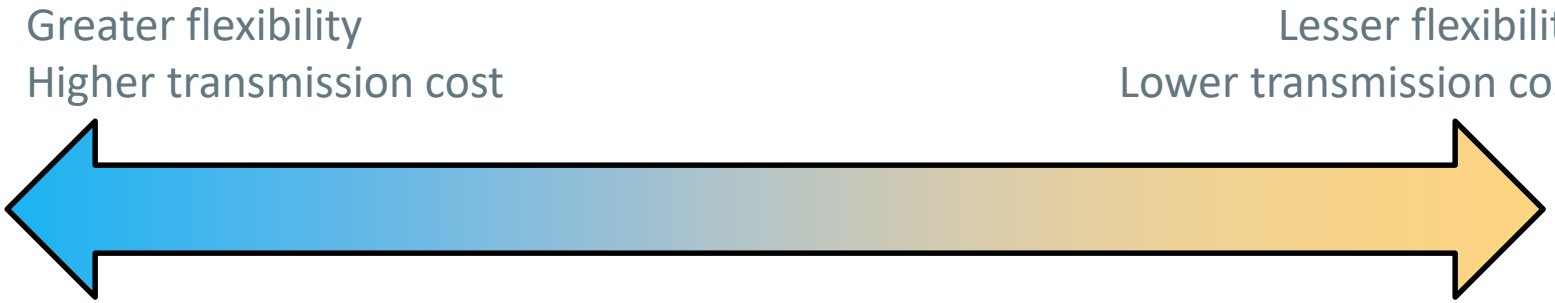
While these conditions are not frequent on a day-to-day basis, they are not necessarily improbable. These conditions occur every year.

Tradeoffs: Reliability and Flexibility vs. Cost

- Should we plan for a condition that happens approximately once per year?
  - A transmission system that can accommodate this condition would allow us to take full advantage of the output of renewable resources installed on the ISO-NE electric system – but might require additional capital investment.
- If we do not plan for this condition, ISO-NE Operations will need to take actions to maintain reliability. These actions:
  - Must be feasible for operators to implement
  - Must be easily understood and not overly complex
  - Could increase emissions or out-of-merit generation costs

Tradeoffs: Reliability and Probability vs. Cost

- Any one of a spectrum of assumptions could be chosen:



- Stakeholder input will help ISO-NE determine the appropriate point on this spectrum to study
- However, we cannot make this decision without full knowledge of the tradeoffs!

Quantifying the Tradeoffs

- To quantify these tradeoffs, we will need approximate answers to the following:
  - What reliability concerns exist at the “corner” conditions?
  - Approximately how expensive are the transmission investments to fully address these reliability concerns?
  - During how many hours per year will these concerns arise?
  - What operational measures would be available to maintain reliability without additional transmission system investments?
  - What is the extent of these operational measures?
    - Complexity and feasibility
    - Frequency, on an hours per year basis
  - What policy changes could be helpful in maintaining transmission system reliability?
    - Some may be outside ISO-NE’s purview

PILOT STUDY PROPOSAL

Pilot Study Overview

- To quantify these trade-offs, ISO-NE proposes a “pilot” study of the conditions described in the September PAC presentation
- This pilot study will *not* be a Needs Assessment, Solutions Study, or competitive transmission RFP
  - Purpose is to test out assumptions, and quantify the tradeoffs between transmission investment and system flexibility
  - Reliability problems found would not be immediately addressed in a Solutions Study or competitive RFP
  - Any transmission solutions proposed would be roughly representative only, and costs would be rough order-of-magnitude estimates
  - Results of the pilot study would inform decisions on assumptions to be used in future Needs Assessments
- DER data collection efforts will proceed in parallel with the pilot study, with the study using the best assumptions possible in the absence of actual data

Why Conduct a Pilot Study?

- ISO-NE and stakeholders must make an informed decision to choose a point on the flexibility/transmission cost spectrum
  - Does a small, targeted transmission investment gain us significantly better flexibility?
  - Does a small reduction in flexibility (for example, curtailing renewables for only a few hours per year) lead to large reductions in transmission upgrade costs?
- If policies regarding DER are pursued, they should be targeted at the most effective changes in DER operation
  - For example: If the pilot study finds that fault ride-through is not a major concern, pursuing changes in protection settings would be a lower priority

Pilot Study Scope

- Pilot study would take a “10,000-foot view” of the entire New England system, rather than any one portion of it
  - Goal is to see the overall trend of system behavior and reliability concerns, not to identify exact needs or exact system upgrades
  - Base cases will represent a likely dispatch for a given condition, rather than attempting to stress any particular portion of the system through generator outages
  - Due to recent study automation efforts, steady-state N-1-1 analysis on the entire system is feasible, and will be performed
  - Stability analysis will concentrate on faults on the 345 kV system, and 230 kV or 115 kV faults that are especially impactful
  - Limited electro-magnetic transient (EMT) study work may be pursued
- Pilot study’s main goal would be to establish assumptions for future Needs Assessments
  - Subsequently, individual Needs Assessments would look at each portion of New England in more detail

Pilot Study Scope

- The results of the pilot study will be most useful if the study begins from fairly conservative conditions
  - We will only observe the trade-offs that are necessary under these conditions if they are studied and examined
- The pilot study will investigate potential paths to address reliability concerns through any or all of:
  - Transmission system investment
  - Operational measures
  - Policy changes
- By testing the sensitivity of the reliability concern to system conditions (solar output, wind output, load level), we can approximate the exposure to the concern (in hours per year)

Proposed Pilot Study Assumptions: Load & Solar

Condition to Study	Power Consumption	Solar Output	Forecasted Net Load in 2029
Spring/Fall Weekend Nighttime (minimum consumption)	8,000 MW	0% x 7,796 MW = 0 MW	8,000 – 0 = **8,000 MW**
Spring/Fall Weekend Mid-Day (minimum net load)	12,000 MW	90% x 7,796 MW = 7,016 MW	12,000 – 7,016 = **4,984 MW**
Summer Weekday Mid-Day (maximum consumption)	100% of 90/10 forecast = 27,462 MW	40% x 7,595 MW = 3,038 MW	27,462 – 3,038 = **24,424 MW**
Summer Weekday Evening (maximum net load)	95% of 90/10 forecast = 26,089 MW	10% x 7,595 MW = 759.5 MW	26,089 – 759.5 = **25,329 MW**

All values based on 2020 CELT report. Solar nameplate of 7,796 MW is based on end-of-year capacity for 2030, and 7,595 MW is based on capacity expected by June 2030.

Proposed Pilot Study Assumptions: Wind

- Studies will examine the end of the output range that is conservative for the condition studied
  - High wind generation when low inertia may be a concern
  - Low wind generation where load serving may be a concern

Condition to Study	Onshore Wind Generation	Offshore Wind Generation
Spring Weekend Nighttime (minimum consumption)	5% (steady-state) 65% (stability)	15% (steady-state) 90% (stability)
Spring Weekend Mid-Day (minimum net load)	55%	60%
Summer Weekday Mid-Day (maximum consumption)	5% (steady-state) 30% (stability)	5% (steady-state) 90% (stability)
Summer Weekday Evening (maximum net load)	5%	5%

Proposed Pilot Study Assumptions: Policy

- Certain study assumptions are affected by policies both within and outside of ISO-NE's purview
  - Distribution system power factor
  - DER voltage and frequency control capability
  - DER fault ride-through capability
- Initially, the pilot study will assume a "business-as-usual" approach to these policies
  - Where changes to the policies would be beneficial, they will be considered as mitigating measures
  - ISO-NE would need reasonable assurance that these policies would be implemented and enforced before they could be relied upon in future Needs Assessments

FEEDBACK & NEXT STEPS

Feedback and Next Steps

- Feedback on the pilot study proposal may be submitted to pacmatters@iso-ne.com by December 4, 2020
- Next Steps:
  - Development of the pilot study base cases
  - Review of the pilot study base cases with PAC
  - Pilot study analysis will begin in late 2020 or early 2021
  - In parallel with the pilot study, outreach to distribution providers regarding DER data collection
  - Further discussion on open questions, and on the pilot study results and tradeoffs on future Needs Assessment assumptions, at future PAC meetings