2020 Economic Study Request

ISO-NE Planning Advisory Committee Meeting
April 23, 2020

nationalgrid

Motivation for the Request

Drivers

States continue to accelerate clean energy and emissions reduction legislation changing the region's future resource mix

- Analysis of a wide range of options to achieve state goals enables cost-effective implementation
- Exploration of the characteristics of new resource mixes can help prepare stakeholders and markets for what may be valued in the future

Purpose

Provide stakeholders analyses of potential pathways to best use the MWh of clean energy resources to meet state goals cost-effectively, leveraging transmission and/or storage as needed

- Evaluate the potential economic benefits associated with the deployment of transmission and/or storage under a range of assumed future resource portfolios
- Assess changes to thermal unit capacity factors, spillage and emissions as related to different resource and dispatch scenarios

Overview

- Key Study Questions
- Building on Previous Studies
- Scenarios Requested
- High-level Assumptions
- Deliverables Requested

Key Study Questions

What may be the electricity market and operational ramifications of meeting state policy goals in ISO-NE?

- **How might resource operations and economics be impacted by an increasing proportion of intermittent resources?**
  - Capacity factors and revenues of natural-gas fired units
  - Spillage of low-emission resources
- **What intra-regional transmission upgrades may be required?**
- **How might customer costs (load serving entity expenses) be impacted?**
- **How might bi-directional transmission capability with neighbors (NB, HQ, NY) and/or battery storage contribute to meeting future needs?**
  - Effectively using available MWhs of clean energy, minimize renewable spillage and emissions
  - Impacts on intra-regional transmission needs and customer costs
  - Identify economic tradeoffs between transmission, storage, and renewables spillage
- **How might system operations and the supply/demand balance for reserves be impacted by the changing resource mix?**
  - Effect of increased intermittent resources on regulation, ramping and reserves (TMNSR, TMOR) requirements
  - Availability of reserves as thermal units retire, new resources come online

Building on Previous Studies

2016 NEPOOL Public Policy Implications Scenarios

Assessed the economic impact of public policy-driven resource expansion's effect on energy market revenues and the cost of operating the system and supplying load

2017 CLF Least-Cost Emissions-Compliant Scenarios

Built upon the low-emissions case from 2016, this study analysed the economic effect of various low-emitting resource mixes – offshore wind vs onshore wind; varying solar and EE amounts; nuclear in and out of service

2019 NESCOE Offshore Wind Integration Study

Performed transmission interconnection and costs analysis and assessed spillage and market impacts of high offshore wind integration

National Grid would like to similarly:

- Assess regulation, ramping and reserves requirements and annual carrying charges for resource types
- Assess capacity factors for unit types and fossil fuel consumption
- Minimize emissions
- Include a high level of offshore wind penetration
- Assess spillage
- Estimate transmission upgrade costs associated with new resource configurations

While also:

- Including state policy additions and updates since 2016
- Looking further out into the future to 2035
- Including a sensitivity with higher amounts of thermal unit retirement
- Include more offshore wind
- Minimizing spillage through transmission, including imports/exports, and/or battery storage usage

Scenarios Requested

	For a 2035 model year	Sensitivities
Renewable Build-Out (Base)	• Begin with FCA 14 cleared and retire Mystic, all coal, nuclear with license expirations prior to 2035, 75% of conventional, including dual-fuel, oil units based on performance/ utilization metric • Add land based and offshore renewables to meet NICR and state policies	• High Thermal Retirement: 50% of the gas and remaining dual-fuel units based on performance/ utilization metric • Additional sensitivities as determined by ISO and/or PAC to answer key study questions and drive understanding of currently outlined scenarios
Renewable Build-out + Bi-directional Transmission	• Meet NICR and state policies with renewables including additional imports • Treat existing ties to neighboring regions as bi-directional • Add more bi-directional transmission ties to neighboring if needed to meet state policies, reduce spillage and/or reduce emissions in peak hours	
Renewable Build-out + Storage	• Meet NICR and state policies by building additional onshore renewables • Add storage to minimize renewable spillage and/or reduce emissions in peak hours	

High-level Assumptions

National Grid will continue to refine the following with ISO-NE and PAC input

Load

- Extrapolate 2020 CELT load net EE to 2035
- Reduce load by 8,000 MW of BTM PV
- Increase load by about 7,000 GWh for EVs
  (~2.2 million light-duty vehicles)
- Increase load by about 9,500 GWh for heating
  (~4,500 MW in winter peak hour)

Retirements

- Mystic units 8 and 9
- Coal units
- Nuclear with license expirations prior to 2035
- 75% of the conventional oil, including dual-fuel units, based on performance/ utilization metric
- Sensitivity: 50% of the remaining natural gas units based on performance/ utilization metric

Supply Additions

- No new thermal units beyond those already planned
- 6000 MW of offshore wind, utilizing interconnection points from 2019 study but excluding Mystic
- Total capacity minimum of
  - 5,000 MW PV in Markets located primarily in the west
  - 2,000 MW onshore wind located primarily in the north
  - 2,500 MW battery storage located primarily near load centers

Overall Comparison to NESCOE Study

Load	Retirements	Supply Additions
Increase in total load consumption, changes to load shape given greater PV, EV and heating assumptions	More thermal retirements	Higher storage and onshore renewable additions

High-level Assumptions continued

National Grid will continue to refine the following with ISO-NE and PAC input

Transmission Projects

- Proposed and Planned reliability projects in the 2020 RSP project list
- Any upgrades associated with signed interconnection agreements
- NECEC into Larrabee Rd at full 1,200 MW

Interfaces

- Internal interfaces as in 2019 NESCOE study
- Increased limit on Surowiec-South of 2,500 MW
- External interfaces vary by scenario:
  - Base/Storage
    - Current limits enforced
    - Historical flows
  - Bi-direction transmission
    - "Open" bi-directional flow at borders
    - Flexible dispatch informed by historical availability profiles

Policy Targets

- Massachusetts
  - 1,200 MW of clean energy (procured as NECEC)
  - 3,200 MW of offshore wind
  - Economy wide CO_2 reductions of 100% by 2050 from 1990 levels
  - 1000 MWh of storage by 2025
- Connecticut
  - 2,000 MW of offshore wind
  - RPS increase to 40% by 2030
- Rhode Island
  - 100% Renewables by 2030
- Maine
  - 45% emissions reduction by 2030; 80% emissions reduction by 2050
- NH
  - 25% Renewables by 2050
- VT
  - 75% Renewables by 2050

Overall Comparison to NESCOE Study

Transmission Projects	Interfaces	Policy Targets
Base transmission is the same; increase NECEC to its full capability	Additional inter-regional transmission capacity and dispatch opportunities	Increase policy target achievement to be consistent with progress by 2035

Deliverables Requested

Goal: Provide insight on wholesale energy market impacts, unit economics, utilization of resources, and role of transmission and battery storage in meeting the needs of a system with a high proportion of intermittent resources

- Identification of transmission / storage capacity that may be needed in the region and high-level cost estimates
- System production costs, load serving entity expenses, congestion, interface flows, energy and ancillary service prices, and emissions as they relate to policy targets
- Generation production and costs, renewable spillage, energy and ancillary service revenues, carrying costs, generation capacity factors, and the marginal fuel
- Range of physical quantities of ramping, regulation, and reserves available and needed