Proposed Assumptions and Methodologies

Future Grid Reliability Study (FGRS) – Phase 1

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Introduction

- ISO-New England has been coordinating with NEPOOL to develop assumptions and clarify scenarios as part of performing FGRS Phase 1
- Today's Presentation is focused on discussions relating to:
  - Assumptions for:
    - Production Cost Simulations (GridView)
    - Ancillary Service Simulations (EPECS)
  - Simulation Study Plans for Resource Adequacy Screen and Probabilistic Resource Availability Analysis (MARS)

GRIDVIEW AND EPECS

Assumptions Discussion

Background:
Production Cost and Ancillary Services Simulations

- This presentation provides an overview of the Phase 1 assumptions
  - ISO recommendations for unresolved assumptions
  - Clarifies work products that are anticipated to be produced
  - Attempts to balance and achieve as many of the following objectives as possible
    - Requested issues to be addressed and analyzed
    - Effort to realize the requested analysis in a timely manner
    - Balance granularity vs. uncertainty in the assumptions
    - Honor the diversity in visions about the future that stakeholders have expressed

Phase 1 Studies Additional Clarifications

Production Cost and Ancillary Services Simulations

- At the February 26 RC/MC meeting
  - The ISO reviewed the assumptions documented to date
  - Identified where key assumptions are needed
- The following slides outline the additional assumption details needed for the Scenario Matrix and Alternative Scenarios
- After today's meeting
  - The ISO will continue to review assumptions defined in the latest version of the Framework document as they start to build the models
  - Will seek clarification as needed from the MC/RC
  - Discussions will begin in May at the PAC on the 2021 Economic Study

SCENARIO MATRICES

Production Cost (GridView) and Ancillary Services (EPECS)

Scenario Matrices

GridView and EPECS Simulations

- Scenarios described by the matrices have been fully enumerated
  - Ensures stakeholders know the specific cases envisioned to be analyzed
  - Some scenarios may result in unserved energy or other issues
  - Many combinations and permutations
    - Results in 34 GridView scenarios
    - Manageable number of scenarios for GridView analysis
    - Suitable for investigating a range of economic and operational issues
  - EPECS simulations focus on *physical* quantities
    - Predominately related to reserves
      - Following the ISO's initial review, fewer simulations are likely to be needed to produce desired metrics
      - "Corner bookends" illuminate the range of physical quantities
    - Eight EPECS scenarios believed to be sufficiently diverse to capture range of physical quantities
      - Other scenarios are within the bounds of identified EPECS scenarios

FGRS Phase GridView 1 Matrix

Describes 34 Scenarios Reading "Down and Across"

	(Resource 1) OSW 8,000 MW DER 18,000 MW	(Resource 2) OSW 8,000 MW DER 25,000 MW	(Resource 3) OSW 17,000 MW DER 31,000 MW
(Load 1) Buildings 9,600 GWh Transport 7,300 GWh	**(5 Scenarios) Matrix Scenario 1 plus Alternatives A, C, D and E**	(3 Sensitivity Scenarios) Scenario 1 (Resource 2 and Load 1) Scenario 2 (Resource 2 and Load 1) Scenario 3 (Resource 2 and Load 1)	(3 Sensitivity Scenarios) Scenario 1 (Resource 3 and Load 1) Scenario 2 (Resource 3 and Load 1) Scenario 3 (Resource 3 and Load 1)
(Load 2) Buildings 6,600 GWh Transport 18,500 GWh	(3 Sensitivity Scenarios) Scenario 1 (Resource 1 and Load 2) Scenario 2 (Resource 1 and Load 2) Scenario 3 (Resource 1 and Load 2	**(5 Scenarios) Matrix Scenario 2 plus Alternatives A, C, D and E**	(3 Sensitivity Scenarios) Scenario 1 (Resource 3 and Load 2) Scenario 2 (Resource 3 and Load 2) Scenario 3 (Resource 3 and Load 2)
(Load 3) Buildings 38,900 GWh Transport 37,500 GWh	(3 Sensitivity Scenarios) Scenario 1 (Resource 1 and Load 3) Scenario 2 (Resource 1 and Load 3) Scenario 3 (Resource 1 and Load 3	(3 Sensitivity Scenarios) Scenario 1 (Resource 2 and Load 3) Scenario 2 (Resource 2 and Load 3) Scenario 3 (Resource 2 and Load 3)	**(6 Scenarios) Scenario 3 plus Alternatives A, B, C, D and E**

EPECS Matrix

Describes 8 Scenarios of Most Interest

	(Resource 1) OSW 8,000 MW DER 18,000 MW	(Resource 2) OSW 8,000 MW DER 25,000 MW	(Resource 3) OSW 17,000 MW DER 31,000 MW
(Load 1) Buildings 9,600 GWh Transport 7,300 GWh	**(1 Scenario) Matrix Scenario 1**		(1 Scenario) Scenario 3 (Resource 3 and Load 1)
(Load 2) Buildings 6,600 GWh Transport 18,500 GWh		**(1 Scenario) Matrix Scenario 2**	
(Load 3) Buildings 38,900 GWh Transport 37,500 GWh	(1 Scenario) Scenario 1 (Resource 1 and Load 3)		**(4 Scenarios) Scenario 3 plus Alternatives B, D and E**

Phase 1 Studies Recommendations

Assumptions for both GridView and EPECS

System Topology

- New England interface flows will be compared against FCA 15 limits for quantifying transmission flows exceedances (except Surowiec South which will have a limit of 2,500 MW).
- Conceptual high-level transmission build-outs will be evaluated against constrained transmission system limits
  - Quantify benefit of conceptual high-level transmission build-outs
    - Investigate three main matrix scenarios first
    - Additional matrix and alternate scenarios as warranted

Phase 1 Studies Recommendations, cont.

Assumptions for both GridView and EPECS

Load-Related Assumptions

- Weather years for base load pattern and Variable Energy Resources (VERs)
  - 2019 for Matrix Scenarios 1-3
  - Historical 2012 & 2015 one-minute resolution ISO load data is no longer available
  - 2019 may be best “jumping off” weather year because
    - High PV penetration
    - Load volatility on one-minute time scale encapsulates high PV penetration
  - Translation of Matrix Scenarios 1, 2 and 3 load shapes to 2019 weather required

Phase 1 Studies Recommendations, cont.

Assumptions for both GridView and EPECS

Battery Energy Storage Systems (BESS) Related Assumptions

- Installed batteries will be divided into 25 independent BESS resources per RSP area (325 total)
  - Located at unconstrained busses in each RSP area (345kV)
  - BESS distributed by RSP share of New England load
  - No explicitly represented co-located BESS and solar / wind
    - Any constraints imposed by co-location can only reduce system-wide benefits
  - BESS characteristics
    - Equal amounts (25% each) of one, two, four and eight hour batteries
    - A one-hour battery is able to discharge its full output over only one hour whereas an eight-hour battery can discharge its energy at full output for eight hours
    - Round trip storage efficiency of 86 percent

BESS Characteristics

Assumption	Matrix Scenario 1	Matrix Scenario 2	Matrix Scenario 3	A Bi-Directional Transmission	B Vehicle to Grid	C Nuclear Retirement	D 100% Clean Electricity	E Onshore / Offshore Grids
Amount Inverter MW	Existing 600 + 1,400	Existing 600 + 3,340	Existing 600 only*	Same as Parent	Add 100,000	Same as Parent	77,700	77,700
Energy (MWh)	7,500	12,525	2,250	Same as Parent	Add 200,000	Same as Parent	2,393,000	2,393,000

Note: "Parent" refers to the scenario to which the alternative is applied. For example when, Alternative Scenario C ("Nuclear Retirement") is applied to Matrix Scenario 1, Matrix Scenario 2 and Matrix Scenario 3 the amount of batteries will be determined by the assumptions for batteries in Matrix Scenario 1, Matrix Scenario 2 and Matrix Scenario 3, respectively.

* Significant energy storage capability assumed via flexible EV charging

Reference: Modeling of Battery Storage in Economic Studies, December 16, 2020
https://www.iso-ne.com/static-assets/documents/2020/12/a9_modeling_of_battery_storage_in_economic_studies.pdf

Phase 1 Studies Recommendations, cont.

Assumptions for both GridView and EPECS

- Alternative Scenarios D and E envision only VERS, BESS and ties
  - All carbon emitting resources retired
  - Current modeling practice excludes “bidding strategies”
  - Need to proceed cautiously with the analyses for these scenarios as GridView and EPECS may produce unexpected metrics with this configuration
    - Proposed assumptions expected to be outside “comfort” range of the software
    - Modifications, given stated goal of these alternative scenarios, may be required

Duration	Inverter (MW)	Energy (MWh/MW)	Storage (MWh)
4 hour	7,000	4	28,000
8 hour	10,000	8	80,000
36 hour	60,700	36	2,185,000
Total	**77,700**	-	**2,293,000**

Phase 1 Studies Recommendations, cont.

Assumptions for both GridView and EPECS

- Unless specified otherwise, PV will be added to each RSP area as follows
  - Allocated to states based on the Draft 2021 CELT Photovoltaic (PV) Forecast
  - Within states with multiple RSP areas, allocation will be by the fraction of RSP load

Reference: Draft 2021 Photovoltaic (PV) Forecast, February 22, 2021
https://www.iso-ne.com/static-assets/documents/2021/02/draft_2021_pv_forecast.pdf

Summary of Interchange With Neighboring Systems

Assumptions for both GridView and EPECS

Assumption	Matrix Scenario 1	Matrix Scenario 2	Matrix Scenario 3	A Bi-Directional Transmission	B Vehicle to Grid	C Nuclear Retirement	D 100% Clean Electricity	E Onshore / Offshore Grids
Ties	NB, HQ PHII, HG, NECEC	NB, HQ PHII, HG, NECEC	NB, HQ PHII, HG, NECEC and NY	Same as Parent	Same as Parent	Same as Parent	Same as Parent	Same as Parent
Bidirectional	No	No	Yes	Yes	Same as Parent	Same as Parent	Same as Parent	Same as Parent
Additions	n/a	1000 MW QU-CMA	1200 MW QU-CMA plus 450 MW to NY	Unconstrained HVDC to CMA	Same as Parent	Same as Parent	Same as Parent	Same as Parent
Base Flow	Historical Profile	Historical Profile	Historical Profile	Same as Parent	Same as Parent	Same as Parent	Same as Parent	Same as Parent
New Ties	Use Rating	Use Rating	Use Rating	Use Rating	Same as Parent	Same as Parent	Same as Parent	Same as Parent

Threshold Price Recommendations

Assumption for GridView Simulations

Bi-directional threshold prices assumed to reflect the value of RECs:

- Curtail imports first, then trigger exports, and only curtail renewables when export capability is exhausted
- Can be referred to as "REC Inspired"
- Prices may be adjusted, will be used in Scenarios 2&3

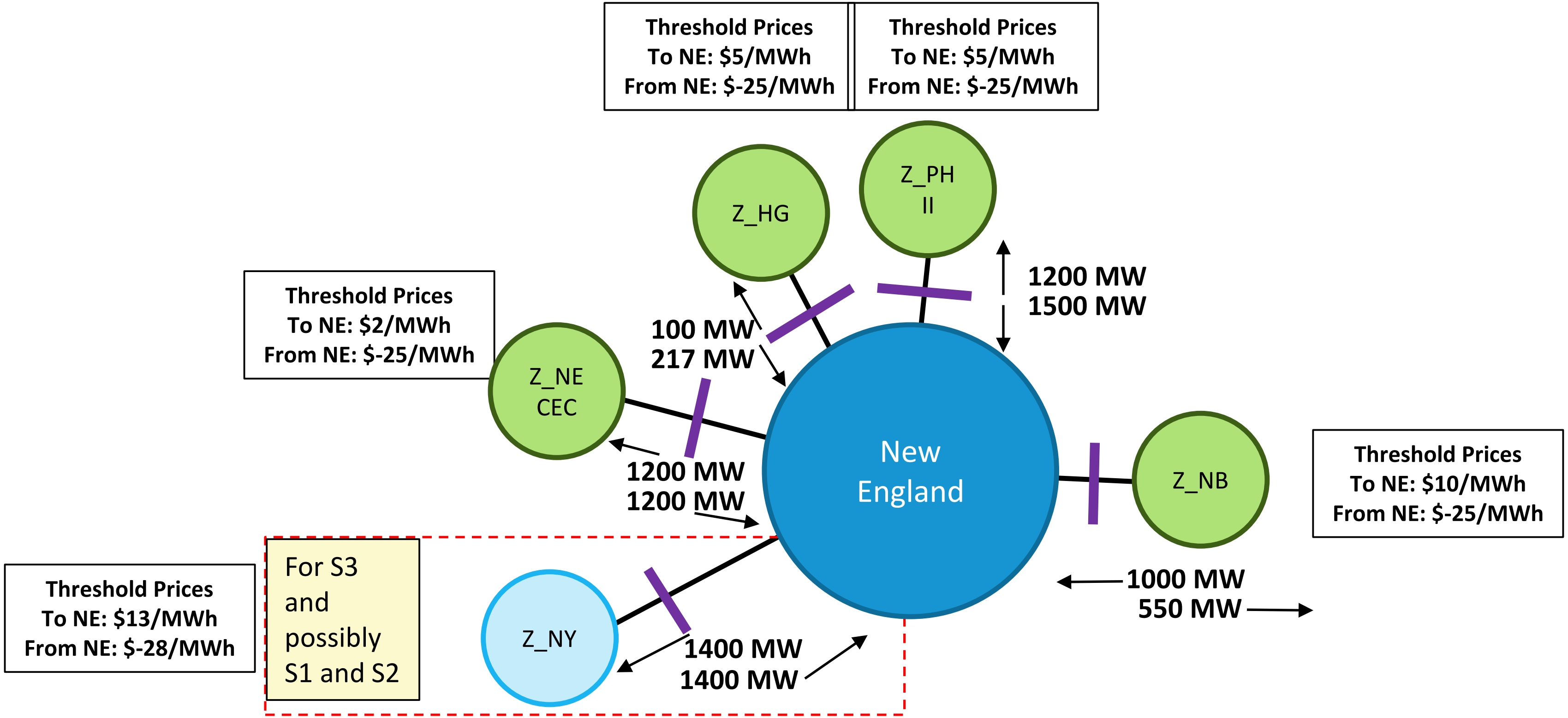
Price-Taking Resource	Threshold Price ($/MWh)
Behind-the-Meter PV	-100
FCM and Energy-only PV	-50
Offshore Wind	-40
Onshore Wind	-30
Trigger for Exports to New York	-25
Trigger for Exports to Canada	-25
NECEC (1090 MW)	2
Imports from Existing HQ	5
Imports from NB	10
Imports from New Ties	11
Imports from Second New Ties	12
Imports from NY	13

Threshold prices are used to facilitate the analysis of load levels where the amount of $0/MWh resources exceeds the system load

- They are not indicative of "true" cost, expected bidding behavior or the preference for one type of resource over another
- Use of a different order for threshold prices than indicated will produce different outcomes, particularly curtailment by resource

Bi-directional Model With NY Added

Assumptions for both GridView and EPECS



Import Priority Threshold Prices

Threshold Prices Prioritizing Imports:

- Triggers exports, curtail renewables when export capability is exhausted. Imports are must run
- Referred to as "Import Priority"
- Used previously in the 2020 Economic Study Sensitives.
- Will be used for Scenario 1.

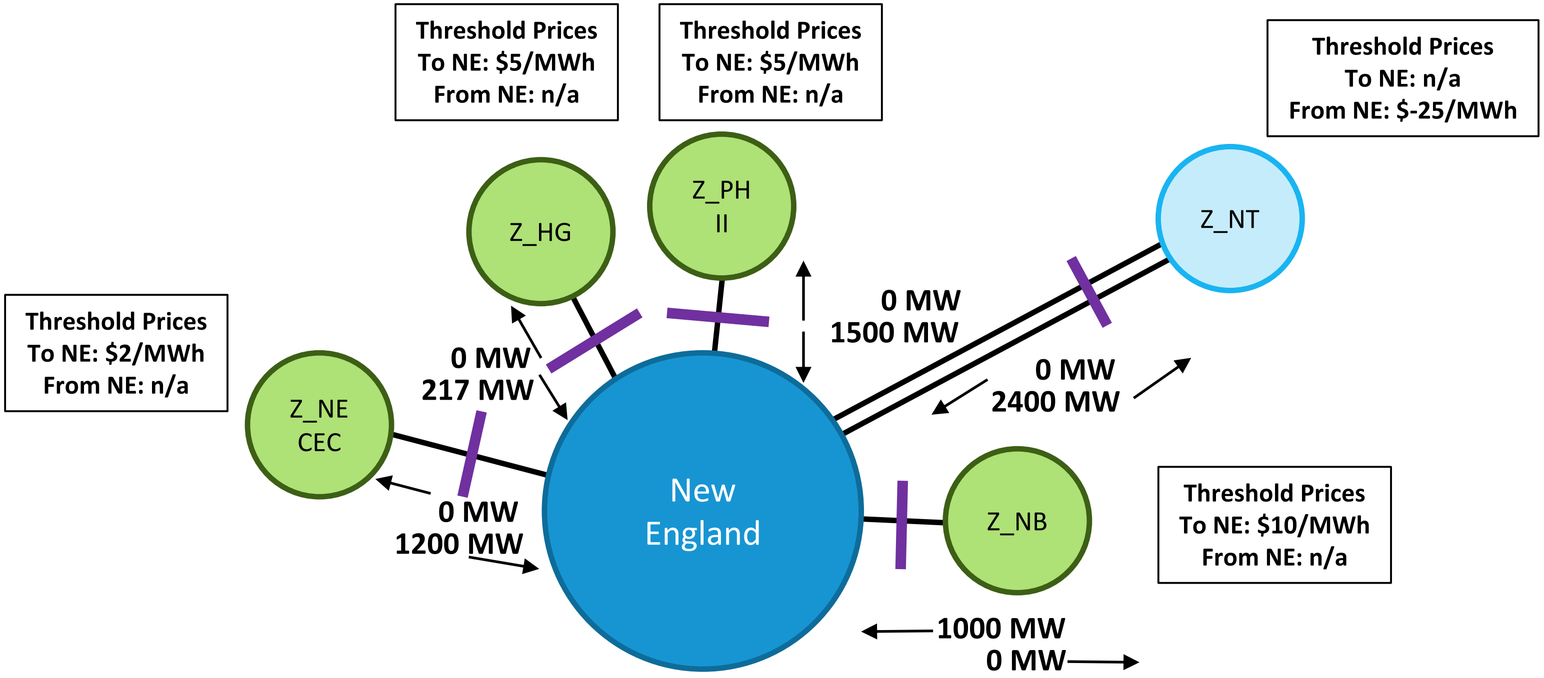
Price-Taking Resource	Threshold Price ($/MWh)
Behind-the-Meter PV	-100
NECEC	-99
Imports from Canada over Existing Lines	-50
FCM and Energy-only PV	-45
Offshore Wind	-40
Onshore Wind	-35
Trigger for Exports on New Line	-25
Imports on New Tie Line	-5

Threshold prices are used to facilitate the analysis of load levels where the amount of $0/MWh resources exceeds the system load

- They are not indicative of "true" cost, expected bidding behavior or the preference for one type of resource over another
- Use of a different order for threshold prices than indicated will produce different outcomes, particularly curtailment by resource

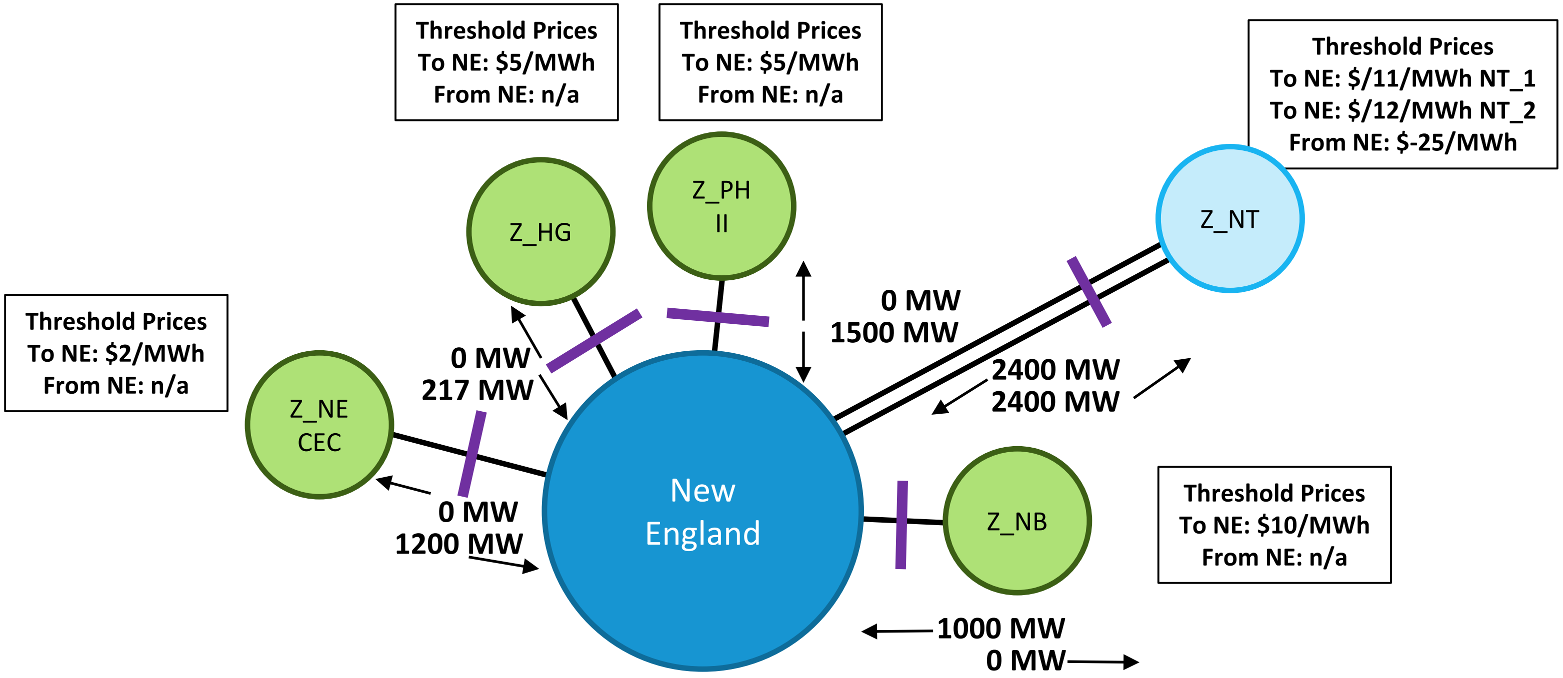
Bi-directional Model Alternative “A” – Step 1

Alternative Scenario A

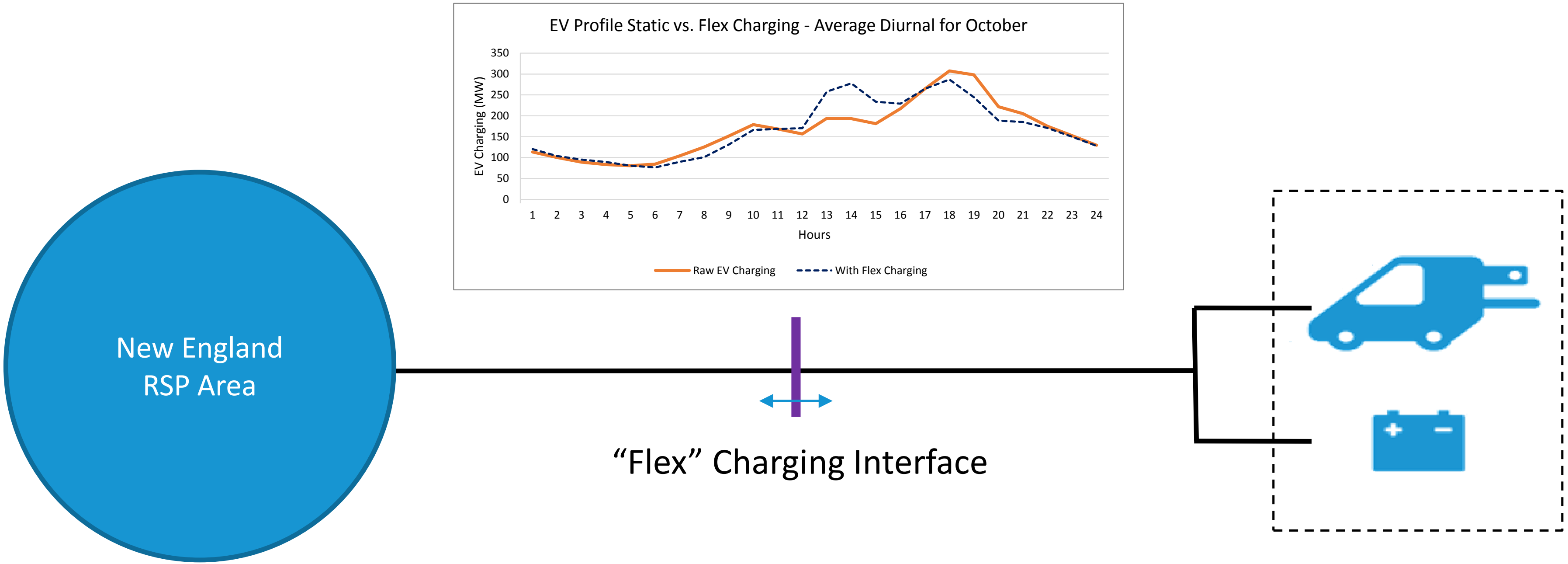


Bi-directional Model Alternative "A" – Step 2

Alternative Scenario A



EV Charging Model: Flows Across Flex Interface



FGRS Matrix Scenario – EV Assumptions

Reduce the Inverter MW so that no energy onto grid as appropriate

	Matrix Scenario Assumptions				Flex Model Assumptions		
Scenario	Number of Vehicles (Million)	Total EV Peak Charging (MW)	Total EV Battery Storage (MWh) *	EV/battery "Inverter" (MW)	EV/Battery Capacity (MWh)	Mode
Matrix Scenario 1	2.2	1,817	180,400	909	3,634	Modify Charging
Matrix Scenario 2	3.7	3,578	303,400	1,789	7,156	Modify Charging
Matrix Scenario 3	7.9	14,714	647,800	7,357	29,428	Modify Charging
Alt Scenario B	7.9	14,714	647,800	100,000	200,000	Vehicle-to-Grid

* Total EV Battery Storage (MWh) based on 82 kWh/vehicle

Summary of Electric Vehicle Load

Assumption	Matrix Scenario 1	Matrix Scenario 2	Matrix Scenario 3	A Bi-Directional Transmission	B Vehicle to Grid	C Nuclear Retirement	D 100% Clean Electricity	E Onshore / Offshore Grids
Peak Charging Load	1,817 MW	3,578 MW	14,714 MW	Same as Parent	Same as Parent	Same as Parent	Same as Parent	Same as Parent
Charging Energy	7.3 TWh	18.5 TWh	40 TWh	Same as Parent	Same as Parent	Same as Parent	Same as Parent	Same as Parent
Operation	Flexible Delay Charging	Flexible Delay Charging	Flexible Delay Charging	Same as Parent	100 GW of 2 hour storage acting as battery	Same as Parent	Same as Parent	Same as Parent

Reference: Developing a GridView Flexible Electric Vehicle Charging Model, February 26, 2021, https://www.iso-ne.com/static-assets/documents/2021/02/a03c_ev_penetration_and_modeling_2021_02_26.pdf

Summary of Heating Electrification Load

Assumption	Matrix Scenario 1	Matrix Scenario 2	Matrix Scenario 3	A Bi-Directional Transmission	B Vehicle to Grid	C Nuclear Retirement	D 100% Clean Electricity	E Onshore / Offshore Grids
Peak Load	5,214 MW	2,991 MW	23,244 MW*	Same as Parent	Same as Parent	Same as Parent	Same as Parent	Same as Parent
Energy	9.6 TWh	6.6 TWh	42.6 TWh*	Same as Parent	Same as Parent	Same as Parent	Same as Parent	Same as Parent
Load Shape	Based on hourly temp	Based on hourly temp	Specified	Same as Parent	Same as Parent	Same as Parent	Same as Parent	Same as Parent

* Sum of residential and commercial profiles for water heating (13.6 TWh) and space heating (29.0 TWh)

EPECS SPECIFIC ASSUMPTIONS

Background for Phase 1 Studies Using EPECS

EPECS simulator consists of four simulation layers addressing different user-defined time scales. The four layers and time scales currently used are:

Step	Description of Layer
SCUC	Day-ahead resource scheduling as a security-constrained unit commitment)
RTUC	Four-hour-ahead, real-time security-constrained resource scheduling as a real-time unit commitment
SCED	Fifteen-minute-ahead, real-time balancing as a security-constrained economic dispatch
Real-Time	Real-time physical power flow with integrated regulation service using one-minute time steps

Phase 1 Studies Recommendations

Assumptions for EPECS

- Time steps and horizons to be used

Layer or Parameter	Time Step	Horizon
SCUC	1 hour	24 hours
RTUC	15 minutes	4 hours
SCED	10 minutes	10 minutes

Phase 1 Studies Recommendations, cont.

Assumptions for EPECS

- Forecast error for wind, solar, and load will be the same as previous EPECS simulations and applied to all scenarios

Forecast Error Statistics			
	Load	Wind	Solar
SCUC	1.65%	12.00%	7.00%
RTUC	1.50%	3.00%	3.00%
SCED	0.15%	3.00%	3.00%

- Daily diurnal profiles will be used to represent hydro generation
  - Hydro dispatch within EPECS has not been upgraded
  - Daily diurnal approach will minimize effect of hydro on performance metrics

Phase 1 Studies Recommendations, cont.

Assumptions for EPECS

- Grid-facing storage
  - All storage dispatched in SCUC, RTUC, SCED layers
  - If feasible, one quarter assumed available to respond to regulation (real-time)
- Electric Vehicles flexible charging, ISO-NE will explore using:
  - One quarter of flex-charging MW amounts will be available in SCUC, RTUC, SCED layers
  - One eighth of flex-charging MW amounts assumed available to respond to regulation (real-time)

Phase 1 Studies Recommendations, cont.

Assumptions for EPECS

- Curtailment of VERs
  - "Do not exceed limits" will not be used to limit reserve fluctuations
  - If used, overall variability would be reduced at the expense of curtailed energy
- The model will attempt to minimize regulation reserve exceedances and system imbalance through re-dispatch

Questions

MARS SIMULATIONS

Study Plan

Objectives

MARS Simulations

- Identify major assumptions for the GE Multi-Area Reliability Simulation (MARS) model used for:
  - Resource Adequacy Screen
  - Probabilistic Resource Availability Analysis
- Discuss high-level modeling considerations, modeling options, and ISO’s recommendations
- Seek stakeholders’ feedback

MAJOR ASSUMPTIONS FOR GE MARS

Resource Adequacy Screen and Probabilistic Resource Availability Analysis

Load Model

MARS Simulations

- The loads will be modeled similar to current Installed Capacity Requirement (ICR) calculations. See Market Rule 1, Section 12
  - Three components of load explicitly modeled as base load or load addition/reduction (modeling details in subsequent slides)
    - Base Load
      - Exclude reductions from Passive Demand Capacity Resources (Energy Efficiency) that are modeled as resources
      - Exclude reductions from BTM-PV that are modeled as separate load component
      - Exclude additions associated with forecasts of transportation electrification load that are modeled as separate load component
      - Include additions associated with forecasts of heating electrification load - air-source heat pumps (ASHP)
    - Transportation Electrification Load (addition to Base Load)
    - BTM-PV Load (reduction to Base Load)
  - Battery charging load
    - Not considered in the past Forward Capacity Auction (FCA) ICR calculations
    - See slide 44 of this presentation for additional modeling

Load Model, cont.

MARS Simulations

- Base Load
  - Use an hourly load shape by Regional System Plan (RSP) subareas with assumed load forecast uncertainty (hourly load varies higher or lower with associated probabilities of occurrence)
  - The ISO recommends to use a composite hourly shape for FGRS MARS studies
    - 2002 weather for summer and 2003/2004 weather for winter
    - Considered representative for resource adequacy studies by NPCC and used for its seasonal assessments
      - Have heat waves in 2002 summer and cold snaps in 2003/2004 winter and multiple days exposure to seasonal peaks
  - Hourly load shape will be scaled to projected target forecasts
    - The shape of heating load component associated with the ASHP is scaled to the adoption target specified for each Matrix and Alternative Scenario
    - The shape of non-heating load component to be extrapolated to 2040 from 2021 CELT
    - Above two shapes are then aggregated into a single load shape
  - The ISO recommends to use FCA 16 Load forecast uncertainty assumptions (based on 25 years of weather history) with adjustment for the winter months to account for additional volatility associated with ASHP load

Load Model, cont.

MARS Simulations

- Transportation Electrification Load
  - An addition to Base Load using a deterministic hourly profile by RSP subareas
  - Use the hourly charging profile provided for each Matrix and Alternative Scenario
  - The ISO is considering using a net hourly charging profile that can be developed from the production cost results to reflect the flexible charging

- BTM-PV Load
  - A reduction to Base Load using an hourly profile by RSP subareas with uncertainty incorporated
  - Hourly profile will be based on the same weather year for Base Load (2002 weather for summer and 2003/2004 weather for winter)
  - Uncertainty will be modeled by randomly selecting a daily profile within a 7-day window (+/-3 days) for the day under study
    - The ISO is willing to use a bigger window (e.g. +/- 7, or, +/- 15 days) to reflect higher degree of uncertainty if desired by the MC/RC

Resource Model

MARS Simulations

- Conventional thermal generation resources
  - Include all resources that cleared in FCA 15, while reflecting the assumed retirements specified for each Matrix and Alternative Scenario
  - Modeled in the same way as in the ICR calculations, using the Qualified Capacity ratings, and the availability parameters (EFORd, maintenance requirements)

Resource Model, cont.

MARS Simulations

- Wind resources
  - Resource Adequacy Screen Analysis
    - Existing wind resources to use ICR modeling methodology for Intermittent Power Resources (IPR), using their Qualified Capacity ratings at 100 percent availability
    - Future wind resources to also use ICR modeling methodology for IPR, using the capacity ratings as determined for new FCM wind resources based on current market rules. See Market Rule 1, Section 13
  - Probabilistic Resource Availability Analysis
    - Both existing and future wind resources will be modeled probabilistically using aggregated hourly profiles by RSP subareas
    - Recommend to have MARS to randomly select from multiple hourly profiles during the simulation to reflect the variable output under different weather conditions
      - 21 years (2001-2020) of DNV-GL historical profile data are available, will incorporate as many as possible to the extent computation capability allows
      - ISO recommends to use the lowest 10 wind output profiles to reflect extreme wind drought condition
  - After the March 26 MC/RC meeting, based stakeholder comments, the ISO recommends to clarify the language in the Framework document related to use of the DNV GL data for the MARS simulations

Resource Model, cont.

MARS Simulations

- PV resources (in front of meter resources)
  - Resource Adequacy Screen Analysis
    - Existing PV resources to use the ICR modeling methodology for IPR, using their FCA 16 Qualified Capacity ratings at 100 percent availability
    - Future PV resources to also use the ICR modeling methodology for IPR, using the capacity ratings as determined for new FCM PV resources based on current market rules
  - Probabilistic Resource Availability Analysis
    - Both existing and future PV resources will be modeled the same way as the BTM-PV, using an hourly profile by RSP subareas with uncertainty incorporated
    - Hourly profile will be based on the same weather year for Base Load (2002 weather for summer and 2003/2004 weather for winter)
    - Uncertainty will be modeled by randomly selecting a daily profile within a 7-day window (+/-3 days) for the day under study
      - The ISO is willing to use a bigger window (e.g. +/- 7, or, +/- 15 days) to reflect higher degree of uncertainty if desired by the MC/RC
    - The ISO recommends to incorporate an *artificial* hourly profile with a certain probability of occurring to reflect reduced output under an extreme weather condition (e.g. dust storm), for example
      - 90% of probability of using the above hourly profile based on the same weather year for load
      - 10% of probability of using an extreme profile without solar output for several consecutive days

Resource Model, cont.

MARS Simulations

- Demand resources
  - Passive demand resources
    - Both Resource Adequacy Screen Analysis and Probabilistic Resource Availability Analysis to use the projected seasonal peak load reduction values by RSP subareas at 100 percent availability as defined for FCA 16
  - Active demand resources
    - Both Resource Adequacy Screen Analysis and Probabilistic Resource Availability Analysis to use ICR modeling methodology for the active demand resources that cleared in FCA 15, using the Qualified Capacity ratings for FCA 16, and the availability parameters (EFORd, maintenance requirements) of FCA 16

Resource Model, cont.

MARS Simulations

- Imports
  - 1,200 MW capacity import over NECEC

Resource Model, cont.

MARS Simulations

- Battery Storage
  - Both Resource Adequacy Screen Analysis and Probabilistic Resource Availability Analysis use the same modeling
  - Battery discharging
    - Modeled as dispatchable daily energy limited resource
      - Assume one cycle per day
      - Dispatch as needed by the system
  - Battery charging load
    - Modeled as an addition to hourly load during predetermined off-peak hours
      - Use the production cost results to identify the off-peak hours for charging
  - For battery type with greater than 24 hour storage capacity
    - Alternative Scenario D
    - Modeling options are unavailable in MARS
    - Recommendation: Assumed as "perfect" capacity, available all the time (no EFORd)

Other Assumptions

MARS Simulations

Tie Benefits Assumptions

- Resource Adequacy Screen Analysis will use annualized FCA 15 tie benefits assumptions
- Probabilistic Resource Availability Analysis will use seasonal assumptions derived from the FCA 15 tie benefits assumptions
  - Although calculated as annualized values, FCA 15 tie benefits assumptions are simulated under the condition where New England system's expected LOLE risks and the need for emergency assistance occur only in the summer. FCA 15 tie benefits assumptions will be used in this study for the summer period.
  - FCA 15 New York tie benefits represents the assistance available from a similar-size system that peaks at the same time. It is mainly the result of the resource diversity, instead of the load diversity. This analysis assumes this summer amount of assistance continue to be available during the winter
  - FCA 15 tie benefits from Quebec and Maritimes are higher, driven by the seasonal load diversity during the summer. As the load diversity diminishes during the winter
    - This analysis assumes Quebec will only be able provide similar amount of assistance as New York from resource diversity
    - This analysis assumes Maritime will only be able to provide 25% of New York's amount due to smaller system

	Maritime Ties	Quebec Ties	New York Ties	Total
FCA 15 (MW)	454	1,023	258	1,735
Proposed seasonal values for FGRS (MW)	454 (S) 65 (W)	1,203 (S) 258 (W)	258 (S) 258 (W)	1,735 (S) 581 (W)

- Recommend to use no tie benefits during the winter because of widespread electrification and geographic reliance of VERS across a wide footprint as a sensitivity to a few scenarios

Other Assumptions, cont.

MARS Simulations

- OP-4 Load Relief from 5% voltage reduction
  - Resource Adequacy Screen Analysis
    - Use 1% of net peak (similar to current ICR calculation methodology)
  - Probabilistic Resource Availability Analysis
    - Recommend to assume no load relief from 5% voltage reduction to account for the increased uncertainties and challenges the high penetration of renewable resources introduce in the operation of the grid – voltage variation, frequency control, etc.

Other Assumptions, cont.

MARS Simulations

- Minimum operating reserve requirement
  - Resource Adequacy Screen Analysis
    - Assume 700 MW as currently used in ICR calculations
  - Probabilistic Resource Availability Analysis
    - An Approach is yet to be decided
    - The ISO will consider results of the EPECS Ancillary Services Simulations, and consult with MC/RC before making a final assumption recommendation

Other Assumptions, cont.

MARS Simulations

- System topology
  - Internal transmission interface limits are not enforced
  - Interface flow statistics will be compared against FCA 15 limits (except Surowiec South which will have a limit of 2,500 MW)

Other Assumptions, cont.

MARS Simulations

- Proxy units
  - 150 MW grid connected battery storage resources for the first 1,000 MW
  - 100 MW CT units afterward

Questions

NEXT STEPS

Next Steps

- The ISO will continue to review the Framework document and associated assumptions, to identify additional areas for clarification as they start to build their GridView and EPECS models
  - Preliminary GridView results for Scenario 1 including Sensitivities and relevant Alternative Scenarios to be presented in June to PAC
  - EPECS preliminary results expected in late summer
  - MARS simulations will commence later in 2021 with results closer to year end
- On March 12, NEPOOL submitted the FGRS Phase 1 work as a 2021 Economic Study Request
  - Discussions will be a PAC over the next few months
  - Upcoming PAC milestones are outlined below

Milestone	Dates
Stakeholder presentation materials are due to ISO	April 8 by Noon
Stakeholders present their requests to PAC	April 14
PAC to discuss the requests	May 19

Questions