Future Grid Reliability Study

Status Update, Discussion, and Feedback

Peter Flynn, November 12, 2020, Revision 1

Overview

- Agenda is to review:
  - the study scope
  - major areas of analysis
  - a phased approach
  - a matrix approach with:
    - nine scenarios
    - and alternative cases
  - assumptions that require additional consideration and
  - next steps

Purpose

- To discuss and affirm consensus wherever possible on the major study areas, the phased approach, the matrix and alternative scenarios, and the approach to populating assumptions
- We're aiming to come together and agree on as much as possible to expedite this process

Our Scope: The First 3 Bubbles

Objective

Assess and discuss future state of the regional power system in light of current state energy and environmental policies

Study Process to Define and Assess Future State of Regional Power System

1. Identify Resource Mix in [Year]
2. Identify Resource & Operational/Reliability Needs

**Assumptions, future scenarios, etc. to be developed within stakeholder process*

Gap Analysis

As part of study process, conduct a gap analysis to determine whether, in the future state envisioned, the markets (current design plus ESI) provide resources/ISO-NE what they need to continue to reliably operate the system? If not, what market deficits need to be addressed to assure reliability?

Discuss Potential Market Approach(es) to Address Gap(s)

Based on study results/gap analysis, explore potential market approaches to address any future gaps identified in the prior step, including evaluation of the pros/cons of different approaches and discussion of how any such market approach contemplates state energy and environmental laws

Major Areas of Analysis

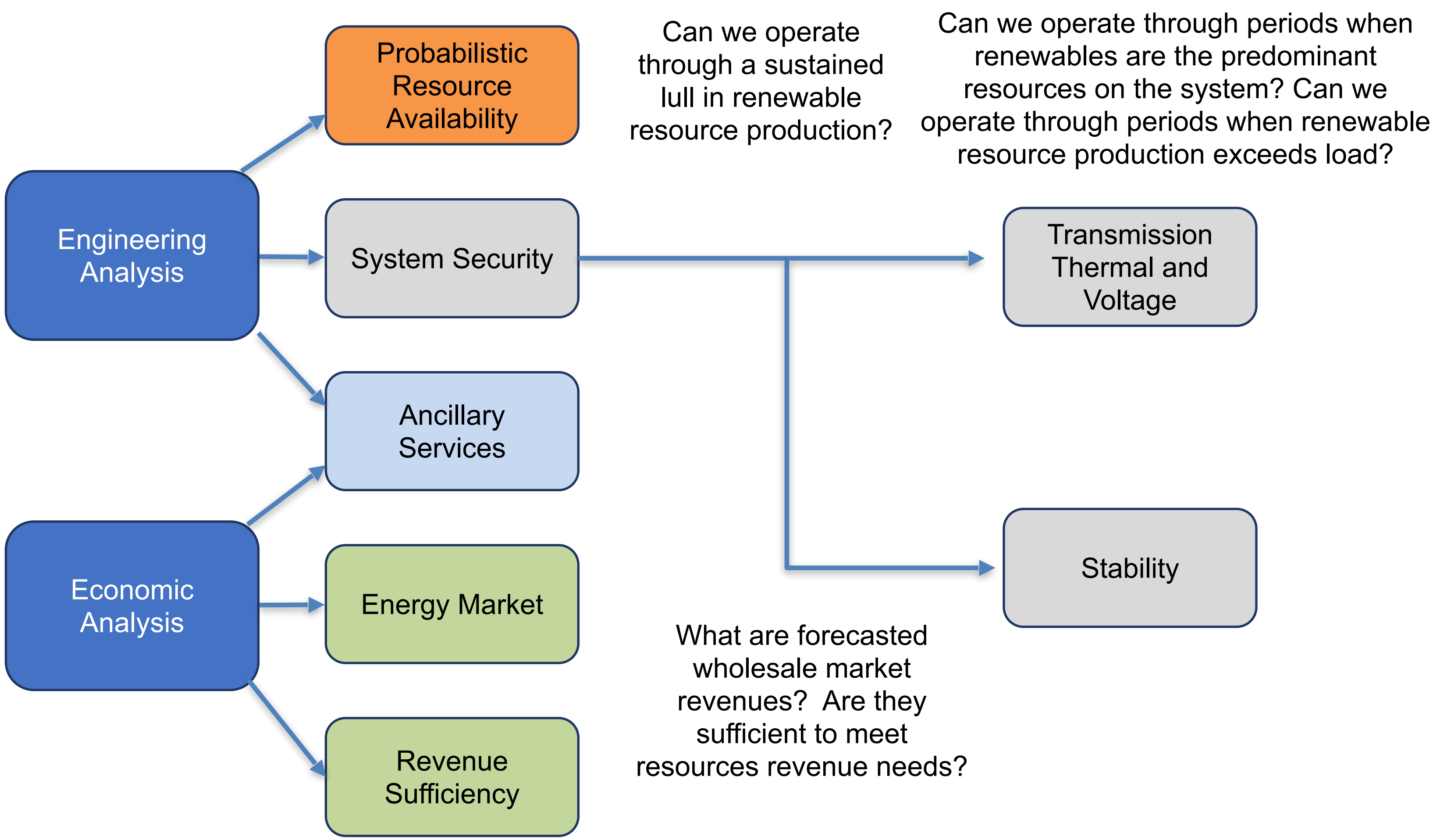
Observations, Study Areas

General Observations

- Future Grid Study is a set of analyses using different models. No single model can address the range of issues stakeholders want to study

- Analyses should be in a logical sequence with results from one stage informing decisions in subsequent stages

Study Areas



Engineering Analysis
Economic Analysis
Probabilistic Resource Availability
System Security
Ancillary Services
Energy Market
Revenue Sufficiency
Can we operate through a sustained lull in renewable resource production?
Can we operate through periods when renewables are the predominant resources on the system? Can we operate through periods when renewable resource production exceeds load?
Transmission Thermal and Voltage
Stability
What are forecasted wholesale market revenues? Are they sufficient to meet resources revenue needs?

Economic Analysis

- What are forecasted wholesale market revenues? Are they sufficient to meet resources revenue needs?
  - Energy Market
  - Ancillary Services
  - Revenue Sufficiency

Engineering Analyses

- What conditions will likely present operational or reliability issues? Can we operate through periods when renewables are the predominant resources on the system? Can we operate through periods when renewable resource production exceeds load? Can we operate through a sustained lull in renewable resource production?
  - Ancillary services
  - Probabilistic resource availability
  - System security
    - Transmission thermal and voltage
    - Stability

Suggested Study Order

- Phase 1 (studies to be performed sequentially, but then iterate among them based on results)
    1. Energy market simulation (Production Cost)
    2. Ancillary services simulation
    3. Probabilistic resource availability
- Phase 2 (studies can be performed in parallel)
    - Revenue sufficiency
    - System security
        - Transmission thermal and voltage
        - Stability
- **Consensus point:** Do stakeholders agree with this phased approach?

Phase 1:

Energy Market Simulation, Ancillary Services Simulation, Probabilistic Resource Availability

Energy Market Simulation

Production Cost Simulation: GridView (ISO-NE capable)

- To show economic dispatches and energy market revenues for different scenarios
- Energy market revenues are needed to assess resource revenue sufficiency needs
- Economic dispatches provide useful information related to operational/reliability analyses and identify conditions upon which further operational/reliability analyses may focus (e.g., congestion)
- Analysis will provide data on system costs and power sector emissions for each scenario

Energy Market Simulation (cont.)

- GridView represents the New England system at an appropriate level to determine resource adequacy metrics for each scenario
  - Ties with New England: external interface flows are assumptions
  - Within New England: RSP zonal pipe-and-bubble representation of transmission topology
  - Net installed capacity requirement calculated using GE MARS
- Scenarios based on matrix approach described on slide 23
- **Consensus point:** Do stakeholders agree with this energy market simulation?

Ancillary Services Simulation

EPECS (ISO-NE capable and consultant) or other sub-hourly high resolution model can:

  - Show if resources will provide the necessary amounts of ramping, regulation and reserves for the matrix scenarios
  - Show ancillary service market revenues for those scenarios
  - Adequate ramping, regulation and reserves are needed for reliable system operation
  - Ancillary service market revenues are needed to assess resource needs

- Augments production cost analyses using GridView's external interface zone assumptions and internal RSP zonal pipe-and-bubble model, but could consider a limited set of scenarios at a more granular level
- Ensure internally consistent results with the GridView energy market analysis
- **Consensus point:** Do stakeholders agree with this ancillary services simulation?

Probabilistic Resource Availability

- A time series approach to probabilistic resource availability to determine what periods of time and conditions may not meet established reliability criterion thresholds using GE MARS or a similar model (ISO-NE capable)
  - A traditional GE MARS analysis of reliability using some of the scenarios that are studied
  - Some extreme change cases will look at low probability, high impact cases such as loss of wind for x days

Probabilistic Resource Availability (cont.)

- GE MARS is built with transmission constraints. Ignoring internal transmission constraints (a “single bus” or “copper sheet” approach) would require modifying the existing model
- Propose that we review and update as appropriate resource adequacy assumptions for intermittent resources and on-peak demand resources
- Potential for energy market and ancillary services iterations to ensure reliability criterion thresholds are met
- **Consensus point:** Do stakeholders agree with this approach?

Phase 2:

Revenue Sufficiency and System Security

Revenue Sufficiency

- Use a consultant
  - Compare revenues from energy market and ancillary services simulations to resource costs by technology type
  - Look to consultant to develop resource cost estimates
  - Present results in appropriate metrics (e.g., $/kW-month, $/year)
- **Consensus point:** Do stakeholders agree with this revenue sufficiency approach?

System Security: Transmission Thermal and Voltage

- Use PSS/E or similar model
  - Use a consultant
  - Joint MC/RC picks a few representative cases from the scenario design matrix or the GridView, EPECS and GE MARS results
  - To screen the transmission system for thermal and voltage limits
  - Respecting thermal limits and maintaining voltage levels are operational and reliability requirements
  - Focus on identifying key areas that may need transmission reinforcement and unlock constraints so as to have secure cases on which to conduct the stability analysis
  - Not a transmission planning study. No optimization of solutions

System Security: Stability

Use PSS/E or similar model:

  - Use a consultant
  - Do a high-level screen to show whether the decline in rotating machines combined with the growth in inverter-based resources will result in stability issues
  - The analysis is needed because maintaining system stability is an operational and reliability requirement
- ISO advises starting with light load conditions and progressing to peak loads
- **Consensus point:** Do stakeholders agree with this system security approach?

Scenarios and Assumptions

Matrix approach, matrix and alternative scenarios, and populating assumptions

Matrix Approach

- For the energy market (GridView) and ancillary services (EPECS) simulations, suggest using a matrix approach with alternatives to represent a range of possible futures.
  - Multiple scenarios are fairly easy to run
  - Demonstrates a wide variety of results along a spectrum, as illustrated by the matrix x and y axes

Matrix Approach Plus Alternatives

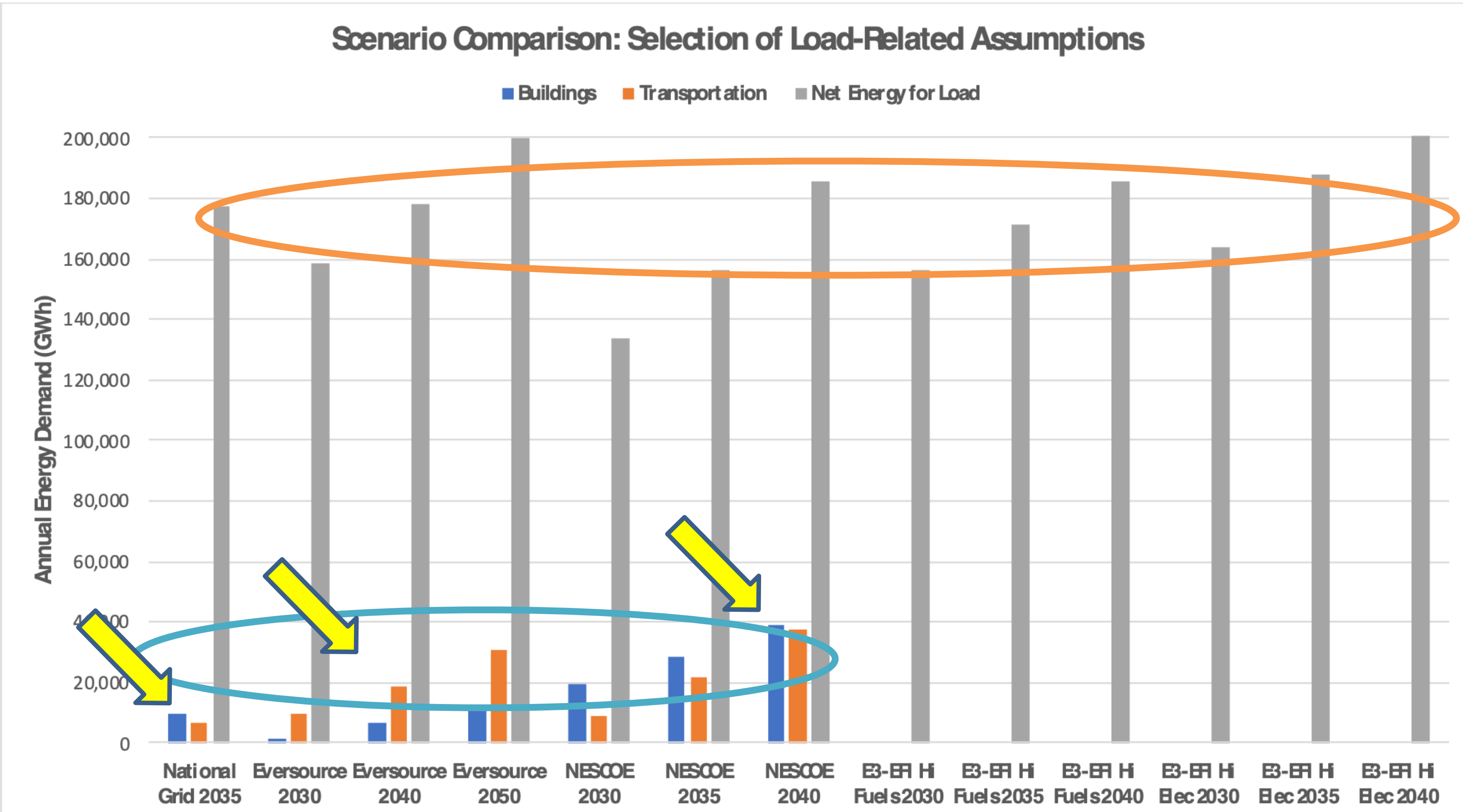
	Resource Mix 1	Resource Mix 2	Resource Mix 3
Load Level and Shape 1	Proposal A +Alternatives	1 Case	1 Case
Load Level and Shape 2	1 Case	Proposal B +Alternatives	1 Case
Load Level and Shape 3	1 Case	1 Case	Proposal C +Alternatives

Alternative Scenario Cases

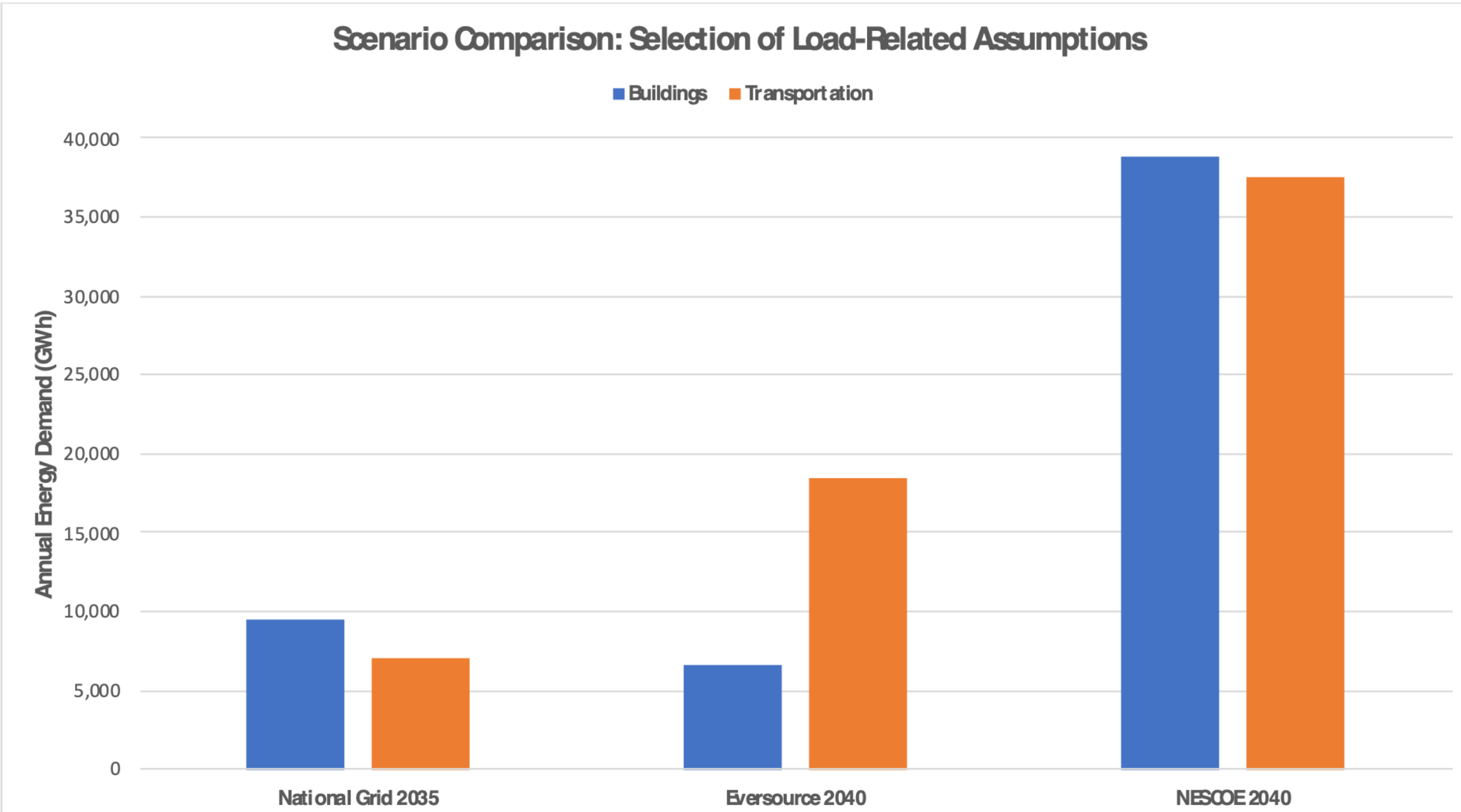
1. Alternative 1 Based on a Study Proposal
2. Alternative 2 Based on a Study Proposal
3. Alternative 3 Based on a Study Proposal
4. Alternative 4 Based on a Study Proposal
5. Alternative 5 Based on a Study Proposal
6. Alternative 6 Based on a Study Proposal
7. Alternative 7 Based on a Study Proposal

Energy Market and Ancillary Services Simulations:
9 Matrix Scenarios + 21 Alternative Scenarios = 30 Scenarios

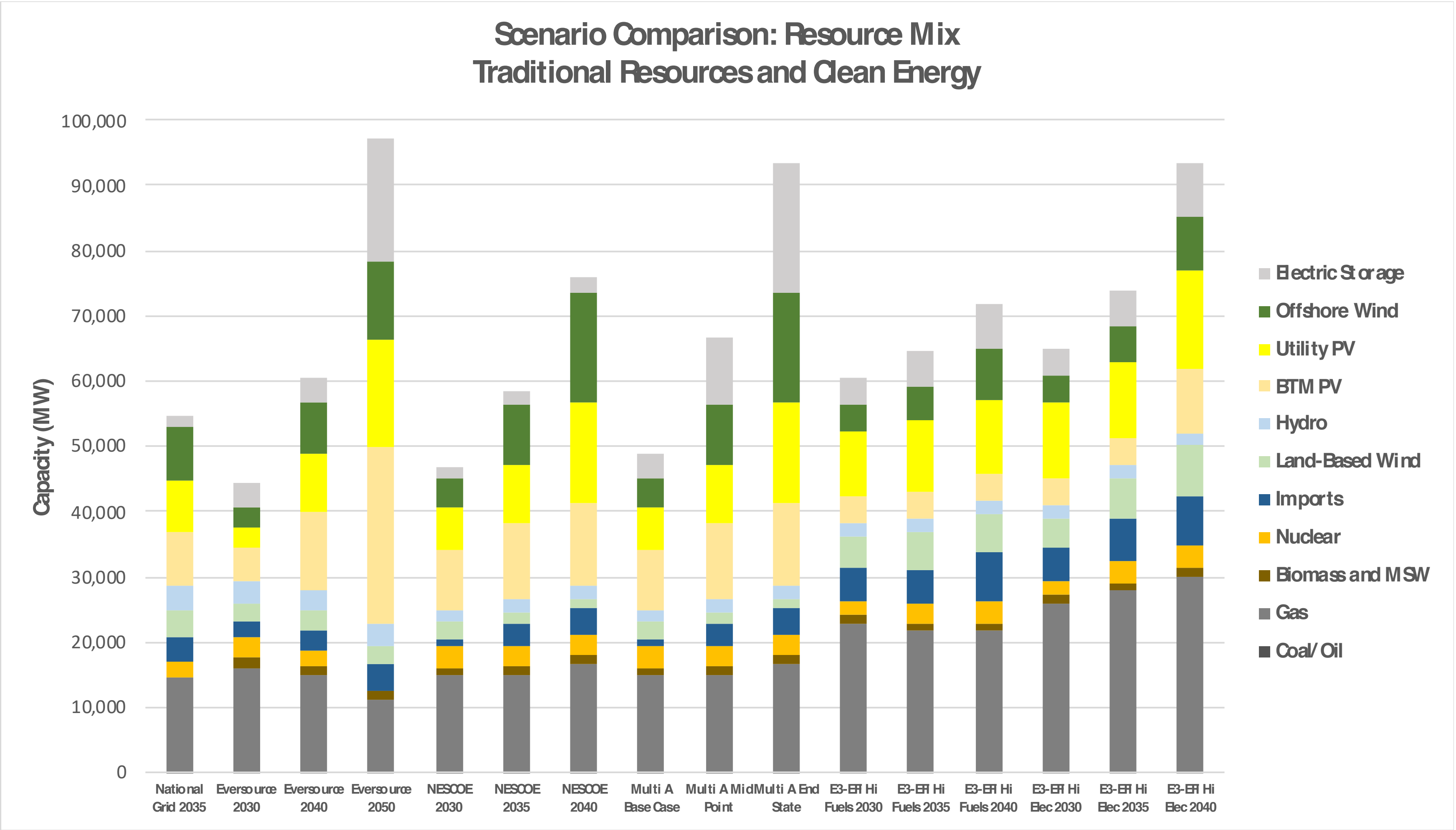
Selected Load-Related Assumptions



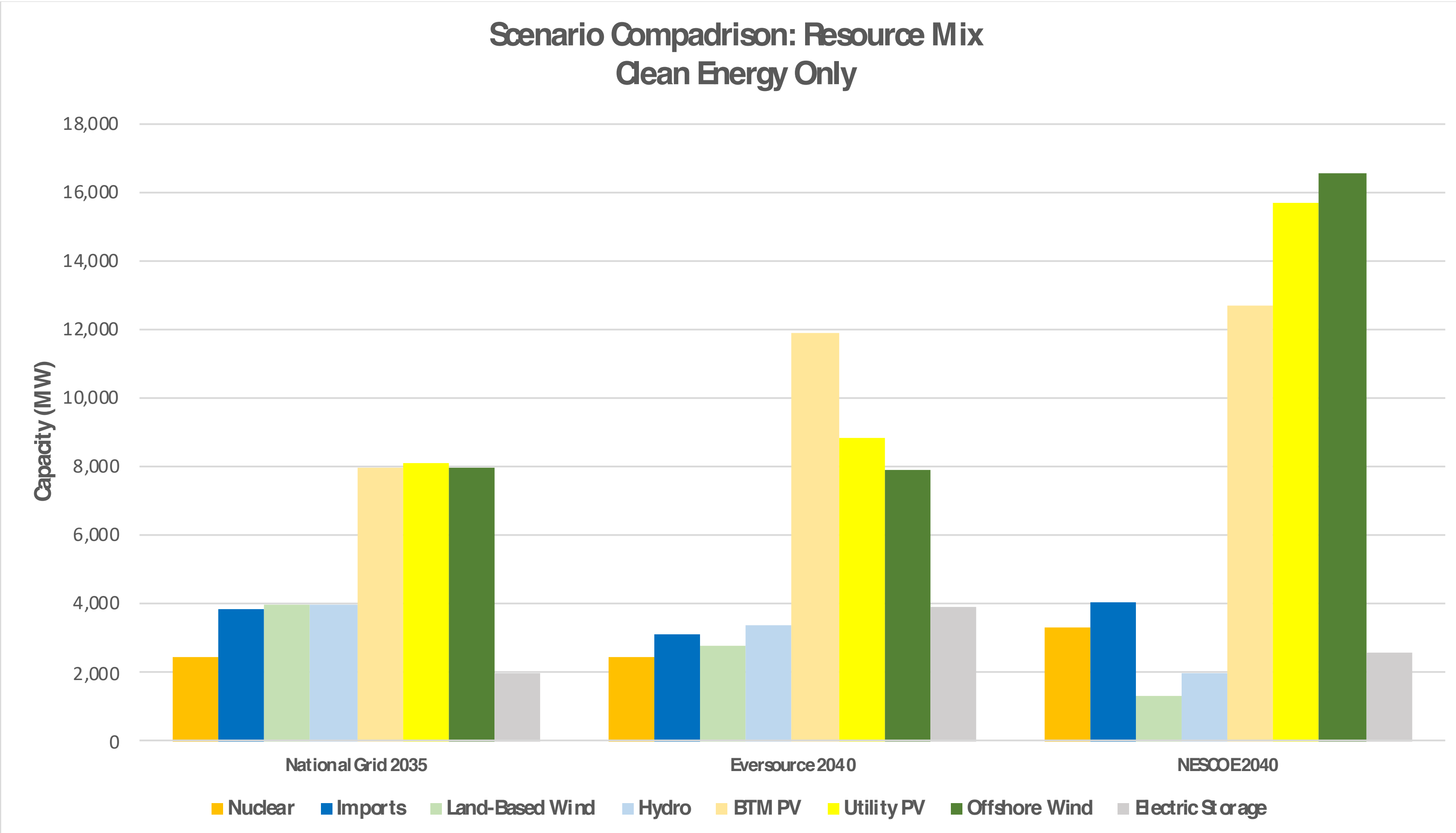
Selected Load-Related Assumptions



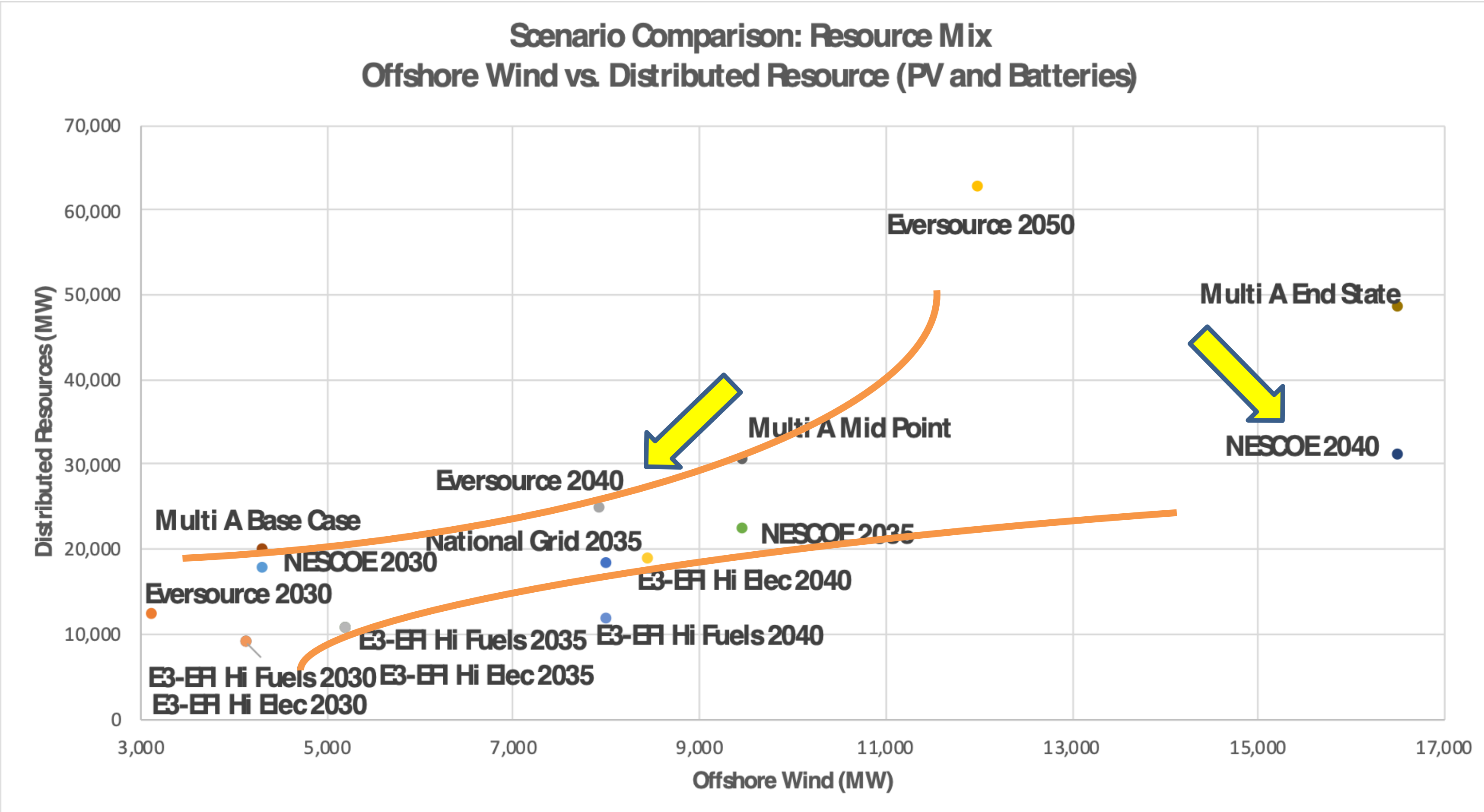
Resource Mix-Related Assumptions



Resource-Mix Related – Select Resources



Resource Mix-Related – Another Selection



Suggested Matrix Scenarios

	OSW 8,000 MW DER 18,000 MW	OSW 8,000 MW DER 25,000 MW	OSW 16,000 MW DER 30,000 MW
Buildings 9,500 GWh Transport 7,000 GWh	Nat Grid 2035 +Alternatives	1 Case	1 Case
Buildings 6,500 GWh Transport 18,500 GWh	1 Case	Eversource 2040 +Alternatives	1 Case
Buildings 40,000 GWh Transport 37,500 GWh	1 Case	1 Case	NESCOE 2040 +Alternatives

- Nine (9) matrix scenarios for the energy market (GridView) and ancillary services (EPECS) simulations based on submitted proposals

Suggested Alternatives to be Studied

In addition to the Matrix Scenarios

1. Storage – Increase Storage (see Multi Sector A)
2. Bi-Directional Transmission (see Nat Grid 2035)
3. Flexible Load / Vehicle to Grid (see Multi Sector A)
4. Energy Only / Capacity Network Interconnection (see Public Power)
5. Nuclear Retirement (see NextEra/Dominion)
6. On-shore and Off-Shore Grids (see Anbaric)
7. No constraints on building economic natural gas infrastructure (see API)

- Twenty-one (21) alternative scenarios for the energy market (GridView) and ancillary services (EPECS) simulations
- **Discussion Point:** Are all of these alternative scenarios within scope of the Future Grid project? Will they likely provide useful information not provided by other scenarios or past Economic Studies?
- **Consensus point:** Do stakeholders agree with this matrix approach?

Assumptions To Be Developed

Load	Gross Load
	Energy Efficiency
	Behind-the-Meter Distributed Energy Resources
	Storage
	Heating
	Transportation
Infrastructure	Transmission Topology / Interface Transfer Limits
Marginal Cost Inputs	Fuel Price Forecasts
	Seasonal Volatility Adjustments
	Emission Allowance Price Forecasts

Resource Portfolio	Existing resources
	Existing external ties
	Retirements
	Additions
	Dispatchable Resource Availability
	Profiled Resource Production / Weather Year / Effective Load Carrying Capability
	Active Demand Response
	Curtailment Prices
	Reserve Margin / Capacity Assessment
	Storage Approach

Assumptions To be developed (cont.)

		Nat Grid 2035	Eversource 2040	NESCOE 2040
Model		ABB GridView		
Cases/ Scenarios/ Sensitivities		30 Cases – See Matrix and Descriptions Above		
Resolution		Pipe-and-Bubble – RSP Zones of New England		
Year(s)		2035	2040	2040
Assumptions				
Load	Gross Load			
	Energy Efficiency			
	Behind-the-Meter Distributed Energy Resources			
	Storage			
	Heating			
	Transportation			
Infrastructure	Transmission Topology / Interface Transfer Limits			
Resource Portfolio	Existing resources			
	Existing external ties			
	Retirements			
	Additions			
	Dispatchable Resource Availability			
	Profiled Resource Production / Weather Year /			

Assumptions To Be Developed (cont.)

- Approach to populating assumptions:
  - Incorporate assumptions from the study proposals being modeled
  - Supplement with:
    - updated assumptions based on methodologies that ISO has used in past studies; and
    - any changes to those assumptions that should be introduced to reflect better anticipated conditions (e.g., consideration of bi-directional constraints with neighboring control areas as in 2020 Economic Study)?
- **Discussion points:** Do stakeholders agree with this approach? What changes to past assumptions should we consider?
- If MC/RC is amenable to this approach, draft assumptions will be posted in advance of December meeting

Assumptions To Be Developed: Modeling Electric Storage

- Need to make assumptions on types of batteries that will be installed
  - Discharge period? 2, 4, or more hours?
  - Charging source? Grid or a renewable resource?
  - Supply-side, demand-side, both?
- Distinguish between types of electric storage (e.g., batteries, pumped storage) based on operating characteristics (including variable O&M costs)

Feedback and Next Steps

- Please provide any additional thoughts or feedback no later than November 20, 2020 to the committee Secretary: EWasik-Gutierrez@iso-ne.com
- At the December Joint MC/RC meeting:
  - Review suggested assumptions for the scenarios
  - Continue to lock down areas of consensus

Acronyms

- EUE – Expected unserved energy. An output of probabilistic resource adequacy models. Estimated megawatt hours (MWh) of unserved energy.
- LOLE – Loss of Load Expectation. An output of probabilistic resource adequacy models.
  The 1-in-10 concept is applied to this metric to form the standard of whether resources are likely to be adequate.
- LOLH – Loss of Load Hours. An output of probabilistic resource adequacy models. Estimated number of hours that include an inadequate amount of resources available to serve expected loads.
- RSP – Regional System Plan. Indicates a description of the system consistent with ISO-NE's RSP description.