NEPOOL Participants Committee

Future Pathways

Round 2: Focus on Energy Only Market and Alternative Resource Adequacy Constructs:

Preliminary Observations and Request for Input

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Nov. 5, 2020

Agenda and Inventory of Pathways

Today's Agenda

1. Quick Overview and Recap
2. Energy Only Market (EOM) & Shortage Pricing
3. Alternative Resource Adequacy Constructs (ARAC) (alternatives to FCM, FCEM & ICCM)
4. Next Steps
5. Questions, Comments, and Request for Input
6. Appendix: Background, Abbreviations & References

Inventory of Identified Pathways

1. Forward Clean Energy Market (FCEM)
2. Integrated Clean Capacity Market (ICCM)
3. Carbon Pricing (CP)
    1. With the RGGI framework (RGGI+)
    2. Carbon pricing external to ISO-NE
    3. Net Carbon Pricing (LMP-NC)
4. Energy Only Market (EOM)
5. Alternative Resource Adequacy Constructs (ARAC)
    1. Fixed Resource Requirement (FRR)
    2. FCM with Balancing Resources (FCM-BR)
    3. Voluntary-Residual Capacity Market
    4. Standardized Fixed-price Forward Contract (SFPFC)
    5. Regional Integrated Resource Planning (Regional-IRP)
    6. State Integrated Resource Planning (State-IRPs)
    7. Net FCM

Quick Recap

Project Goal

Compares Pathways across two key questions:

- Whether and to what extent the Pathway supports the clean energy policies of States?
- Whether and to what extent the Pathway garners efficiency of regional markets?

Presentation on Dec. 3, 2020

Project Report: Draft targeted for late Nov.; final in late Dec.

ISO Retained Functions and Caveats

For the Pathways and Variations, it is presumed that ISO-NE would continue to conduct energy dispatch, unit commitment, maintenance scheduling, transmission planning, market monitoring and mitigation, and market administration and settlement

For the Pathways and Variations, markets are used to procure energy, capacity (except for EOM and some ARACs), ancillary services, although the type, structure and administration of these markets may vary across Pathways

Pathways are inextricably linked to regional and State specific policies

High-level Findings (Preliminary)

1. Whether the MOPR applies to a particular pathway, e.g., the Forward Clean Energy Market (FCEM) or the Integrated Clean Capacity Market (ICCM), affects whether ”double payment” for clean energy occurs and whether price suppression occurs

2. As Variable Renewable Energy Resources (VRERs) increase, whether using a resource adequacy construct to maintain sufficient existing units to provide Balancing Resources (BRs) is appropriate should be considered
   - More definition of BRs, the services that they need to provide, and the reliability criteria that they are used to satisfy is needed

3. Energy Only Market (EOM) addresses the ”double payment” issue, maintains a regional market, even more so if carbon pricing is added, but additional changes to the ancillary services markets may be needed to ensure sufficient BRs
   - One regional market metric is the percentage of revenue a resource obtains from the ISO-NE markets

High-level Findings (Preliminary), con't

4. Some Alternative Resource Adequacy Constructs (ARACs) may address the MOPR issue but by reducing regional markets and associated efficiency benefits

5. All but one ARAC, FCM-BR, do not have a mechanism for ensuring sufficient BRs

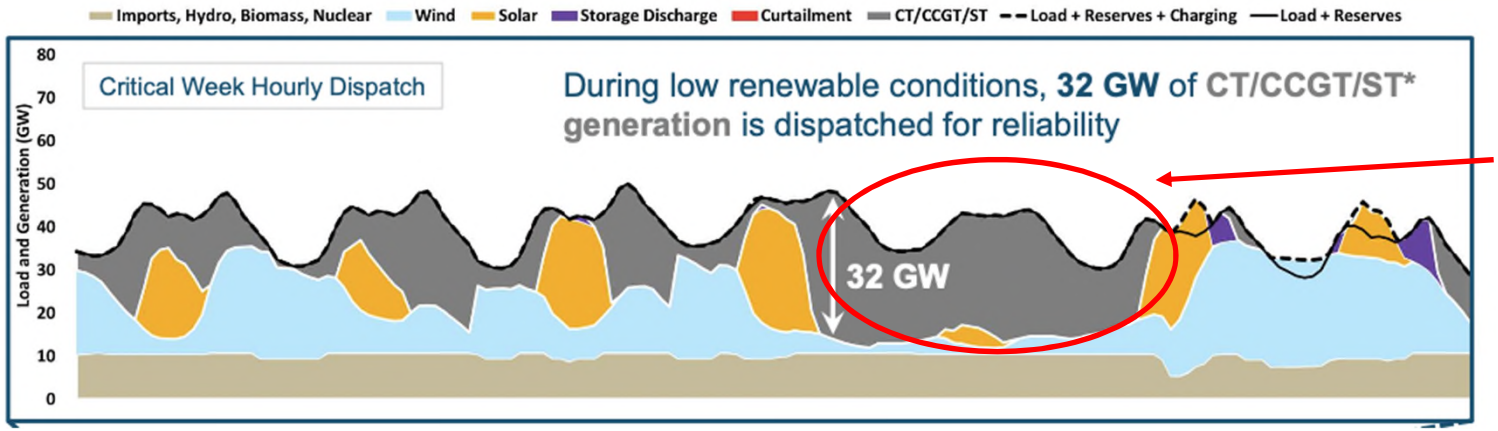
6. There is a possible alternative, Net FCM, that addresses the MOPR issue while maintaining regional markets that should be considered

7. The anticipate major replacement of generation resources throughout New England with new capacity at new locations with very different operating characteristics than historical generation strongly suggests that transmission planning and cost allocation need to be considered when evaluating possible Pathways to avoid costly investment decisions

MOPR Applicability High-level Finding (#1) (Preliminary)

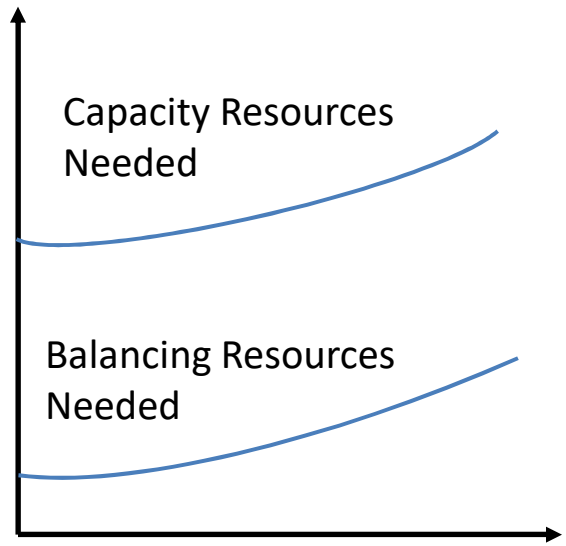
Resource Adequacy	Does the MOPR Apply?
Forward, Mandatory Capacity Market	Yes, based upon FERC ruling (a new Commission could change this) *Not clear why or how FCEM or ICCM avoids the MOPR issue*
Carbon Pricing with FCM (or FCEM or ICCM)	Yes, but mitigates MOPR impact by increasing energy revenue and therefore reducing capacity offer floor *May not eliminate the double payment issue and raises concerns about increasing wholesale electricity prices (mitigated with net-carbon pricing)*
Mandatory Capacity Market without forward obligation	Likely, given FERC's current MOPR order *FCM, FCEM and ICCM depend on a multi-year forward commitment*
Voluntary Capacity Market	Perhaps not, given that PJM FRR allows for self-supply, which in effect makes the capacity market voluntary
Capacity Requirement without a Market	No likely, given that FRR allows for a capacity requirement
Standardized Fixed-price Forward Contract (SFPFC)	Unclear, may depend on who administers the SFPFC auction
Energy Only Market	No, removes the mechanism that the MOPR is attached to and eliminates the double payment

High-level Finding (#2) Re: Variable Renewable Energy Resources (VRERs) and Balancing Resources

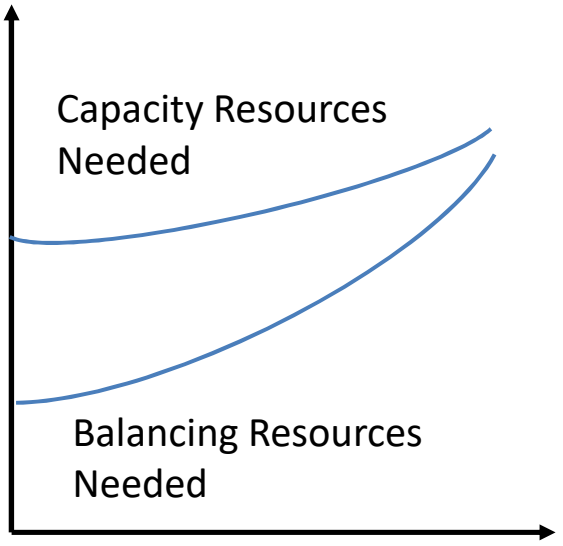


E3, Electric Reliability Under Deep Decarbonization in New England, Aug. 4, 2020, p. 38

How likely is this week and what balancing services are needed to address it?



The shape and location of these lines affect the extent and timing of specific BR mechanisms as the system transitions to more VRERs



BRs Definition, High-level Finding (#2) (Preliminary)

1. More clarity is needed regarding the definition, services, and reliability requirements of BR
    1. What is the definition of BRs?
    2. What are the balancing services that are needed?
    3. What are the reliability requirements that set the amounts of needed BRs?
    4. How are the amounts of each type of balancing services determined?
2. Some BRs provide capacity, some do not, and not all BRs are generators (e.g., synchronous condensers)

Variable Energy Resources	**Balancing Resources (BR)**	**Capacity Resources (CR)**
PV Solar Wind (onshore and offshore) Run of river hydro Others?	Combined cycle Flexible steam units Flexible gas turbines Some storage Dispatchable hydro Some demand response Imports? Others?	Combined cycle Steam units Gas turbines Some storage Some dispatchable hydro Some run of river hydro Some demand response Imports Others?

Understanding how much BRs are needed for different levels of renewable penetration and whether the FCM without modification will cost-effectively procure BRs would help inform the value of the FCM

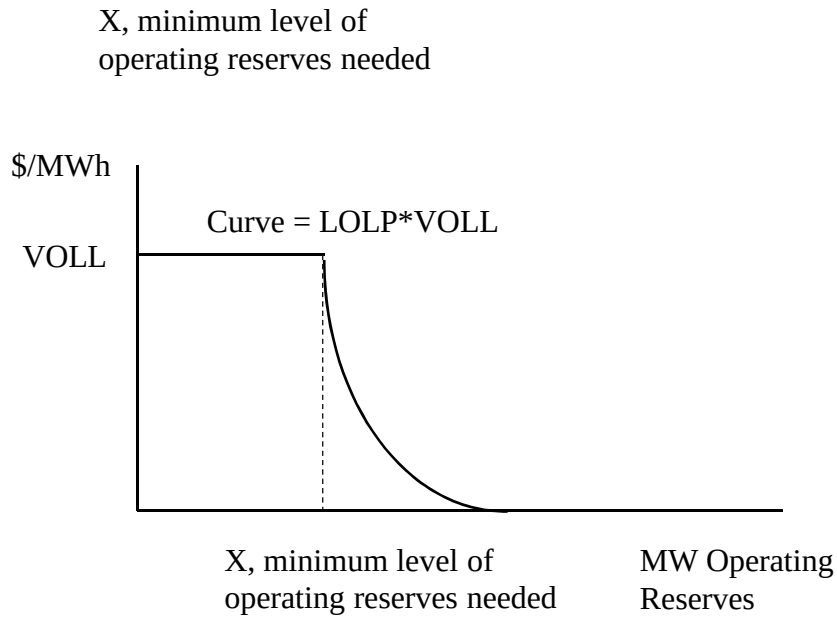
Energy Only Market Pathway Description

Texas energy only market model (aka Operating Reserve Demand Curve (ORDC))

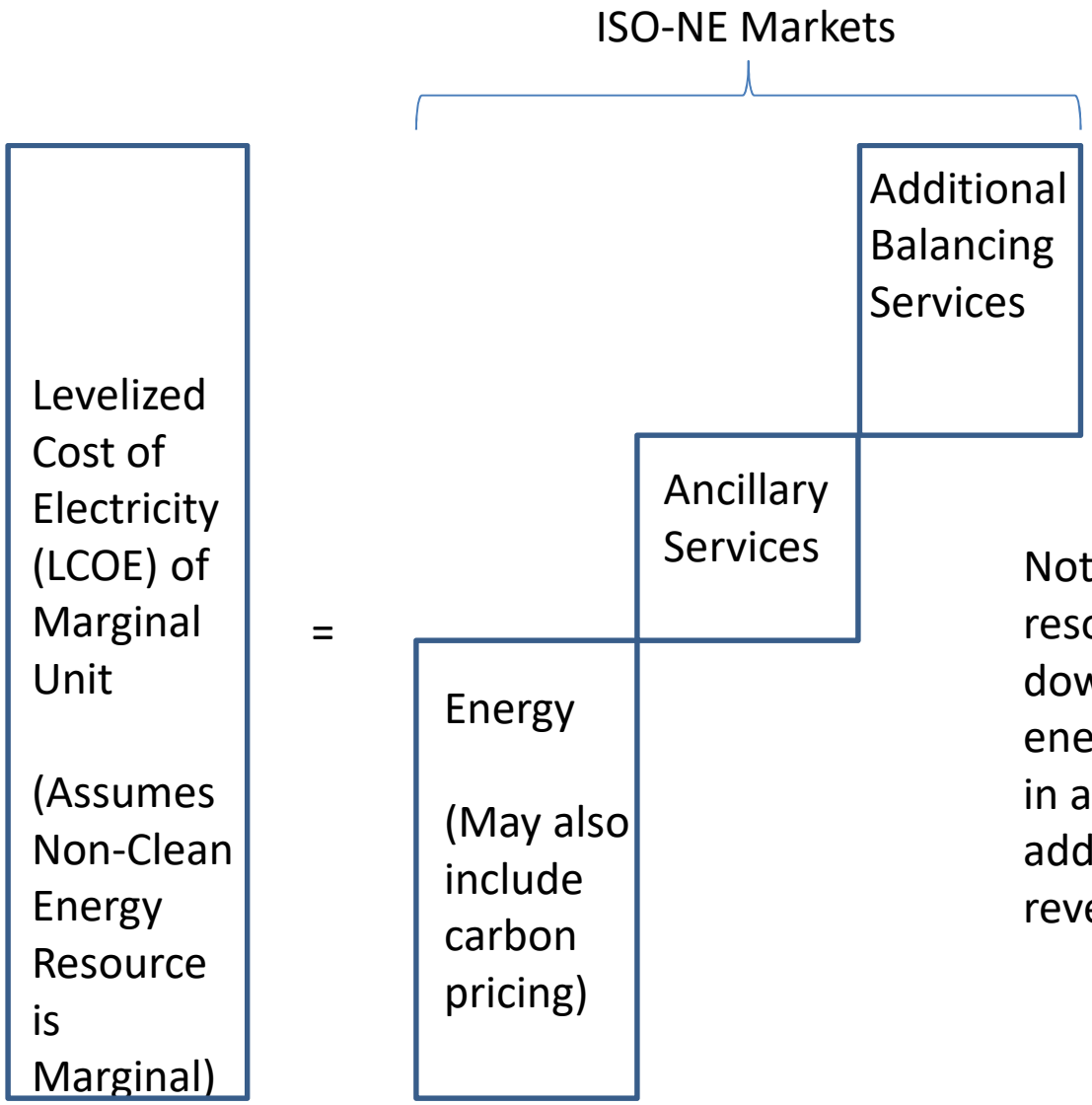
ORDC based upon Value of Lost Load (VOLL) and Loss of Load Probability (LOLP)

<u>Key Design Variables</u>

- VOLL
- X, min. level of op. reserves needed
- Have additional reliability adders to offset price suppression?
- Whether to co-optimization with economic dispatch?
- Whether there are price adders for multiple reserve products?
- Whether there are zonal/locational reliability adders?



Energy Only Market Revenue Streams



Not drawn to scale

Note: States' clean energy resource requirements will likely put downward pressure on wholesale energy prices, requiring increase in ancillary service prices and/or additional balancing service revenues to ensure reliability

EOM High-level Findings (#3) (Preliminary)

1. EOM addresses the MOPR double-payment issue and allows States to individually or collectively pursue their clean energy policies as they see fit
2. EOM and existing ancillary service markets may not provide sufficient flexibility and ramping services (i.e., sufficient BRs)
    1. The need for BRs due to the penetration of Variable Renewable Energy Resources (VRERs), may be addressed either via current wholesale market mechanisms (energy, ancillary services) and/or new constructs
3. EOM can be combined with Carbon Pricing (CP);
    1. Proportion of revenue recovery shifts to DA and RT energy markets away from States' clean energy funding mechanisms
4. Shortage pricing, the key feature of EOM, can be combined with FCM and its variations (e.g., FCEM and ICCM) and ARRCs
    1. Shifts focus of revenue recovery to DA and RT energy markets away from capacity markets and constructs

ARACs High-level Findings (#4-5) (Preliminary)

1. Many ARACs address the MOPR double-payment issue but by reducing the role of a centralized, regional market for capacity that is economically linked to the energy and ancillary services markets
2. Some ARACs have the ISO-NE set resource adequacy requirements (FCM-BR, FRR and Voluntary-Residual Capacity Market) whereas other constructs could have States set the requirements (SFPEC, Regional-IRP, and State-IRPs)
3. Since ARACs are resource-adequacy based (FCM-BR also has a BR demand curve), with an increasing need for BRs, additional mechanisms for BRs may be necessary

Fixed Resource Requirement (FRR) Pathway Description

- Based upon PJM's FRR (but accommodating LSEs)
- LSEs can opt out of the capacity market by demonstrating that they have sufficient resources available to meet the reliability requirement for the LSE's load
- Election is for a minimum number of years, e.g., 5 years
- LSEs capacity plans that are insufficient pay an FRR Commitment Insufficiency Charge
- Capacity resources must meet the same Capacity Performance Requirements as resources participating in the FCM

FRR Findings (Preliminary)

- Addresses the MOPR double payment issue
- Design for integrated utilities in non-retail energy market States instead of LSEs who have multi-year commitments for resources
  - May not align well with some clean energy procurement strategies such as RPS/RES, which are annual
- LSEs loads over multiple years may be too volatile to make FRR a viable option
- Does not address the need for BRs and may compound the problem if the capacity resources in the FRR are not BRs
- Reduces the regional reach of the FCM and associated efficiency benefits

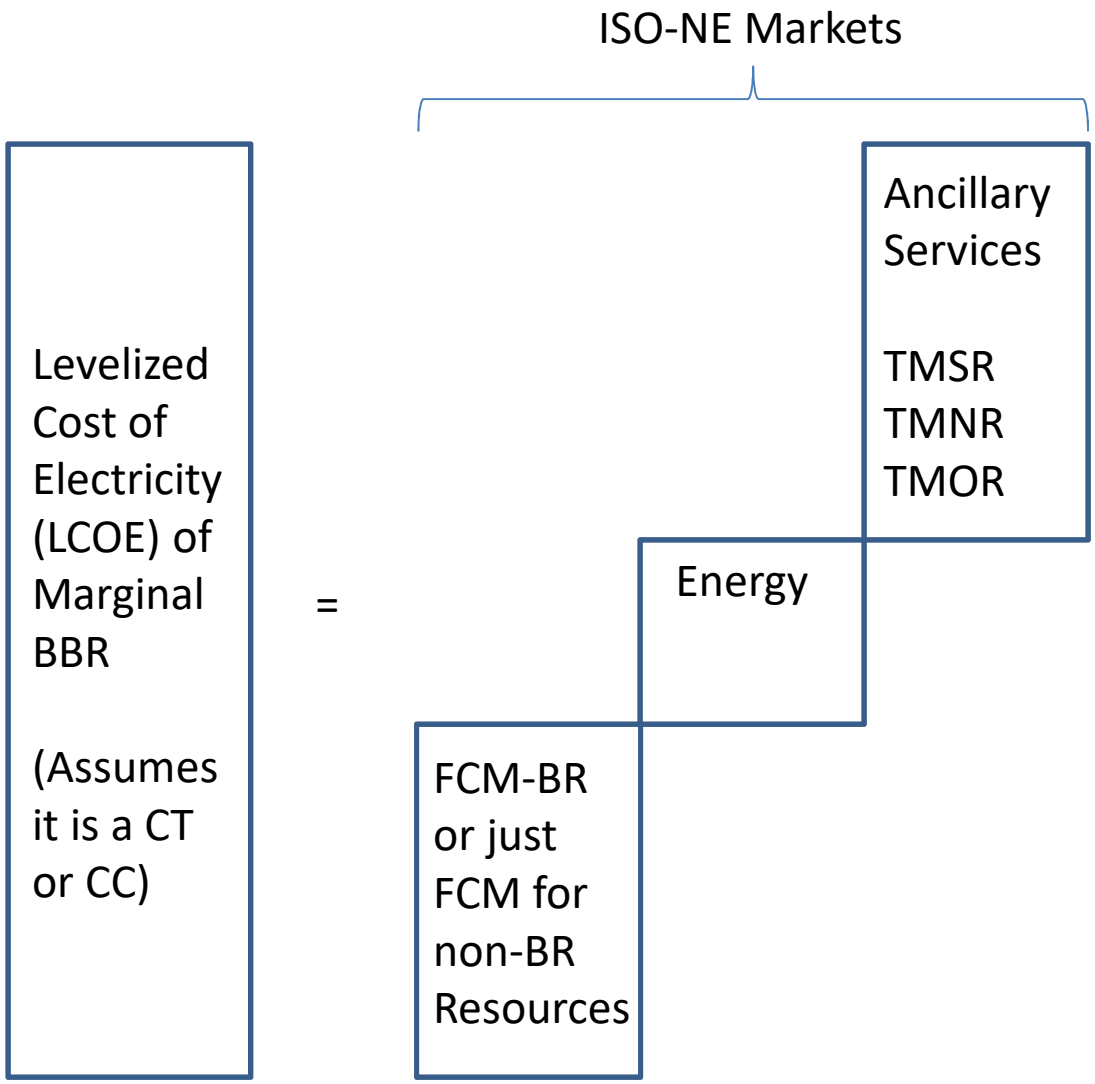
FCM-Balancing Resources (FCM-BR) Pathway Description

- Eliminate MOPR for all resources and replaces CASPR
- Use Effective Load Carrying Capability (ELCC) to determine Qualified Capacity for all resources participating in the FCM
- Construct a Marginal Reliability Impact (MRI) demand curve that Balancing Resources (BRs) would get paid (basically an adder to the primary FCA system price)
- One approach: The total payment to BRs at the total quantity of Energy Security Improvement (ESI) requirement equals Net CONE

  ESI = GCR+RER+EIR
  GCR: General Contingency Reserves
  RER: Replacement Energy Reserves
  EIR: Energy Imbalance Reserves
- Additional recommendations: make FCM voluntary and use sealed bid auction

Ref. Energy Market Advisors, Oct. 15, 2020, http://nepool.com/uploads/FGP_S_Public_Power_Systems.pdf

FCM-BR Revenue Streams



Abbreviations:

TMSR: 10-minute Spinning Reserves
TMNR: 10-minute Non-Spinning Reserves
TMOR: 30-minute Operating Reserves

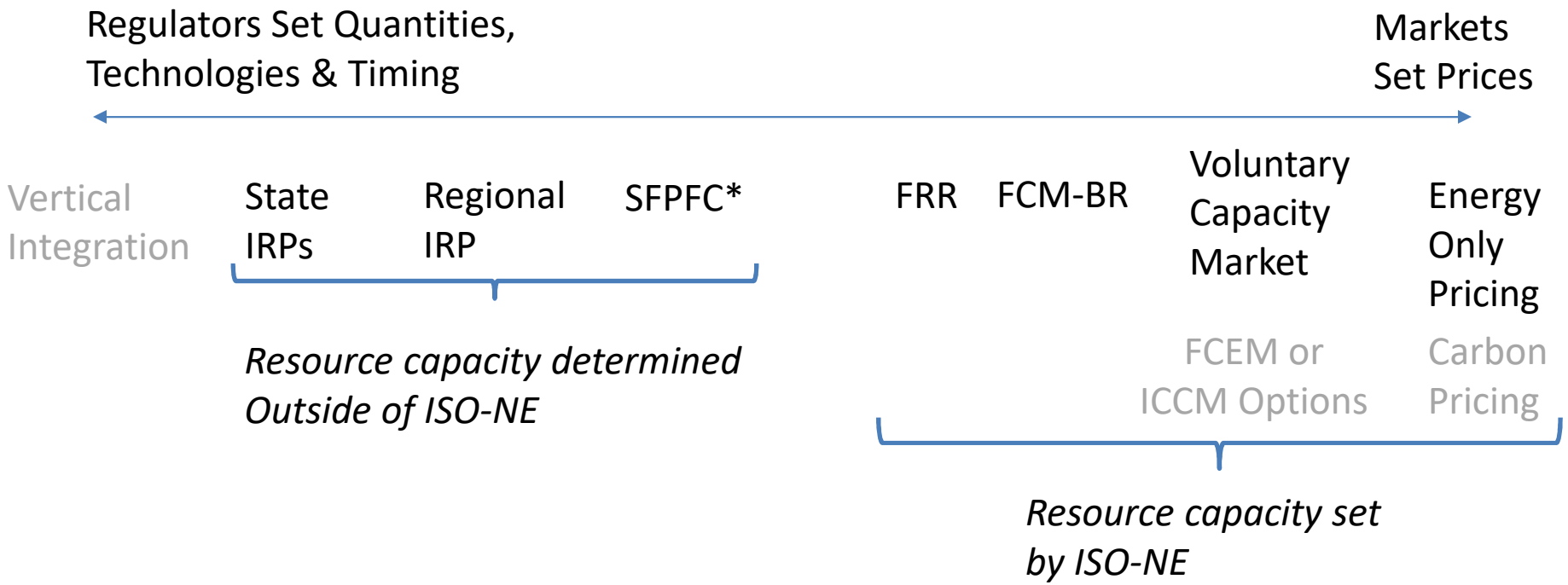
Not drawn to scale

FCM-BR High-level Findings (Preliminary)

- Builds upon existing construct as opposed to developing a new one
- Addresses price suppression due to State Sponsored Resources for BR resources (but not non-BR ones)
- May still trigger MOPR and therefore not address the double payment issue, i.e., does not guarantee that State Policy Resources will clear the FCA auction given out of market support
  - Although many non-State Sponsored resources would be eligible for the additional BR revenues, not all are eligible and would be competing against State Sponsored resources

Ref. Energy Market Advisors, Oct. 15, 2020, http://nepool.com/uploads/FGP_S_Public_Power_Systems.pdf

Regulatory-Market Tradeoffs of ARACs



The Energy Shortage component of Energy "Only" Pricing can augment other ARACs

Additional balancing requirements, services and procurement mechanisms may be needed

*Standardized Fixed-price Forward Contract, presentation by Prof. Wolak to follow

ARACs Design Variables

Pathway	Capacity Requirement	Centralized Capacity Market	Forward Requirement
EOM	No	No	No
Voluntary Capacity Market	Yes	Yes	No
FCM-BR	Yes	Yes	Yes
FRR	Yes	Yes	Yes
Capacity Requirement	Yes	Yes	Yes
SFPFC	No, but has firm energy requirement	No, but mandatory SFPFC auction	Yes, via firm energy requirement
Regional IRP	States Collectively	No	Yes, but via IRP procurement
State IRP	Individual States	No	Yes, but via IRP procurement

Carbon and Shortage Pricing Variations of EOM & ARACs

Resource Capacity Requirements	Variations	Comment
Energy Only Market	Carbon Pricing at Social Cost of Carbon (SCC)	Not aware of any stakeholder support for this pathway
FCM-BR	Carbon Pricing at Social Cost of Carbon (SCC) and/or Shortage Pricing	Carbon pricing reduces impact of MOPR, if applicable, and increases revenues obtain via wholesale electricity markets, enhancing the regional market and efficiency Shortage pricing may provide a "resource adequacy backstop" particularly as capacity procurement becomes more decentralized and diffused
Capacity Requirement with Voluntary Capacity Market		
FRR		
LSE Energy Requirement		
Regional IRP		
State IRPs		

High-level Tradeoffs: EOM & ARACs

<table>
<tr><th>Resource Capacity Requirements</th><th>Supports States Clean Energy Policies</th><th>Garners Efficiency of Regional Markets</th><th>Additional Mechanism for Balancing</th></tr>
<tr><td>Energy Only Market</td><td>Not interfere with States' policies; MOPR not apply and States have flexibility to pursue clean energy policies without double payment</td><td>Somewhat; single set of wholesale energy prices but affected by States' clean energy policies and associated out of market payments</td><td rowspan="6">Additional balancing requirements, services, and procurement mechanisms may be needed</td></tr>
<tr><td>FCM-BR</td><td rowspan="2">Depends if MOPR applies</td><td rowspan="2">Somewhat; integrated energy market and capacity(or firm energy) requirement, although States' clean energy policies may limit benefits of regional markets</td></tr>
<tr><td>Capacity Requirement with Voluntary Capacity Market

SFPFC</td></tr>
<tr><td>FRR</td><td rowspan="3">Yes, "double payment issue" is avoided and States have flexibility to pursue clean energy policies without double payment</td><td rowspan="3">No regional capacity product; regional benefits depends on success of regional planning, if any</td></tr>
<tr><td>Regional IRP</td></tr>
<tr><td>State IRPs</td></tr>
</table>

Another ARAC for Consideration, Net FCM, High-level Finding (#6) (Preliminary)

1. Assume MOPR exists and both a FCEM and FCM are desirable

   To avoid double payment:

2. Run FCEM first
3. Based upon clean energy resources that clear the FCEM, calculate the net capacity requirement, i.e., the remaining needed capacity to meet resource adequacy requirement using the current rules for adjusting the capacity values of VRERs
4. Run the FCM based on the net capacity requirement (and if concerned about BR, use FCM-BR)

   Advantages:

5. Does not trigger MOPR because clean energy resources are not selling capacity but are reflected in the required amount of capacity that load must purchase
6. Load only purchases the net amount of needed capacity after deducting the capacity contribution from clean energy resources
7. Although clean energy resources do not get paid capacity revenue, load does not pay for capacity twice
8. Provides States an incentive to use the FCEM because if they do not, their load double pays for capacity

Next Steps

1. Opportunities for written feedback and comments to this (and future) presentations are available

2. All comments will be considered, although comments that improve and contribute to the analysis of tradeoffs of Pathways and Variations will be the more helpful than advocacy

   *Please provide any written feedback on this presentation or other Pathways to NEPOOL Counsel (slombardi@daypitney.com) by COB Thursday, November 19 or sooner; all comments will be posted on the NEPOOL website

3. Preparation of presentation for Dec. 3 NEPOOL Participants Committee Meeting

4. Goal to issue final report by end of the year, which will be circulated as a draft for comment, targeted for end of Nov.

QUESTIONS AND COMMENTS

Abbreviations

ACP: Alternative Compliance Payment
ARAC: Alterative Resource Adequacy Constructs
CCS: Carbon Capture and Sequestration
CEAC: Clean Energy Attribute Credit
CONE: Cost of New Entry
CP: Carbon Pricing
EOM: Energy Only Market
ERCOT: Electricity Reliability Council of Texas
FCEM: Forward Clean Energy Market
FCM: Forward Capacity Market
FRR: Fixed Resource Requirement
ICCM: Integrated Clean Capacity Market
IRP: Integrated Resource Planning
LOLP: Loss of Load Probability
LSE: Load Serving Entities
MOPR: Minimum Offer Pricing Rule
ORDC: Operating Reserve Demand Curve
PPA: Power Purchase Agreement
RDPA: Reliability Deployment Price Adder
REC: Renewable Energy Credit
RES: Renewable Energy Standard
RGGI: Regional Greenhouse Gas Initiative
RGGI+: RGGI Plus Additional Emission Reductions
RPS: Renewable Portfolio Standard
SCED: Security Constrained Economic Dispatch
SFPFC: Standardized Fixed-price Forward Contract
VOLL: Value of Lost Load

References

- Forward Clean Energy Market (FCEM)
  - Brattle, 2017. A Dynamic Clean Energy Market in New England, The Brattle Group, presentation, Nov., http://files.brattle.com/files/11819_a_dynamic_clean_energy_market_in_new_england.pdf
  - Brattle, 2018. Harmonizing Environmental Policies with Competitive Markets, The Brattle Group, discussion paper, Jul., http://files.brattle.com/files/14206_harmonizing_environmental_policies_with_competitive_markets_final.pdf
  - Brattle, Apr. 2019. How States, Cities, and Customers Can Harness Competitive Markets to Meet Ambitious Carbon Goals Through a Forward Market for Clean Energy Attributes, The Brattle Group, https://brattlefiles.blob.core.windows.net/files/16343_how_states_cities_and_customers_can_harness_competitive_markets_to_meet_ambitious_carbon_goals.pdf
  - Brattle, Sep. 2019. How States, Cities, and Customers Can Harness Competitive Markets to Meet Ambitious Carbon Goals Through a Forward Market for Clean Energy Attributes, Expanded Report Including Detailed Market Design Proposal, The Brattle Group, https://brattlefiles.blob.core.windows.net/files/17063_how_states_cities_and_customers_can_harness_competitive_markets_to_meet_ambitious_carbon_goals_-_through_a_forward_market_for_clean_energy_attributes.pdf
  - Forward Clean Energy Market A Market-Based Option For States To Achieve Their Clean Electricity Goals, The Brattle Group, presentation to NPC, Jul. 2020
  - ISO-NE, Jan. 2017, NEPOOL 2016 IMPAPP Proposals: Observations, Issues and Next Steps, http://nepool.com/uploads/IMAPP_20170125_ISO-NE_Discussion_Paper_Rev.pdf

References

- Carbon Pricing (CP)
  - Analysis Group, 2020a. Carbon Pricing for New England: Context, Key Factors, and Impacts, The Analysis Group, paper, Jun., https://www.analysisgroup.com/globalassets/insights/publishing/2020-june-analysis-group-carbon-pricing-for-ne-main-report.pdf
  - Analysis Group, 2020b. Carbon Pricing for New England: Context, Key Factors, and Impacts, Summary for Policy Makers, The Analysis Group, paper, Jun., https://www.analysisgroup.com/globalassets/insights/publishing/2020-june-analysis-group-carbon-pricing-for-ne-summary-for-policy-makers.pdf
  - NYISO, Integrating Public Policy Task Force Carbon Pricing Proposal, Dec. 7, 2018, https://www.nyiso.com/documents/20142/3911819/Carbon-Pricing-Proposal%20December%202018.pdf/72fe5180-ef24-f700-87e5-fb6f300fb82c
  - RFF, 2019. Concepts for Carbon Pricing, Resources for the Future, Presentation, Jul. 26, 2019, https://www.pjm.com/-/media/committees-groups/task-forces/cpstf/20190726/20190726-item-05-carbon-pricing-concepts.ashx

References

- Alternative Resource Adequacy Constructs (ARAC)
  - Duke, 2019. State Participation in Resource Adequacy Decisions in Multistate Regional Transmission Originations, Duke Nicholas Institute, Policy Brief, March, https://nicholasinstitute.duke.edu/sites/default/files/publications/state_participation_in_resource_adequacy_decisions_web.pdf
  - Grid Strategies, 2020, Resource Adequacy Models and Low Carbon Power Markets, presentation, Sep. 3, http://nepool.com/uploads/NPC_20200903_A10_Presentations.pdf
  - Gramlich and Hogan, Wholesale Electricity Market Design for Rapid Decarbonization: A Decentralized Market Approach, Jun. 2019, https://www.mass.gov/doc/gramlich-paper-panel-1/download
  - Corneli, Gimon, and Pierpont, Wholesale Electricity Market Design for Rapid Decarbonization: Long-term Markets, Working with Short-term Energy Markets, Jun. 2019, https://www.mass.gov/doc/corneli-paper-panel-1/download
  - Wolak, Frank, Long-term Resource Adequacy in a Low Carbon Electricity Supply Industry, Nov. 1, 2019, file:///Users/frankafelder/Downloads/CPUC_Resource_Adequacy_Sacramento-Wolak.pdf
  - Wolak, Frank, Market Design in a Zero Marginal Cost Intermittent Renewable Future, Oct. 15, 2020
  - Energy Market Advisors, LLC, Conceptual Framework for Supporting Balancing Resources in New England without the Minimum Offer Price Rules, Oct. 15, 2020, http://nepool.com/uploads/FGP_S_Public_Power_Systems.pdf
  - NESCOE, New England States' Vision for a Clean, Affordable, and Reliable 21st Century Regional Electric Grid, Oct. 2020, http://nescoe.com/wp-content/uploads/2020/10/NESCOE_Vision_Statement_Oct2020.pdf