NEPOOL's Pathways to the Future Grid Process

Project Report

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I. Preface

As part of New England's Future Grid Initiative[1], NEPOOL commenced stakeholder discussions in 2020 focused on identifying and exploring potential alternative pathways/market frameworks that may help advance the region's clean energy transition. To support these explorative discussions among Participants, State officials and ISO-NE, NEPOOL engaged Independent Electricity Consultants, LLC to provide technical support from September to December 2020 to the NEPOOL Participants Committee (NPC).[2] This support consisted of reviewing a multitude of potential pathways and identifying and assessing their tradeoffs between achieving the clean energy policy objectives of the New England States and maximizing the benefit of efficient, regional wholesale markets. I have also worked to identify additional decision areas on details and design that would need to be made in order to more fully assess and compare the various potential pathways/frameworks.

The intended purpose of the explorative effort to date has been to develop a common understanding among a diverse group of stakeholders and State officials by clarifying issues, discussing pathway elements and their implications, and facilitating constructive exchanges on the relative merits of each identified pathway. As I explain further herein, my assessment of the various pathways has focused in particular on the following two questions: 1) whether and to what extent pathways support (or help to advance) the clean energy policies of States and 2) whether and to what extent pathways garner efficiency of regional markets? This final draft report summarizes my higher-level qualitative observations and assessment and is being distributed for review and written comment. More specific observations are documented in the series of presentations that I made before the NPC and posted on NEPOOL's website.

II. Background

State energy policies in New England (and elsewhere in the country) are generally devised to meet certain economic, environmental and/or political objectives at low costs whereas efficient markets are designed to maximize social surplus, the difference between the economic

[1] As stated in the 2020 NEPOOL Annual Report (https://nepool.com/uploads/Annual_Report_2020.pdf), NEPOOL leadership, working closely with NESCOE and ISO-NE representatives, launched New England's Future Grid Initiative in two parallel processes. (1) to define and assess the future state of New England's regional power system ("Future Grid Reliability Study") and (2) to explore and evaluate potential market frameworks that could be pursued to help support New England's clean energy transition ("Pathways to the Future Grid").

[2] Technical support is being provided by Frank A. Felder, Ph.D., Independent Electricity Consultants, LLC. The work product provided herein reflects my views and opinions and not necessarily those of NEPOOL, ISO-NE, individual NEPOOL participants, or State officials.

benefits of consuming electricity and the costs of producing it.[3] In other words, States would like to achieve their specific policy objectives cost effectively, whereas wholesale electricity markets are designed to maximize economic efficiency. Although there is some substantial overlap between the States' objectives of decarbonization and environmental enhancements, economic development, and political acceptability, and the objective of efficient, regional wholesale electricity markets, these objectives are not necessarily reconcilable.

New England States are pursuing the decarbonization of the electric power sector by employing a slate of policies to accomplish their clean energy policy objectives, including turning to out-of-market, state-sponsored support for certain generation. These policies envision replacing most if not all of the existing generation fleet with variable renewable energy resources (VRER) whose output is intermittent, and many of these new resources, such as offshore wind, are likely to be at different locations than existing power plants. Because decarbonization will result in major changes in the types and locations of generation, it raises the fundamental question of how to achieve the least cost deployment of generation and transmission to meet demand within the context of wholesale electricity markets and State policies.

Further adding to the challenge, under the direction of the FERC, the eastern RTOs/ISOs (including New England) has adopted minimum offer prices for new resources bidding into its capacity markets (i.e., the "MOPR"). Although the MOPR has been employed to address the potential adverse impact of out-of-market, state-sponsored contracts on price formation in the wholesale competitive markets, the MOPR has also resulted in state-sponsored resources[4] not clearing in the FCM and not being counted to help satisfy ISO-NE's resource adequacy requirements. As observed herein, resolving this tension through any one pathway or combination of pathways remains a challenge.

Within NEPOOL's "Pathways to the Future Grid" process, four major categories of pathways were discussed and are listed in Table 1. These identified pathways varied regarding their number of alternatives, level of detail, and expressions of support. For instance, the Forward Clean Energy Market (FCEM) contains several major design variables that substantially change the characteristics and outcomes of specific FCEM alternatives as well as the associated tradeoffs that would occur. Some elements within the identified pathways are potential stand-alone market improvements that could be considered separately from the broader pathway discussions but are discussed in this report as part of a pathway category. For example, an Energy Only Market (EOM) can be a stand-alone reform or be part of a larger future pathway to

[3] A socially efficient market would include the costs of negative externalities as part of production costs.

[4] State-subsidized resources are those that obtain at least some of their compensation via a State-sanction policy such as a renewable portfolio or energy standard. *See, e.g.*, FERC's December 2019 PJM Capacity Market Order, where the Commission defined State Subsidy as "[a] direct or indirect payment, concession, rebate, subsidy, non-bypassable consumer charge, or other financial benefit that is (1) a result of any action, mandated process, or sponsored process of a state government, a political subdivision or agency of a state, or an electric cooperative formed pursuant to state law, and that (2) is derived from or connected to the procurement of (a) electricity or electric generation capacity sold at wholesale in interstate commerce, or (b) an attribute of the generation process for electricity or electric generation capacity sold at wholesale in interstate commerce, or (3) will support the construction, development, or operation of a new or existing capacity resource, or (4) could have the effect of allowing a resource to clear in any PJM capacity auction." December 2019 Order, 169 FERC ¶ 61,239 at p. 67, cited in 173 FERC ¶ 61,061, p. 6.

help support regional decarbonization. Pathway related references are provided in the Reference section at the end of this paper.

Table 1: Inventory of Pathway Categories

No.	Pathway Name and Abbreviation
1	Forward Clean Energy Market (FCEM), with potential inclusion of a Balancing Resource Constraint (BRC) and/or Integrated Clean Capacity Market (ICCM)
2	Carbon Pricing
3	Energy Only Market (EOM)
4	Alternative Resource Adequacy Constructs (ARAC)

To kick off discussions on various identified pathway, invited speakers presented to the NPC describing different concepts/market frameworks followed by presentations I delivered comparing the tradeoffs among the pathways and their alternatives. Stakeholders provided oral feedback during the question-and-answer portion of each presentation and have also submitted written comments, which are posted on the NEPOOL website.[5]

[5] http://nepool.com/Fut_Grid_Poten_Pathways.php

Table 2: Presentations on Clean Energy Transitions and Potential Future Pathways[6]

Date	Presentation Title	Presenter and Affiliation
Jun. 24, 2020	Challenges Associated with Deep Decarbonization and Evolving Grid Systems	Melanie Kenderdine, Energy Futures Initiative
Jun. 24, 2020	BPS Reliability, Perspectives for 2050	Jim Robb, NERC
Jun. 24, 2020	What Pathways Have Others Chosen or Are Considering	Frank Felder, IEC
Aug. 6, 2020	Forward Clean Energy Market: A Market-based Option for States to Achieve Their Clean Electricity Goals	Kathleen Spees, The Brattle Group
Aug. 6, 2020	Carbon Pricing for New England	Joseph Cavicchi, Analysis Group
Sep. 3, 2020	ERCOT's Energy Only Market	Beth Garza, R Street
Sep. 3, 2020	Resource Adequacy: Panel Introduction, Dimensions & Options, and Resource Adequacy Models and Low Carbon Power Markets	Sharon Reishus, Reishus Consulting Steve Corneli Rob Gramlich, Grid Strategies, LLC
Oct. 1, 2020	The Integrated Clean Capacity Market: A Design Option for New England's Grid Transition	Kathleen Spees, The Brattle Group
Oct. 1, 2020	Round 1: Focus on FCEM and Carbon Pricing: Preliminary Observations and Request for Input	Frank Felder, IEC, LLC.
Nov. 5, 2020	Round 2: Focus on Energy Only Market and Alternative Resource Adequacy Constructs: Preliminary Observations and Request for Input	Frank Felder, IEC, LLC.
Nov. 5, 2020	Long-Term Resource Adequacy with Significant Intermittent Renewables	Frank Wolak, Stanford University
Dec. 3, 2020	Capacity as a Commodity	Michael Borgatti, Gabel Associates
Dec. 3, 2020	Round 3: Focus on SFPFC and Draft Report	Frank Felder, IEC, LLC

The pathway discussions spawned a long list of abbreviations, which are listed in Table 3 to aid in reading this report and reviewing the associated presentations and references.

[6] Available at https://nepool.com/future-grid-initiative/potential-pathways/

Table 3: Abbreviations Related to Clean Energy Transition and Future Pathways

ACP: Alternative Compliance Payment
ARAC: Alterative Resource Adequacy Constructs
BRC: Balancing Resource Constraint
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
RPS: Renewable Portfolio Standard
SCED: Security Constrained Economic Dispatch
SFPFC: Standardized Fixed-Price Forward Contract
VOLL: Value of Lost Load
VRER: Variable Resource Energy Resources

II. Potential Pathways/Market Frameworks to Support New England's Clean Energy Transition

Across the different pathways discussed, there are some common presumptions regarding how the region is to achieve its clean energy transition and the role of the ISO-NE. Markets would be used to procure energy, capacity (as applicable), ancillary services, although the type, structure and administration of these markets may differ across pathways. As I understand the frameworks presented at the NPC, ISO-NE would continue to conduct energy dispatch, unit commitment, maintenance scheduling, transmission planning, market monitoring and mitigation, and market administration and settlement.

From the review and discussion of pathways, I have observed three key issues that have emerged that I believe need to be addressed in order for New England to proceed with a new pathway/market framework to support the region's clean energy transition. First, the effort

underway to reconcile conflicting objectives of wholesale electricity markets and States' clean energy policies is clearly an ambitious and challenging undertaking. Any successful reconciliation is not likely to occur without broad agreement being reached among the New England States and NEPOOL stakeholders. The importance of agreement among New England States is particularly important for two of the pathways that have garnered substantial interest, Forward Clean Energy Market (FCEM) and Integrated Clean Capacity Market (ICCM), because both depend upon a regional auction of inter-State tradeable clean energy and/or capacity products.

Second, the required types, amounts and timing of balancing services needed to accommodate increasing levels of VRER has not been defined or articulated. Without knowing these requirements, analyzing whether proposed pathways will be successful in providing the resources needed for reliability to support decarbonization let alone cost effectively cannot be performed. The reliability criteria and metrics should be specified in order to establish the balancing services needed to plan and reliably operate the bulk power system given increasing penetration of VRERs, perhaps as part of the NEPOOL's ongoing Future Grid Reliability Study effort.[7] Specifically, with large amounts of renewables, resource adequacy requirements may need to be set based upon meeting demand with sufficient resources over multiple cloudy, non-wind days, and additional changes to the ancillary services markets may need to occur to ensure sufficient flexibility to balance supply and demand over various time steps from cycles to seconds to weeks. Whether employment of an FCM-like mechanism is the preferred means to procure the required balancing services is an open question given that such a mechanism is designed primarily to procure new resources to maintain resource adequacy as opposed to maintain existing resources to provide balancing services.

Third, the proposed pathways that the region decides to continue to be discussed need more development and specificity before a complete analysis of their implications and impacts can be conducted. At this stage, the pathways are really collections of similar high-level proposals that vary, in some cases substantially, within each pathway category. Furthermore, the outcomes of pathways depend on how they interact with energy dispatch and curtailment, unit commitment, ancillary service definition and opportunity costs, imports and exports of power, bid and offer incentives, transmission planning and cost allocation, deployment of smart grid technologies, dynamic retail pricing, market monitoring and mitigation, wholesale and retail credit policies, and regional and State energy policies. One major example of the need for more development is the intersection of the proposed pathways and transmission expansion and cost allocation, and the region's push for extensive expansion of offshore wind is a prime example. Evaluating impact on generation and transmission investments due to the intersection of a particular pathway and regional transmission planning will be necessary in order to ensure that these investment decisions are aligned to achieve the least cost joint deployment of generation and transmission.

[7] Further information on NEPOOL's Future Grid Reliability Study effort can be accessed at https://nepool.com/meetings/future-grid-reliability-study/.

III. High-level Description of Pathways and Open Issues

This section describes the criteria that pathways are being evaluated against followed by a brief description of each of the pathways. Pathway descriptions, motivations, and claimed benefits are provided in the cited references. In addition, the subsequent section discusses more detailed findings related to potential pathways and many of their alternatives and variations.

Recall that the thrust of this high-level qualitative assessment is how each of the pathways answer the following two questions: 1) whether and to what extent pathways support the clean energy policies of States; and 2) whether and to what extent pathways garner efficiency of regional markets?

To help answer these two questions, four criteria are suggestions to be used to evaluate potential pathways.

The first criterion is the achievement of *States' energy objectives*. As noted above, States would like to set the timing, quantity and type of clean energy resources to meet their particular objectives. In general, there is a tradeoff between achieving States' specific clean energy objectives that use quantity mandates via, for example, renewable portfolio or energy standards, to incentivize clean energy resources versus using regional markets that rely on price signals. The more specific the clean energy requirements are, the more difficult it is to implement a regional, technology neutral mechanism in which clean energy resources compete based upon price and performance.

The second criterion is addressing the so-called *double capacity payment* issue. If state-subsidized clean energy resources do not clear the Forward Capacity Market due to the MOPR, then States will have advanced certain clean energy resource objectives but without necessarily garnering the financial value of resource adequacy that those resources provide. Retail electricity consumers could be paying twice for the capacity value that the state-sponsored clean energy resources provide to the system.

The third issue is ensuring sufficient price integrity in the markets (i.e., addressing *price suppression*). If without the MOPR, State-subsidized clean energy resources clear the FCM because the subsidy provides these resources with additional revenue that would not have occurred but for the subsidy, then capacity and energy prices would be lower, i.e., suppressed, than without the State subsidy.[8] Price suppression is an identified concern for both economic efficiency and reliability reasons (which is discussed below regarding balancing resources). It is an economic efficiency concern because the social welfare benefits of out-of-market subsidizes of clean energy resources depend both on the relative benefits of reducing greenhouse gas and other emissions with the relative costs including the price suppression and distortions of the subsidizing mechanism. Whether the net impact of increasing the amount of clean energy resources and suppressing prices is positive or negative is an open question and depends on the particular setting.

[8] This could occur if the FERC reversed itself and eliminated the MOPR.

The tradeoff between "double payment" and price suppression is unavoidable and caused by the divergence between individual State's clean energy policy objectives and the pursuit of regional markets to maximize social surplus. Reducing the magnitude of the double payment may increase the amount of price suppression and vice-versa.

The fourth issue is the increasing need for *balancing resources* in a future state. Pathways may not procure sufficient amounts and types of balancing resources that the region needs to operate the grid reliably or if they do, it is not clear that they do so in the most cost-effective manner. Having sufficient balancing resources is partially connected to the price suppression issue. If a pathway results in substantially added price suppression in the organized markets, premature retirements of resources that may be needed for balancing could result due to the reduction in wholesale market prices. And if there is not another means of compensating the needed balancing resources, then reliability may be adversely affected. If a pathway avoids or minimizes the double capacity payment issue, that does not, however, mean that the pathway necessarily efficiently procures and/or retains the necessary balancing resources that are needed for reliability.

With these four criteria in mind, each pathway is considered. In the following discussion, pathways are grouped for ease of explanation and the order is not indicative of anything else. More detail on each of the identified pathways is provided in presentation and other background materials on NEPOOL's dedicated Future Grid Initiative webpages.

A. Forward Clean Energy Market and Integrated Clean Capacity Market

The Forward Clean Energy Market (FCEM) framework would use an auction mechanism to procure the quantity and amount of clean energy resources based upon demand curves constructed by each participating New England State and then combined into a regional demand curve (Brattle, Sep. 2019). As presented by Dr. Kathleen Spees of The Brattle Group, the FCEM would be conducted before the forward capacity market (FCM). Although there are many design components to the FCEM, the key elements are a downward sloping demand curve for clean energy resources, a forward auction, e.g., 3 years, with a possible multi-year commitment period for new resources (e.g., 3-7 years), an unbundled Clean Energy Attribute Credit (CEAC) that is tradeable via bilateral and spot markets, and associate market administration policies regarding tracking, credit, and market power monitoring and mitigation policies.

The Integrated Clean Capacity Market (ICCM) integrates the FCEM and the FCM into one auction in which resources offer in to provide both clean energy and capacity (Brattle, Oct. 2020). Resources that clear the joint procurement auction sell unbundled capacity and CEAC products. The motivation for the ICCM is to obtain the benefits of jointly optimizing the procurement of capacity and clean energy as opposed to running the FCEM and the FCM sequentially. One open question is whether it is possible to design and implement such a joint auction that is feasible and practical (ISO-NE, Jan. 2017).

Given their similarities, the FCEM and ICCM are analyzed together against the four criteria. States may need to relinquish some control of their more targeted policy objectives or preferences in order to obtain sufficient agreement with other States so that the FCEM or ICCM

have sufficient uniformity in the definition of clean energy resources to garner the regional efficiency benefits of these auction mechanisms. The major claimed advantage of the FCEM and ICCM is that they procure the least cost set of clean energy resources, but they do so by having broad definitions of clean energy resources and setting a regional demand for these resources to foster regional competition.

Whether the FCEM and ICCM avoid the double capacity payment issue by procuring resources that are not considered receiving States' subsidies for the purposes of the MOPR is not clear. If the FCEM or ICCM were part of a FERC approved tariff, then the claim could be made that resources that clear these markets are not State-subsidized and do not have an additional revenue stream that advantages them over other resources participating in the wholesale market. If this were to occur, then any resulting or remaining price suppression issues would have to be addressed. On the other hand, if the clean energy resources that the FCEM or the ICCM procure are defined too narrowly and State specific, then there may be a higher potential of FERC either not accepting the FCEM or ICCM as part of a FERC tariff or possibly insisting on continued imposition of some form of MOPR, which could result in continued tensions associated with the double capacity payment issue. Finally, neither the FCEM nor the ICCM explicitly address the balancing resource issue.

B. Alternatives to the Forward Capacity Market

The FCM with a minimum balancing resource constraint (BRC) is intended to address the balancing resource issue (and therefore the reliability concerns associated with price suppression) by incorporating into the FCM requirements the balancing resources necessary to reliably operate the grid (Energy Market Advisors, 2020) but appears to have the same limitations as do the FCEM and ICCM with respect to achieving States' energy objectives and double capacity payment. The BRC presumably would be established to provide the types and amounts of balancing services determined to meet reliability requirements as discussed in the prior section.

Two options propose changes/reforms to the FCM: Capacity as a Commodity (Gabel Associates, 2020) and Always on Capacity Exchange ("AOCE") (Reliable Energy Analytics, 2019). As currently formulated, however, both options have not explicitly made clear how they would help to advance or achieve States' clean energy objectives, address the double payment/price suppression tradeoff, or ensure sufficient balancing resources. If either of these options are pursued in future pathway discussions, it would be useful to understand how they would specifically help to facilitate the resolution of one or more of these issues.

The FCM could be replaced with a standardized fixed-price forward contract (SFPFC) (Wolak Oct. 2020 and Nov. 2020). SFPFC would mandate load serving entities (LSEs) to purchase and hold for delivery standardized forward energy contracts with increasing percentages of their load in the near delivery years that are shaped to hourly system demand and backed by sufficient credit requirements to ensure delivery. In and of itself, SFPFC alone does not achieve decarbonization or other States' clean energy policy objectives. As presented, it presumes that additional renewable resources are being incentivized and then develops a mechanism in which these VRERs are combined with other resources to meet resource adequacy

requirements, although formulated using energy obligations instead of capacity ones. How the SFPFC would facilitate addressing decarbonization and related objectives requires more development of this possible pathway taking into account more fully the particular context and characteristics of the New England region.

Similarly, the FCM could be replaced with energy scarcity pricing, for example with an operating reserve demand curve (ORDC) model used in the Electric Reliability Council of Texas (ERCOT) (i.e., "Energy Only Market" or "EOM"), but again, this market construct in and of itself would not achieve States' clean energy objectives or alone address the balancing resource challenges.

Eliminating the FCM, either by adopting the SFPFC or EOM, as first glance would seem to resolve the double payment problem. Without a capacity market, the MOPR would also be eliminated because there would not be capacity offers for the MOPR to restrict. The result would be resolving the double payment issue but possibly at the expense of price suppression. The States' subsidies would continue to provide revenue streams to clean energy resources that would enable them to recover some or much of their costs outside of the region's wholesale electricity markets. This would possibly affect the efficiency and reliability concerns discussed in the prior section.[9] The SFPFC or EOM pathways do not explicitly have a mechanism to ensure the sufficient procurement of needed balancing services.

C. Carbon Pricing

Instead of using a FCEM or ICCM to acquire clean energy resources via a regional market mechanism, another approach is to supplement the current Regional Greenhouse Gas Initiative price on carbon dioxide (CO_2) with an additional regional CO_2 price. One approach is net carbon pricing (NYISO, Jun. 20, 2019). In short, this pathway would require an agreement upon a social cost of carbon (SCC), subtract out the RGGI CO_2 price, have ISO-NE charge emitting generators this additional cost of carbon, and net out (i.e., rebate) back to load serving entities (LSEs) the additional CO_2 revenue. Net carbon pricing mitigates, but not necessarily solves, the double payment issue by raising the revenues clean energy resources would earn in the energy markets but would reduce the States' ability to tailor specific timing and type of clean energy resources to meet their individual policy objectives. Net carbon pricing does not explicitly address the balancing resource issue.

IV. Specific Findings Regarding Pathways and Their Variations

The presentations and associated discussions on the identified pathways raised numerous insights that are documented below and that may inform future discussions.

[9] Given that the FERC's historical concerns regarding price suppression (as reflected in its establishment of the MOPR), it is at least conceivable that the FERC could adopt an analogous mitigation construuct with respect to energy offers if the FCM was eliminated. Whether the FERC would do so and how it would go about crafting such a rule may need to be considered if discussions about eliminating the FCM proceed.

A. Overall Findings Comparing Pathways

In general, the four categories of pathways vary among two major sets of dimensions: regional vs. State specific and planning vs. markets. Carbon Pricing and EOM are regional and market based. Planning refers to States setting the types, quantities and timing of clean energy investments, whether through specific mandates or market mechanisms such as RPS/RES. The FCEM, ICCM and ARACs are more planning based than Carbon Pricing and EOM and, depending on their variations, can be regional or State specific. Some variations of ARACs are intended to further State-specific clean energy objectives. These ARAC alternatives, such as the alternatives that involve regional or state-level integrated resource planning, were not extensively discussed as part of this effort. Of the pathways identified, FCEM, ICCM and CP are primarily directed at reducing greenhouse gas emissions, whereas the other two categories (EOM and ARACs) are different ways to provide resource adequacy, although some ARACs are directed at advancing/supporting States' clean energy objectives. Figure 1 provides a conceptual orientation of the four core pathways across these two dimensions, including variations within each identified pathway category.

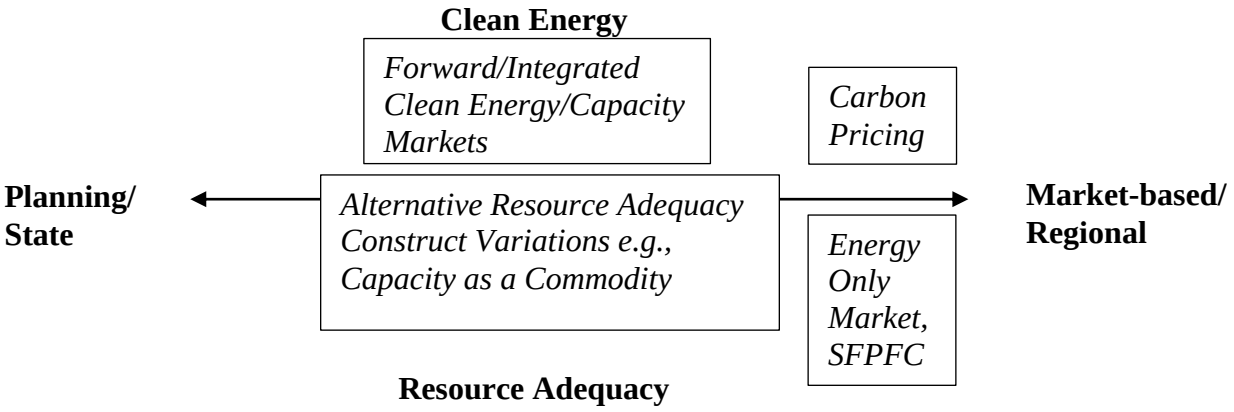

Figure 1: Conceptual Comparison of Pathways along Planning-Market-based and State-Regional Dimensions

When States set the type, quantity and timing of clean energy investments (i.e., planning), they have more control of outcomes and financing costs may be lower with longer and more certain guarantees than with other market mechanisms. Ratepayers, however, would ultimately bear the risk of such state-imposed requirements, whereas developers/investors take on the risks in the competitive markets. Regional market-based approaches/pathways may also result in lower costs than state integrated resource planning due to technology flexibility and decreasing costs of clean energy resources over time (although would still need to address potential market power and manipulation issues).

Each of the identified pathways has variations, some of which substantially alter the pathway's characteristics and outcomes. Moreover, many pathways could be combined with each other with varying degrees of merit, although EOM and ARACs are by definition mutually exclusive. Table 3 summarizes each pathway's objectives, whether they are regional or State specific, their major variations and design variables, and their organizational structure.

Table 3: High-level Comparison of Four Pathways and Major Variations

Major Components	Forward Clean Energy Market/Integrated Clean Capacity Market		Carbon Pricing	Energy Only Market	Alternative Resource Adequacy Constructs	
	Regional	State Specific	Regional	Regional	Regional	State Specific
Primary Objective	Clean Energy via regional coordination	Clean Energy by accommodating different States' objectives and procurement strategies	Reducing regional CO_2 emissions in the power sector and extending to other sectors	Resource adequacy via scarcity pricing	Resource adequacy	Resource adequacy and State Clean Energy objectives
Major Design Questions, Components and/or Alternatives	Forward auction of unbundled Clean Energy Attribute Credit (CEAC) Integrated with FCM or not Explicit BR requirements Definition of Credit CEAC; static or Dynamic CEAC? Downward sloping demand curve of aggregated State or individual State clean energy goals? Demand curve reference price set to SCC or Clean Net CONE Multiple-year commitment period for new resources or not? Technology specific carve-outs or not? Grandfathering of existing contracts or not? Banking of CEAC restrictions if any Compliance via spot market and demand curve (to replace alternative compliance penalties)		Social cost of carbon equivalent to regional emission caps How to allocate the revenues from the sale of emission allowances or revenues from pricing CO_2? Use RGGI framework or pursue an alternative approach, e.g., via ISO-NE? How to extend to other non-power sectors?	VOLL that sets the ORDC cap Minimum quantity of reserves needed for system security Shape of the ORDC based upon LOLP*VOLL LOLP calculation Additional reliability adders to offset price suppression impacts of reliability actions Whether ORDC is co-optimized with SCED? Multiple reserve products and adders? Zonal/locational reliability adders Policies regarding reliability unit commitment	Definition of resource adequacy? Centralized or decentralized capacity market, standardized fixed-price forward contract (SFPFC), Capacity as a Commodity, Always on Capacity Exchange (AOCE) Regional or State Specific resource adequacy requirements? Fixed Resource Requirement option allowing for States/Load Serving Entities (LSE) to self-supply Regional Integrated Resource Planning (IRP) State IRPs that determine the combination of energy resources that meet the State's clean energy policy and resource adequacy requirements using long-term financial arrangements	
Contemplated Organizational Structure	ISO-NE market or RGGI-like organization?	Individual State sanctioned organizations	ISO-NE (net carbon pricing or RGGI or something else	ISO-NE	ISO-NE	Individual State structures

Both Carbon Pricing and EOM pathways fundamentally rely upon short-term, wholesale energy prices and their expectations (augmented by longer-term forward bilateral markets) to drive major capital investment decisions, whereas the FCEM and certain ARACs provide longer-

term commitments as part of their constructs.[10] Some of the variations of the ARACs are modifications to the existing ISO-NE forward capacity markets and therefore fit within the current wholesale market structure whereas other variations likely require a substantially different structure or institutional framework.

B. Forward Clean Energy Market and Integrated Clean Capacity Market Related Findings

In theory, co-optimizing the forward procurement of clean energy resources with capacity needed for adequacy would maximize the social surplus of meeting States' clean energy objectives and regions' resource adequacy requirements, but as noted above, it is not clear if this can be implemented in practice. If ICCM has multiple products, then co-optimization becomes more difficult, if at all, to implement because the co-optimization problem becomes more complicated as the types of products and requirements increase. Without co-optimization, resources offering into the FCEM would have to estimate their expected revenues in the FCM and if those estimates are incorrect, inefficient outcomes may result.

The value of co-optimizing the FCEM with the FCM, i.e., an ICCM, depends in part on the extent that resources have both clean energy and capacity attributes. The less they overlap, i.e., if clean energy attributes provide little capacity value or vice-versa, then co-optimization provides less benefits because there is little to co-optimize. If FCEM has multiple and individually targeted resources, then the value that a regional market provides is less than with fewer targeted resources because there is less flexibility across resources to optimize than without targeted resources. In other words, an FCEM design that limits eligibility to a more narrow or targeted set of resources or technology types would garner less efficiency benefits than an FCEM with a broader (more inclusive) definition of "clean energy" because the more types of clean energy resources that compete in the FCEM, the more cost-effective it will be.

C. Carbon Pricing Related Findings

Carbon Pricing alternatives are at the regional market end of the spectrum as indicated in Figure 3 and do not necessarily result in desired State outcomes, whether levels of CO_2 reductions or deployment of specific technologies.[11] Under Carbon Pricing, it is possible that carbon emissions do not decrease sufficiently to meet States' ambitious carbon reduction goals and requirements. Instead, generation units pay the Carbon Pricing to emit perhaps above the

[10] In light of a recent New England FERC Order, careful consideration should be given as to whether these constructs would withstand scrutiny before the FERC. On December 2, 2020 FERC issued an order finding that ISO-NE's current 7-year price-lock mechanism for new capacity resources is no longer just and reasonable and directed ISO-NE to remove them from the Tariff. Specifically, the FERC found that, "in light of changed circumstances, the New Entrant Rules are unjust and unreasonable because they result in unreasonable price distortion." The FERC further found that the FCA price assurance that the FERC previously found necessary in approving these rules is no longer required to attract new entry, with the benefits provided by price certainty no longer outweighing their price suppressive effects. FERC directed ISO-NE to submit a compliance filing, on or before February 1, 2021, eliminating the price lock rules for new entrants starting in FCA16. *See December 2 Order* at: https://www.iso-ne.com/static-assets/documents/2020/12/el20-54-000_12-2-20_order_new_entrant_rules.pdf.

[11] For ease of explanation, the terms *carbon pricing* and *carbon emissions* are used generically to cover carbon dioxide and other greenhouse gases.

total emission levels set by States. States still could use their RPS combined with other policies to meet specific their specific clean energy goals with Carbon Pricing. Compared to options that are designed to procure clean energy resources such as FCEM, ICCM and integrated resource planning, Carbon Pricing using the SCC (either explicitly or setting emission caps to reflect the SCC) is generally viewed as more economically efficient these alternatives. Carbon Pricing does work by increasing the wholesale price of electricity, which does incentivize demand reduction but may not be politically palatable.

New England is part of the Regional Greenhouse Gas Initiative (RGGI), which prices carbon emissions using a cap-and-trade mechanism. The Carbon Pricing pathway would almost certainly increase the price put on carbon above that which is presently set implicitly through RGGI in order to achieve States' decarbonization goals. One way for New England to do this is via RGGI by agreeing to lower States' emission caps over time at a much faster rate than currently planned. Another Carbon Pricing alternative is for the SCC to be internalized into the offers of carbon emitting resources (after netting out the implicit price of carbon embedded in RGGI). These resources would have to pay the SCC minus the RGGI cost. If this is implemented by the ISO-NE, presumably FERC approval would be needed. The payments applicable generators would make to emit carbon would be collected by the ISO-NE and rebated to LSEs. The NYISO has developed a proposal along these lines that may serve as a starting point for discussions (NYISO, Jun. 20, 2019). One major issue is how to define precisely how the carbon revenues are allocated to LSEs. The Carbon Pricing alternative identified by ISO-NE, referred to as net-carbon pricing, contemplates having LSEs pay the net of the SCC minus what they receive via the rebates.

The cost to finance resources depends, in part, on policy certainty, which depends on the specific alternative within a given pathway but also on the underlying political jurisdiction and dynamics. Under Carbon Pricing, energy prices increase, thereby increasing the energy margins of low or non-emitting CO_2 resources. These resources offering into the FCM have larger energy margins with Carbon Pricing than without and recover more of their fixed costs in the energy market enabling them to be more competitive in the FCM given the MOPR. In the context of Carbon Pricing, an observed concern regarding financing is whether investors believe that sufficient carbon pricing will be implemented over the long-term to justify developing lower or non-carbon emitting resources. Some alternatives in other pathways have more direct, and longer-term commitments to finance resources than the Carbon Pricing pathway (e.g., FCEM and ICCM constructs).

The interaction with Carbon Pricing and RPS/RES could be complicated given the MOPR. With the MOPR's restrictions on offers, owners of low and non-emitting carbon resources must decide if they earn more profits by selling RECs and not participating in the FCM or not selling RECs and participating in the FCM. As Carbon Pricing increases, these resources may become economic in the FCM even with the MOPR because their energy revenues increase sufficiently so that the MOPR is no longer an impediment to clearing the FCM. Thus, Carbon Pricing would likely help to mitigate the double capacity payment concern that States have with the MOPR, although, as noted above, at the expense of raising wholesale energy prices.

If New England increases the price on carbon compared to other RGGI regions, then, depending on the increase, that may materially affect inter-regional power flows within RGGI and regions bordering RGGI and beyond. This could increase leakage, i.e., the importation of low-cost but carbon emitting resources into New England, unless a mechanism is devised to account for the carbon emissions of imports. Conversely, exports of power from New England would likely be relatively more expensive if New England increases its carbon prices.

D. Energy Only Market Related Findings

As noted above, the EOM removes the FCM and therefore would eliminate the current mechanism that the FERC is employing to address price suppression, although it is conceivable that the FERC could implement some type of MOPR analog for the energy market. If the FERC does not do so, then the EOM should permit States to individually or collectively pursue their clean energy policies without facing the current "double payment" issue associated with application of the MOPR in the FCM. Under this scenario, price suppression would occur, which raises issues regarding having sufficient BR to meet the reliability requirements with increasing penetration of VRERs. EOM and existing ancillary service markets may not provide sufficient flexibility and ramping services. The need for BRs due to the penetration of VRERs under an EOM pathway may be addressed either via current wholesale market mechanisms (energy, ancillary services) and/or new constructs.

Shortage pricing, the key feature of EOM, can be combined with FCM and its variations (e.g., FCEM and ICCM) and ARACs. Doing so shifts the focus of revenue recovery to day-ahead and real-time energy markets away from capacity markets. Shortage pricing does not necessarily ensure sufficient balancing resources that are likely to be needed in a future state to provide flexibility and/or ramping capability beyond just the production of energy.

E. ARACs Related Findings

As discussed in the prior section, the two ARACs that had stand-alone presentations at the NPC, SFPFC and Capacity as a Commodity, did not explicitly propose mechanisms for the procurement of clean energy resources. Since Capacity as a Commodity retains a capacity market, presumably the MOPR would still be in place and therefore the double capacity pricing issue would remain a concern.

Other ARACs may address the MOPR double-payment issue by eliminating the capacity market such as the SFPFC or implementation of regional or State integrated resource planning (IRP). IRP alternatives could retain the resource adequacy construct but not have a capacity market. IRP alternatives may have explicit BR requirements or leave BR procurement to an ISO-NE administered market or markets.

Another ARAC is a Fixed Resource Requirement (FRR), which PJM has as an option in its Tariff. This FRR option is would permit States or LSEs the ability to satisfy their resource adequacy requirements (outside of PJM's Reliability Pricing Model market) by having a portfolio of resources that they have procured to prospectively serve load over a period of time, such as five years that met the load's capacity obligation. This option in PJM was designed for

integrated utilities in States that do not have retail energy markets instead of LSEs that have much shorter time horizons than utilities given the mobility of load among LSEs. Based upon how current resource adequacy requirements are determined, the FRR does not address the need for BRs and may compound the problem if the capacity resources in the FRR are not BRs. FRR may also reduce the regional reach of the FCM and associated efficiency benefits of that auction and associated bilateral markets.

V. Summary

The New England region's discussions on, and exploration of, potential pathways to its future grid brings into focus the tensions between Federal wholesale markets and States' clean energy transition plans. In addition, the discussions I have observed to date have identified the importance of defining the criteria for determining the types and quantities of balancing resources needed to reliably plan and operate the regional power grid as the penetration of renewable energy resources increase. As these discussions continue, more detailed evaluations and assessments of pathways will be necessary (including quantitative analysis where able), which will require greater specificity on design details and probing the pathway's interaction with other regional policies such as transmission planning.

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