NEPOOL Participants Committee

Future Pathways

Round 1: Focus on Forward Clean Energy Market and Carbon Pricing:

Preliminary Observations and Request for Input

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Today's Presentation Will Cover

1. Overview: Purpose, Summary & Content, Pathways & Variations

2. Forward Clean Energy Market and Variations: Tradeoffs

   Break for Questions and Comments

3. Carbon Pricing: Tradeoffs

4. Next Steps:

   Questions, Comments, and Request for Input

5. Appendix: Abbreviations & References

Purpose of Project and Today's Presentation

Project Goal: By end of December, build a common understanding of Future Pathways by defining Pathways and their variations, describing key design variables, and analyzing tradeoffs among Pathways and Variations

1. Develop a common understanding of the Pathways and Variations

2. Analyze tradeoffs of Pathways (and Variations)

3. Receive input from stakeholders

OVERVIEW

1. **Overview**

   Context
   Clean Energy Investments and Their Linkages
   Retained ISO-NE Roles & Related Policies
   Pathways (identified to date; others may be proposed):
   - **Forward Clean Energy Market (FCEM)**
   - **Carbon Pricing (CP)**
   - **Energy Only Market (EOM)**
   - **Alternative Resource Adequacy Constructs (ARAC)**
   - **Integrated Clean Capacity Market (ICCM)**

2. Forward Clean Energy Market Pathway and Variations
3. Carbon Pricing Pathway and Variations
4. Next Steps
5. Appendix

Context: States Decarbonization with a Regional Grid and Markets

Presents preliminary observations on possible Pathways and initial request for input with focus on 2 Pathways

1. Presumes extensive and long-term effort to decarbonize the New England power sector and other energy sectors
2. Examines Pathways that have been proposed to integrate New England States' clean energy objectives with recognition that modifications to the region's wholesale market and power system may also require other changes
3. Compares Pathways across two key questions:
    1. Whether and to what extent the Pathway supports the clean energy policies of States?
    2. Whether and to what extent the Pathway garners efficiency of regional markets?

Pathways Retain ISO Functions and Their Success Depend on Many Other Polices

1. 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

2. 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

3. The outcomes of the Pathways depend on how they interact with the following:

   energy dispatch and curtailment, unit commitment, ancillary service definition and opportunity costs, imports and exports of power, bids and offers 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

Today's Focus is on Two Pathways and Some of Their Variations

1. **Forward Clean Energy Market (FCEM)**
   1. **Numerous variations**

2. **Carbon Pricing (CP)**
   1. **With the RGGI framework (RGGI+)**
   2. **LMP carbon pricing in New England (LMP-C)**
   3. **Carbon pricing external to ISO-NE**

3. Energy Only Market (EOM)

4. Alternative Resource Adequacy Constructs (ARAC)
   1. Fixed Resource Requirement (FRR)
   2. Regional Integrated Resource Planning (R-IRP)
   3. Others?

5. Integrated Clean Capacity Market (ICCM)

Today's presentation focuses on FCEM & CP

FORWARD CLEAN ENERGY MARKET (FCEM)

1. Overview
2. **Forward Clean Energy Market and Variations**

   FCEM Numerous Variations
   Regulatory-Market Tradeoffs

3. Carbon Pricing
4. Next Steps
5. Appendix

The FCEM Pathway Has Numerous Variations

FCEM Core Market Components

1. Unbundled Clean Energy Attribute Credit (CEAC): resource-neutral, uniform product, additional types of resources eligible than RECs
2. 3-year forward auction with 7-year commitment for new resources
3. Downward sloping demand curve
4. Bilateral and spot market trading

Major FCEM Market Design Variations

1. Static or dynamic CEAC
2. Demand curve anchored by social cost of carbon (SCC) or Clean Net CONE (CN-CONE)
3. Whether to allow targeted resource types
4. Whether FCEM is co-optimized with the ISO-NE FCM
5. Whether preexisting clean energy commitments are removed from the demand curve

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

Regulatory-Market Tradeoffs of FCEM Variations

Regulators Set Quantities, Technologies & Timing

Markets Set Prices

Vertical Integration | Integrated Resource Planning | FCEM Targeted Resources & Grandfathering | FCEM-CN-CONE & Static CEAC | FCEM-SCC & Dynamic CEAC | Carbon Pricing

1. The many FCEM variations are located at different places on the regulatory-market continuum
2. Fundamental tradeoff between imperfect regulation and imperfect markets

<u>Tradeoffs</u>

States have more control of outcomes

Ratepayers bear regulatory risk

Lower cost of capital with longer financial guarantees

States have less control of outcomes

Developers bear market risk

Lower costs due to technology flexibility and decreasing costs

There are Numerous FCEM Variations

Regulators Set Quantities, Technologies & Timing

Markets Set Prices

FCEM Design Choices

Dynamic CEAC	NO	NO	NO	NO	YES	NO	NO	NO	YES	YES	YES	NO	YES	YES	YES	YES
Social Cost of Carbon	NO	NO	NO	YES	NO	NO	NO	YES	NO	NO	YES	YES	NO	YES	YES	YES
Base Resources - No Targeted Resources	NO	NO	YES	NO	NO	YES	NO	YES	NO	YES	NO	YES	YES	NO	YES	YES
No Pre-existing resource commitments	NO	YES	NO	NO	NO	NO	YES	NO	YES	NO	NO	YES	YES	YES	NO	YES

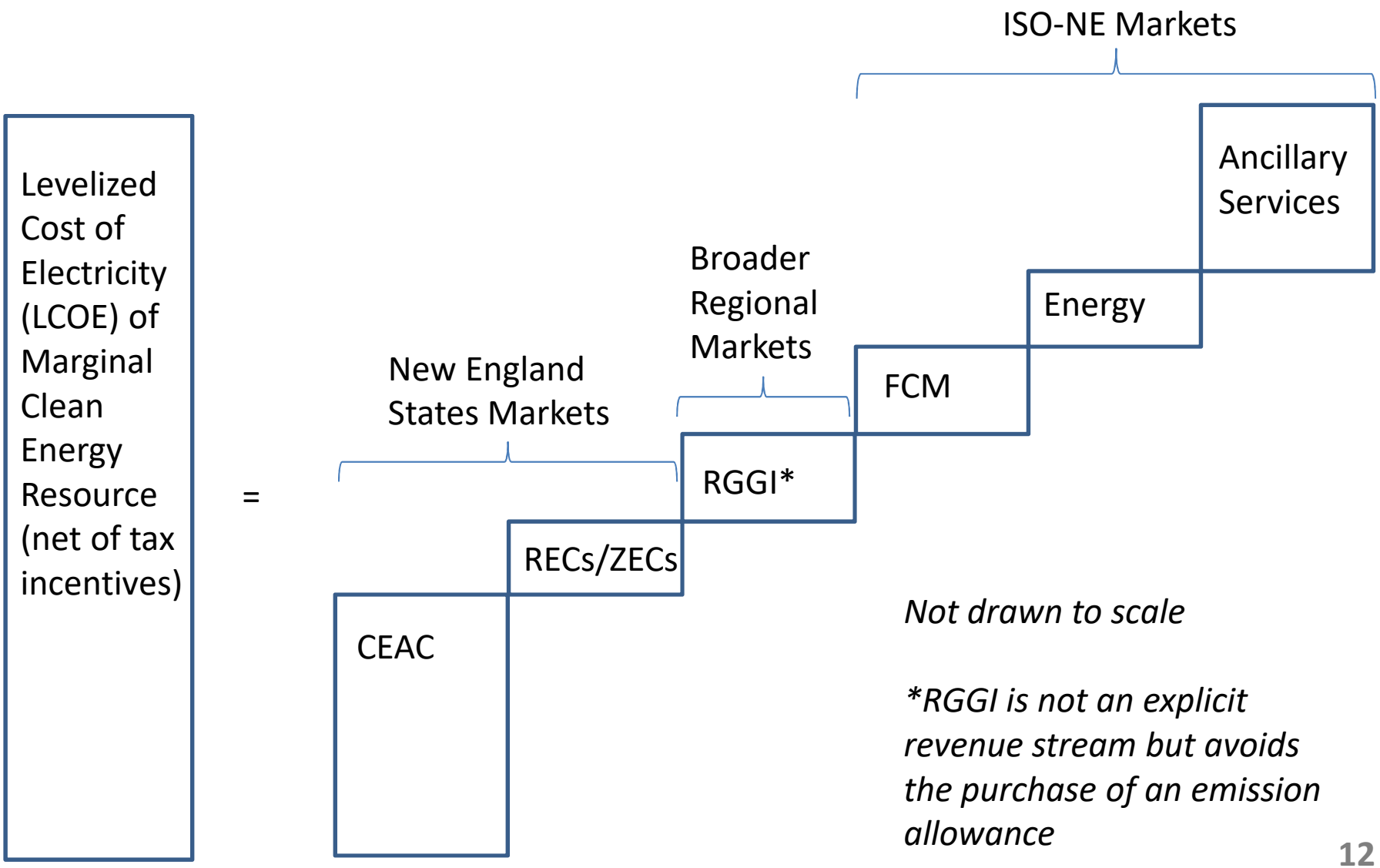
More likely to achieve States specific resource objectives

More likely to achieve efficiency

Additional Observations

1. The States need to determine if they can agree on the key design features of a FCEM
2. Having multiple States' FCEMs would be administratively challenging
3. FCEMs impact on ancillary services requirements including whether FCEM resources can be curtailed should be considered
4. How the FCEM market is monitored and mitigated should be considered

FCEM Revenue Streams for Clean Energy Resources



Not drawn to scale

**RGGI is not an explicit revenue stream but avoids the purchase of an emission allowance*

FCEM, Dynamic CEAC, SCC, No Targeted Resources

- Over time, revenue streams shift from ISO-NE markets to the New England States' FCEM
  - Single, region-wide CEAC price would likely provide major source of revenue for clean energy resources
  - RGGI allowance and energy prices decrease
  - If States retain RPS/RES, whether resources can sell both RECs and CEACs or only one of them affects if and how each of these markets clear and at what prices
- Dynamic CEAC likely incentivizes reduction of CO_2 emissions and development of energy storage
- Compared to Clean Net CONE (CN-CONE), using the social cost of carbon (SCC) to anchor the FCEM demand curve emphasizes efficient CO_2 emission reductions over specific amounts of reductions and particular resource technologies

FCEM, Dynamic CEAC, SCC, No Targeted Resources (con't, 1)

- LCOE Marginal Adequacy Resource is likely combustion turbine (CT) recovering capital costs in FCM and operating costs in energy and ancillary service markets or energy storage recovering capital costs in FCEM and operating costs in energy and ancillary service markets
  - With large amounts of renewables, resource adequacy requirements may need to be set based upon satisfying demand over multiple cloudy, non-wind days (not unique to FCEM)
  - With large amounts of renewables, additional changes to the ancillary services markets may need to occur to ensure sufficient flexibility to balance supply and demand over various time steps
- Energy prices close to zero (but still have congestion and marginal loss components) but periodically spike to clear the energy market

FCEM, Dynamic CEAC, SCC, No Targeted Resources (con't, 2)

- If new clean energy resources procured via a FCEM do not clear the FCM due to a MOPR rule, then States will have achieved their clean energy resource goals but without garnering the financial value of resource adequacy that those resources provide, so called "double payment"
- If new clean energy resources procured via a FCEM clear the FCM because the FCEM provides them with additional cost recovery that would not have occurred but for the FCEM, then capacity and energy prices would be lower than without the FCEM, so called "price suppression"
  - An economic efficiency analysis of "price suppression" depends, in part, on the SCC
    - If SCC = 0, out-of-market payments inefficiently reduce prices
    - If SCC > 0 (which it is), then the combined efficiency impact of reducing emissions by using out-of-market payments while suppressing prices needs to be considered
  - A reliability analysis of "price suppression" depends, in part, whether changes to resource adequacy and ancillary services requirements and markets are necessary to account for the impact of substantial increases of renewable energy (same applies to CP)

FCEM Bookend Comparison

FCEM Structure	Clean Energy Investments	FCEM	FCM	Energy & Ancillary Services
Dynamic CEAC, SCC, No Targeted Resources	SCC may not be sufficient to achieve States' decarbonization goals or technological outcomes	Major source of revenue recovery for clean energy resources over time Multiple technologies compete to provide CEACs, lowering costs to satisfy demand	Price in FCM depends if marginal adequacy resource is CT or energy storage	<u>Applies to both cases</u> <u>Energy</u> prices are typically near zero with congestion and marginal loss components but periodically spike to clear the market <u>Ancillary services</u> Increase in importance to ensure sufficient flexibility to match supply and demand over multiple time scales Opportunity cost of providing ancillary services includes not producing a CEAC for qualifying resources
Static CEAC, Clean Net CONE, Targeted Technologies,	States achieve specific technology outcomes and carbon reduction goals	Dominant source of revenue FCEM has multiple tiers of pricing to accommodate targeted technologies at higher cost than without Non-competitive outcomes may result due too narrowly defined targets	Static CEAC does not support storage but FCEM targets may do so	

Co-optimizing FCEM with FCM

- In theory, co-optimizing would maximize the social surplus of meeting States' clean energy objectives and regions' resource adequacy requirements
- Not clear if can be implemented in practice*
- Without co-optimization, resources offering into the FCEM will 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 depends in part on the extent that resources in one can participate in the other; the less the overlap, the less the benefits that co-optimization provides

* 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

Co-optimizing FCEM with FCM (con't)

- If FCEM has multiple targeted resources, then the value that co-optimization provides is less because there is less flexibility across resources to co-optimize than without targeted resources
- If FCEM has multiple products, then co-optimization becomes more difficult, if at all, to implement
- If FCEM (or other pathways) fundamentally changes the location of generation resources on the grid compared to current resources, then the joint optimization/planning problem of generation and transmission becomes very important

BREAK FOR QUESTIONS AND COMMENTS

CARBON PRICING (CP)

1. Overview
2. Forward Clean Energy Market and Variations
3. **Carbon Pricing**

   CP Variations:
   - **RGGI**
   - **LMP-C**
   - **New England Carbon Pricing external to ISO-NE**
   - **Economic Efficiency vs State Energy Objectives**
   - **Administrative tradeoffs**

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CP* Variations

RGGI: Cap & Trade

1. Set emissions cap
2. Define and allocate emission allowances
3. Establish penalty for non-compliance
4. Allow for bilateral trading
5. RGGI has other offramp and banking policies that keep emission allowance prices within a bandwidth

LMP-C: Carbon Price

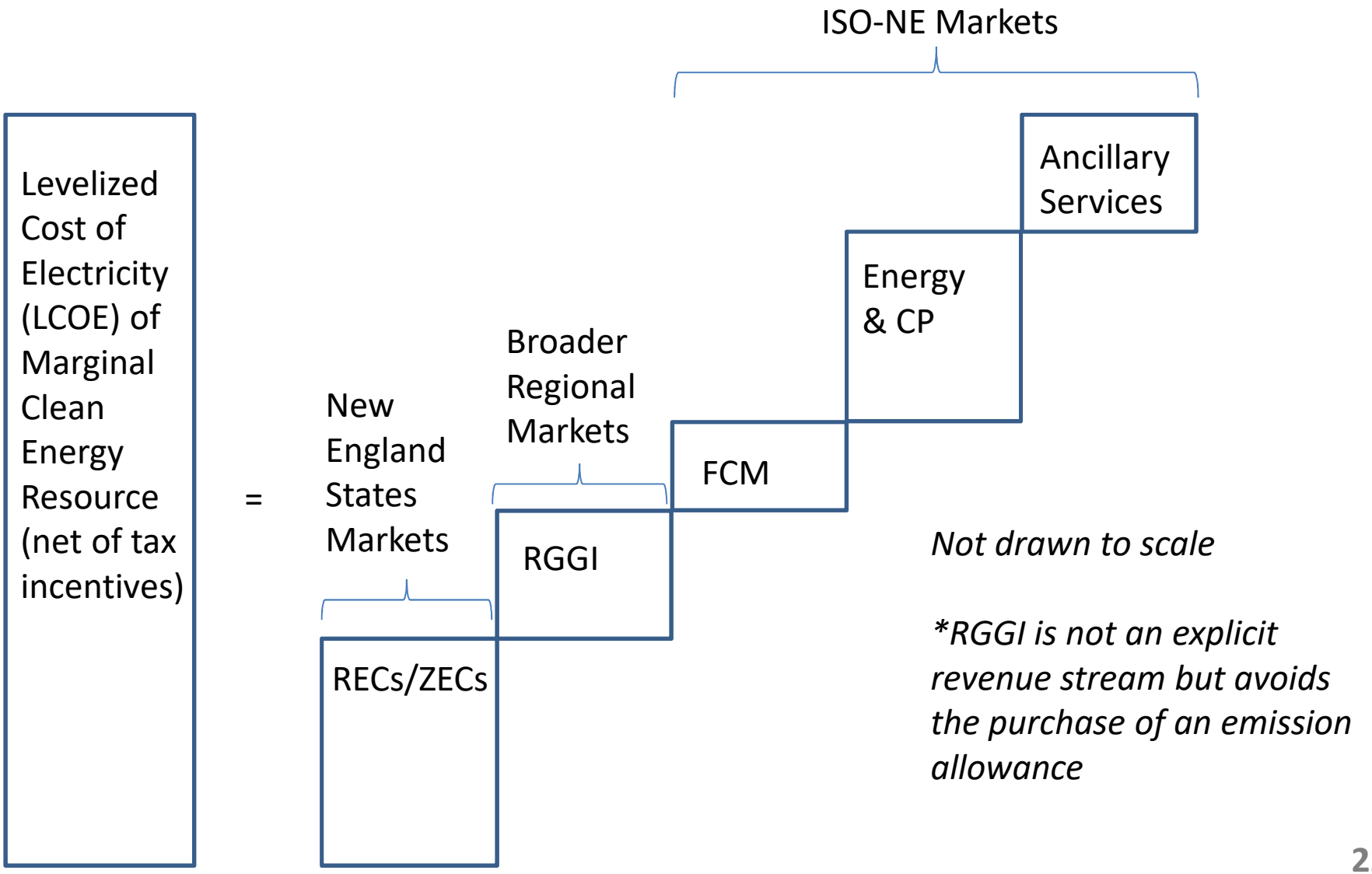
1. SCC is selected
2. ISO-NE administers carbon pricing as part of LMP
3. LMP-C nets out RGGI allowance cost (if done in conjunction with RGGI)
4. Revenues from LMP-C are allocated, e.g., to load

Carbon Tax External to ISO-NE

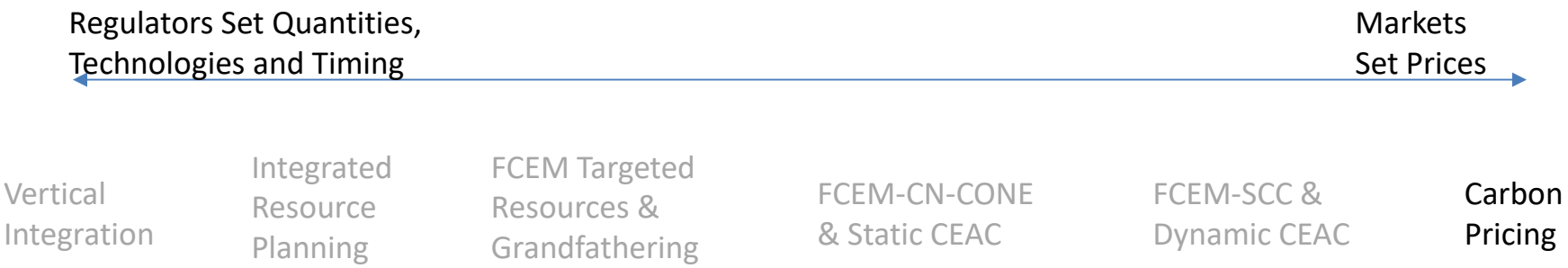
1. New England States select carbon tax
2. Carbon tax could account for RGGI allowance cost
3. New England States collect carbon tax from fuel suppliers and allocate revenues or
4. ISO-NE collects the tax from emitting generators

*Carbon pricing is used as a shorthand term for $/$CO_2$ ton, which accounts for the molecular weight of carbon dioxide

CP Revenue Streams for Clean Energy Resources

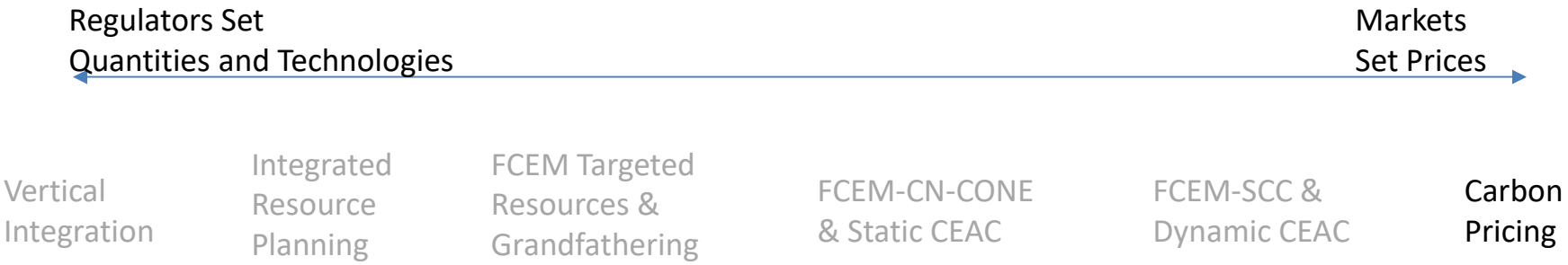


Some Observations on CP Variations



1. CP approaches do not necessarily result in desired State outcomes, whether levels of CO_2 reductions or deployment of specific technologies, although States still could use RPS/RES to meet specific State clean energy goals (although may be subject to MOPR)
2. Compared to FCEM, CP is more economically efficient due to resource flexibility and using SCC

Some Observations on CP Variations (con't)



1. RGGI variation uses an existing, non-FERC jurisdictional organization
2. RGGI variation may require negotiations with non-New England States
3. LMP-C pricing would be FERC jurisdictional and require tariff changes
4. LMP-C with existing RGGI may be administratively cumbersome
5. The cost to finance resources depends, in part, on policy certainty, which depends on the Pathway and Variation but also on the underlying political jurisdiction and dynamics

CP-RGGI+ vs CP New England Alone (LMP-C or Tax)

- To achieve major CO_2 reductions, RGGI's emission cap must be substantially reduced so that prices of emission allowances are close to the SCC **(or substantial carbon price)**
- Energy prices increase in near to medium term, increasing the energy margins of low or non-emitting CO_2 resources
- With MOPR, low and non-emitting CO_2 resources decide if it is more profitable to sell RECs and not participate in the FCM, not sell RECs and participate in the FCM, or become economic in the FCM because their energy revenues increase so that the MOPR is not longer an impediment to clearing the FCM

CP-RGGI+ vs CP New England Alone (LMP-C or Tax)

- Low and non-emitting CO_2 resources offering into the FCM have larger energy margins and recover more of their fixed costs in the energy market enabling them to be more competitive in the FCM
- RGGI emission allowance prices increase under RGGI+, which may affect inter-ISO energy transfers (with likely more changes in energy transfers with CP New England Alone than with RGGI+)
- Less carbon leakage will occur with RGGI+ than with CP New England Alone

Additional Comparisons Between RGGI+ vs LMP-C or Carbon Tax

RGGI+

- Sets cap, so emission reductions (subject to RGGI offramp policies) are ensured
- If cap is too high, zero or small reductions occur
- If cap is too low, price of allowances is high (although allowance banking and resetting the cap can mitigate this)
- Requires agreement among RGGI States

LMP-C or Carbon Tax

- Sets carbon price so emission reductions are not guaranteed but the cost of the policy is capped
- If carbon price too low, low amounts of emission reductions occur
- If carbon price is too high, wholesale electricity prices rise more than necessary

NEXT STEPS

1. Overview
2. Forward Clean Energy Market and Variations
3. Carbon Pricing
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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, October 15 or sooner; all comments will be posted on the NEPOOL website

3. Preparation of similar presentation for Nov. 5 NEPOOL Participants Committee Meeting on preliminary observations on other identified Pathways: Energy Only Market, Alternative Resource Adequacy Constructs, Integrated Clean Capacity Market and possibly others

4. Additional presentation in December with goal to issue final report by end of the year, which will be circulated as a draft for comment

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

VOLL: Value of Lost Load

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