NEW ENGLAND POWER POOL

PROPOSED AGENDA

Integrating Markets and Public Policy (IMAPP)
Solution Ideas Day
August 11, 2016
Colonnade Hotel, Boston, MA

Opening Plenary Session 10:00 a.m. - 12:30 p.m.

- Introduction and Overview of IMAPP Process
- Presentation and Discussion on Potential Solutions
  - Public Power Representative
  - National Grid
  - RENEW
  - Conservation Law Foundation
  - AR/End User Sector Representative

Lunch Break 12:30 - 1:00 p.m.

Closing Plenary Session 1:00 - 5:00 p.m.

- Continued Presentation and Discussion on Potential Solutions
  - Exelon
  - NextEra
  - FirstLight Power Resources
  - NRG
  - High Liner Foods
  - Acadia Center
  - Environmental Defense Fund
- Concluding Remarks/Discussion of Next Steps

Integrating Public Policy & Markets in New England

August 11, 2016

Presented on Behalf of:

New England's Publicly Owned Entity Sector

Overview

- Process Improvement Considerations
- Overarching Objective
- Current ISO-NE Objectives
- Additional Objectives
- Market Structure Considerations
- Centralized Market Alternative Solutions
- Voluntary Bilateral/Centralized Residual Market Alternative Solutions
- Final Thoughts

Disclaimer

- The region's public power systems believe that the New England region is rapidly approaching a turning point.
- Consumers and policymakers have lost confidence that as an industry we can achieve the objectives they believe are critical.
- We have put this presentation together with the goal of identifying the widest possible range of potential alternatives.
- ***Inclusion of a potential solution in this presentation should not be interpreted to mean that any individual public power system, or public power collectively, will necessarily support any or all of these alternatives once the final details are developed.***

Process Improvement Considerations

- The current wholesale electricity market structure is not achieving outcomes desired by policymakers and electric consumers in general:
  - Increasing dependence on natural gas, combined with a limited natural gas transport capability
  - Retail rates remain significantly higher than the national average (and the gap is getting wider)
    - Lack of trust in markets is driving customers to seek control over costs by installing “behind the meter” resources whether or not they make economic sense.
  - Retirement of existing resources, including nuclear unit retirements
  - Ability to meet environmental stewardship objectives
  - Challenges getting low/no carbon energy resources qualified and cleared in Forward Capacity Market

Process Improvement Considerations

- The starting point for process improvement needs to be defining the set of objectives we are looking to achieve (i.e. agree on “What constitutes success…”)
  - Objectives and goals define structures and design approaches
  - Structures and design approaches drive outcomes
- The process also needs to focus on achieving a balance between the range of potentially conflicting policy objectives that many consider to be important.

Overarching Objective

- Public Power believes that the overarching objective for the New England region is:
  - ***Maintain reliability at the lowest reasonable cost to consumers, taking into account the broad range of policy goals defined and agreed upon by policymakers within the New England States.***
- Public power believes that competitive market solutions can and should be used in achieving these overarching objectives, but only when they actually deliver value to electric consumers.

Current ISO Objectives

- Based on the Participants Agreement, the current ISO Mission is much more narrowly defined:
  - Assuring the New England bulk power system conforms to proper standards of reliability; and
  - Creating and sustaining economically efficient markets for energy, capacity, and ancillary services.

Additional Objectives Not Included in ISO Mission

- Public Power believes that there are at least three additional objectives that need to be incorporated into the ISO Mission:
  - Maintaining a diverse supply of fuels for producing and pricing electricity to mitigate risk and exposure to extreme events.
  - Reduce consumer costs by narrowing the gap between retail electric prices in New England and retail electric prices in other parts of the country.
  - Meeting environmental stewardship requirements, including preserving existing low/no carbon resources.

Market Structure Considerations

- The current centralized procurement structure puts ISO in the role of being the single wholesale buyer and the single wholesale seller in the region.
  - All generation gets delivered to the ISO markets at a price defined by the ISO Market Rules.
  - All load gets served through the ISO markets at a price defined by the ISO Market Rules
- ***If, as a region, we want to preserve this "single buyer-single seller" structure, the additional objectives identified above need to be explicitly included as part of the ISO-NE Mission.***

Alternative Solutions under Centralized Market Structure

- Revisit the concept of multiple pricing “tranches” or “tiers” in the Forward Capacity Market, with quantities for non-dispatchable and/or low-no carbon resources modeled as constraints in the auction clearing process.
- Consider replacing the Forward Capacity Market with a “Texas-style” energy-only market with an Operating Reserve Demand Curve (ORDC), that allows prices to get very high, but only when the system gets short of reserves.
- Impose a substantially higher price for carbon (possibly for all uses) within the region.
- Consider market rule changes to permit greater deployment of distributed energy resources consistent with state policies while providing transparency to ISO-NE but preserving customer control over procurement and operating decisions.

Voluntary/Residual Market Alternative

- If we cannot agree on modifying the ISO Mission, a much different structure is needed.
  - In the first instance, consumers, States and other consumer interests should be enabled to procure and pay for resources to meet their overarching objectives.
  - ISO would remain responsible for procuring any additional resources needed to meet its ongoing reliability and economic efficiency objectives through a residual market structure.
  - ISO would remain responsible for short term operations and coordinated market settlements for the region much like it does today.

Voluntary-Residual Market Structure

- ISO, State representatives, and regional stakeholders develop a set of incremental design changes and resource requirements (the “Coordinated Plan”) to meet reliability, market efficiency, environmental policy and other design goals.
- Responsibility for advancing design changes and procuring resources on behalf of load also established as part of this process.
- Responsible parties have a period of time (in advance of delivery date) to certify changes and/or procure resources. (Note, must be compatible with *Hughes v. Talen* decision.)
- After this date certain, ISO responsible for addressing any “residual” needs not otherwise met through the Coordinated Plan. (Based on existing short-term reliability and market efficiency objectives.)

Final Thoughts

- Public Power believes that New England is at a crossroad, similar to what we faced almost 20 years ago when we embarked on the path of electric restructuring.
- Consumers are increasingly frustrated, distrustful, and have options and opportunities that few would have believed existed 20 years ago.
- The region's public power systems stand ready to work on recapturing this trust and continue contributing to this process.

Publicly Owned Entity Sector Perspective on
Integrating Public Policy Objectives into the Wholesale Electric Markets

June 3, 2016

Both the ISO-NE Board and the New England States have requested the NEPOOL Sectors to provide more specific input on potential alternative solution spaces to integrate broader public policy objectives for the regional electricity sector with the existing wholesale electric market design. The States are obligated to achieve outcomes that are consistent with State energy policies and environmental laws. While the States have expressed a strong preference for utilizing sustainable competitive markets to achieve these objectives, achieving the outcomes associated with these energy policy and environmental objectives is most important.

This document attempts to provide some thoughts on potential "paths forward" for achieving these objectives. We come at this from the perspective that for process improvements, objectives and goals define the structures and design approaches and structure and design, in turn, drives outcomes. As a starting point, we need to agree on a set of desired objectives for the region before evaluating (or re-evaluating) specific structural and design alternatives to achieve outcomes consistent with those objectives.

Most of our thoughts have focused on implementing broad-based and longer term changes to the current wholesale electric market design. We also recognize that there may be nearer term actions that may be possible to help start us down the path of achieving the results contemplated by the broader based State policy objectives. Since it seems to be in vogue today, the Public Power Sector is not averse to considering a "Combo Platter" of short and long term initiatives to achieve the desired outcomes.

Overarching Objective

For this effort to be effective, we believe that it is important to develop an overarching objective that will help guide discussions. For Public Power, this overarching objective has been (and will continue to be) the following:

> *Maintain reliability at the lowest reasonable cost to consumers, taking into account the broad range of policy goals defined and agreed upon by policymakers within the New England States.*

Public Power also recognizes that competitive market solutions can and should be used in achieving this overarching objective, but only where they actually deliver value to consumers.

ISO Objectives and State Policy Objectives

Based on the Participants Agreement, the Mission of ISO-NE is narrowly defined:

a) Assuring the New England bulk power system conforms to proper standards of reliability; and
b) Creating and sustaining economically efficient markets for energy, capacity and ancillary services.

The Policies and Markets Problem Statement circulated by the States does a good job of illustrating how such a narrow mission presents challenges in meeting the "states' legal obligation to execute state energy and environmental laws." Based on discussions within the Public Power Sector and discussions

with various State and other representatives, we believe there are at least three additional objectives that are not incorporated into the current ISO Mission. These are:

a) Maintaining a diverse supply of fuels for producing and pricing electricity;
b) Narrowing the gap between retail electric prices in New England and retail prices in other parts of the country; and
c) Being good stewards of the environment.

The Current Wholesale Market Structure Drives Outcomes

The current centralized procurement structure of the wholesale electric markets puts the ISO in the role of being the single wholesale buyer and the single wholesale seller in the region. Effectively all generation gets delivered to the ISO markets at a price defined by the ISO Market Rules. Similarly, virtually all load gets served through the ISO markets at a price that is defined by the ISO Market Rules.

Because the current ISO Objectives do not reflect the overarching objectives that are codified in State laws and/or critical to the States and consumers in general, it is not surprising that the current ISO market structure is not delivering the outcomes required for the region to meet these policies. The exclusive emphasis on market efficiency contributes to these "sub-optimal results" with respect to meeting the requirements of these overarching objectives. Specific examples include the following:

a) The concentration of new gas-fired generation in the resource mix, presenting commodity supply reliability concerns and adding to price volatility;
b) Challenges to getting new low/no carbon resources to clear in the capacity markets; and
c) Lack of trust in wholesale and retail market outcomes driving consumers to install "behind the meter" distributed generation whether or not it makes economic sense.

Two Paths to Achieving the Overarching Objectives

The region's Public Power systems do not believe that the current system is meeting the expectations of the region's electric consumers. We do not believe that putting additional "Band-Aids" on the current wholesale market rules will achieve the results that the States and consumers are looking for without either 1) changes and expansion of objectives ISO is trying to achieve through the current centralized procurement structure, modified as necessary to accommodate the revised objectives, or 2) changes in the wholesale market structure to reflect a coordinated planning and long-term procurement process designed to achieve outcomes that meet State energy and environmental policies, with ISO managing residual requirements not otherwise satisfied by the Coordinated Plan to meet reliability and market efficiency objectives.

If, as a region, we want to preserve the centralized, "single buyer, single seller" wholesale electric market structure, then as a starting point the ISO's mission needs to be expanded to explicitly incorporate the additional energy and environmental policy objectives agreed upon by the States and the other stakeholders in the region. This would then allow consideration of alternative market design changes to achieve outcomes consistent with the broader and integrated policy objectives. Specific design alternatives to consider include the following:

a) Revisit the issue of "tranches" in the capacity market, with (minimally) a defined tranche (or tranches) for resources that are not dispatchable and/or have limited fuel and/or low/no carbon emissions.
b) At the recent Restructuring Roundtable meeting, Professor William Hogan and a number of others suggested replacing the current Forward Capacity Market construct with a "Texas-style" Operating Reserve Demand Curve (ORDC) structure that would allow energy market prices to get very high when the system starts getting short of reserves.
c) Impose a substantially higher price for carbon (possibly for all uses) within the region.
d) Other options?

On the other hand, if we cannot agree on an expansion of the current ISO Objectives, then we should pursue as a region development of a much different approach designed to achieve coordinated planning and long-term procurement of our needs. This would leave ISO in a position to manage any additional needs, and efficiently transfer supply and demand obligations though residual markets, to address short-term trends not met through the Coordinated Plan. While this approach requires much greater and more detailed definition, key steps along this path include the following:

a) ISO works with State representatives and regional stakeholders to develop a set of incremental system design changes and resource requirements (the "Coordinated Plan") to meet an integrated set of reliability, market efficiency and environmental policy goals.
b) Responsibility for advancing these system design changes and procuring the identified resources on behalf of load interests would also be established as part of this process.
c) Responsible parties would have a period of time (in advance of an annual delivery date) to implement system changes and/or procure resources. Such procurements may be through long-term contracts, short-term procurements and/or other mechanisms, with compensation mechanisms to be determined. Any such structure must be compatible with guidance from the Supreme Court in the *Hughes v. Talon* decision.
d) After this "date certain", ISO would be responsible for addressing any residual needs not otherwise met through the Coordinated Plan based on its existing short-term reliability and market efficiency objectives.

<u>Observations and Conclusions</u>

We believe that the New England region is rapidly approaching a turning point. Consumers have lost confidence that as an industry we can achieve the objectives that they believe are critical. Load defection is real, and electric consumers increasingly have options to meet their needs that very well could adversely affect the ISO's ability to achieve its narrow objectives. Trying to "draw a line in the sand" and prevent these changes is certain to lead to more controversy and pressure for even more sweeping changes. The fact that retail electric prices in New England remain well above the national average (and are probably even more above the national average than they were in the late 1990s and early 2000s when we embarked on wholesale electric market restructuring) further underscores the need to get past "business as usual". We believe that after 20 years of experimentation the time is right to once again consider "Big Ideas" and Big Changes" that are aimed at delivering value to the region's electric consumers.

The region's public power systems stand ready to contribute to this process.

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A Forward Clean Energy Market for New England?

Timothy J. Brennan

Integrating Markets and Public Policy (IMAPP) Solution Ideas Day

August 11, 2016, Colonnade Hotel, Boston, MA

A Forward Clean Energy Market for New England?

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From "Policies and Markets Problem Statement" of May 17, 2016, available at http://www.nepool.com/uploads/IMAP_20160517_Problem_Statement.pdf:

"…*The challenge is finding a means to execute states' policy-related requirements at the lowest reasonable cost without unduly diminishing the benefits of competitive organized markets or amplifying the cost to consumers of implementing those state policies in order to maintain markets. In the same way that market mechanisms identify the lowest cost way to satisfy the region's reliability needs, states seek to determine whether market mechanisms can accommodate public policies without unreasonably increasing the costs to consumers. …*

…To be sustainable over time, markets must reasonably accommodate various policy requirements such as, for example, carbon-emissions …

… the states will be pleased to continue working with ISO-NE and NEPOOL to that end. The states are hopeful that New England will succeed in crafting a way forward that enjoys relatively broad support, cognizant of the timing imperatives."

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From "Policy and Markets: Goal Posts" of June 2016, available at http://www.nepool.com/uploads/IMAP_20160621_Goal_Posts_States.pdf:

"…*The high-level market design objective associated with potential competitive markets-based solutions is to (i) ensure a sufficient revenue stream to incent the construction and operation of new resources that are able to satisfy some states' current and future policy requirements as reflected in state laws, and (ii) provide support if and to the extent needed to existing non-carbon emitting resources to enable their continued viability if one or more states conclude their customers should provide support to such existing resources in furtherance of their state(s)' policy objectives. …*"

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- National Grid is pleased to have this opportunity to participate in this Integrating Markets and Public Policy (IMAPP) Solution Ideas Day and to offer one idea of a potential solution for consideration
- This is just one of many ideas National Grid continues to explore and consider as potential solutions for IMAPP issues
- As we move forward in this process National Grid welcomes the opportunity to receive feedback (questions, concerns, suggested improvements, etc.) from all stakeholders on this and any other potential solutions it may be able to offer for consideration
- National Grid also highly values the opportunity to learn of new ideas from others, as we attempt to find IMAPP solutions least disruptive to the competitive markets while being most cost effective for our customers

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- National Grid has previously presented (in 2011 or earlier) the idea of a Forward Renewable Capacity Market ("FRCM") as a potential solution to IMAPP issues
- The Forward Clean Energy Market ("FCleanEM") idea is, in almost every way, identical the FRCM idea, except that the procured product is "clean" energy rather than capacity
- While the FRCM may still be an idea worthy of further consideration, National Grid chose to present the FCleanEM idea today for the following reasons:
  - Most clean energy/carbon reduction goals are based on clean energy rather than clean capacity goals/measurements
  - The possibility of achieving the most effective results for customers by allowing potential clean energy resources to decide for themselves whether and how they can provide energy and/or capacity given their expected intermittency/capacity factors/performance during scarcity events, and their associated risk tolerance

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- **The Forward Clean Energy Market ("FCleanEM")**
  - **Like the existing Forward Capacity Market ("FCM"), clean energy commitments could be procured approximately 3.5 years forward through a competitive auction-based central procurement administered by ISO-New England**
    - **Allows new clean resources to compete with existing clean resources**
  - **Like the FCM, payments for cleared/committed clean energy would be provided , and charges from the appropriate load serving entities would be collected, when the clean energy is actually dispatched/delivered in the commitment period**
  - **Like the FCM, payments and charges would be governed and assured under a FERC-approved tariff**

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- **The states would be responsible for establishing and agreeing on the FCleanEM auction total requirements and any additional auction clearing constraints (*National Grid recommends avoiding/minimizing the use of additional auction clearing constraints which could limit competition and inhibit procurement of the cheapest clean energy for the region*)**
  - **Total of X MWh of qualified clean energy to be procured, plus(?), e.g., …**
    - **A minimum of X MWh of onshore wind must clear in Northern New England states?**
    - **A minimum of Y MWh of offshore wind must clear off the coast of Southern New England states?**
    - **Only clean energy offered below a certain clearing price will be procured?**
- **Like the FCM, new clean energy clearing the auction could choose to lock in the FCleanEM clearing price for up to seven annual commitment periods**

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- **Energy Cleared in an FCleanEM auction would be paid the higher of the FCleanEM auction clearing price and the energy market clearing price at the time the energy is delivered in the applicable commitment period**
  - **Any incremental costs would be allocated through the ISO-NE settlement system to the appropriate wholesale market participant serving the load in the state for which the clean energy was procured in the FCleanEM**
- **An example of remaining questions/details to be considered …**
  - **Would bidders be expected to assume responsibility for any significant transmission investments required (over an above direct interconnection facilities) for deliverability through existing constraints?**
    - **Answer could significantly affect FCleanEM auction clearing prices**

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- **Resources with clean energy clearing the FCleanEM could, but would not be obligated to, participate in the subsequent FCM auction for the same commitment period**
  - **Any FCleanEM revenues would be considered valid market revenues, not "out-of-market" revenues or subsidies, in the MOPR determination for FCleanEM resources also seeking qualification for participation in the FCM**
  - **ISO-NE would continue to be responsible for the qualification/determination of the ICR/resource adequacy contribution of such resources, regardless of the amount of clean energy cleared by such resources in the FCleanEM auction**

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- **A Forward Clean Energy Market has the potential to achieve the stated "Goal Posts"**
  - ***Enable reaction to different market conditions and changing public policy priorities over time (i.e., not assume that the requirements of state laws are static over time***
  - ***Focus on achieving longer-term goals (10-30 years) cost-effectively, with the ability to incorporate needed shorter-term mechanisms to achieve near-term policy requirements.***
  - ***At a minimum, enable the achievement of the current RPS requirements of each state.***
  - ***In the near-term, consider the need to accomplish current policy objectives under discussion including, for example, up to 2,400 MWs of hydropower and 1,200 MWs of on- or off-shore wind. These numbers are illustrative and could vary according to the outcome of current matters, including but not limited to the three-state Clean Energy RFP.***
  - ***E. Consider mechanisms to ensure consumers in any one state do not fund the public policy requirements mandated by another state's laws***
  - ***F. Attempt to minimize short-term financial effects to current existing resources.***

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- **A Forward Clean Energy Market administered by ISO-NE could potentially help New England States achieve their clean energy goals more efficiently, competitively, transparently, and cost-effectively for customers**

- **Questions?**

RENEW Northeast

Integrating Markets and Public Policy (IMAPP): Solution Ideas Day

August 11, 2016

About RENEW

An association of the renewable energy industry and environmental advocates united to promote renewable energy in New England and New York.

Disclaimer

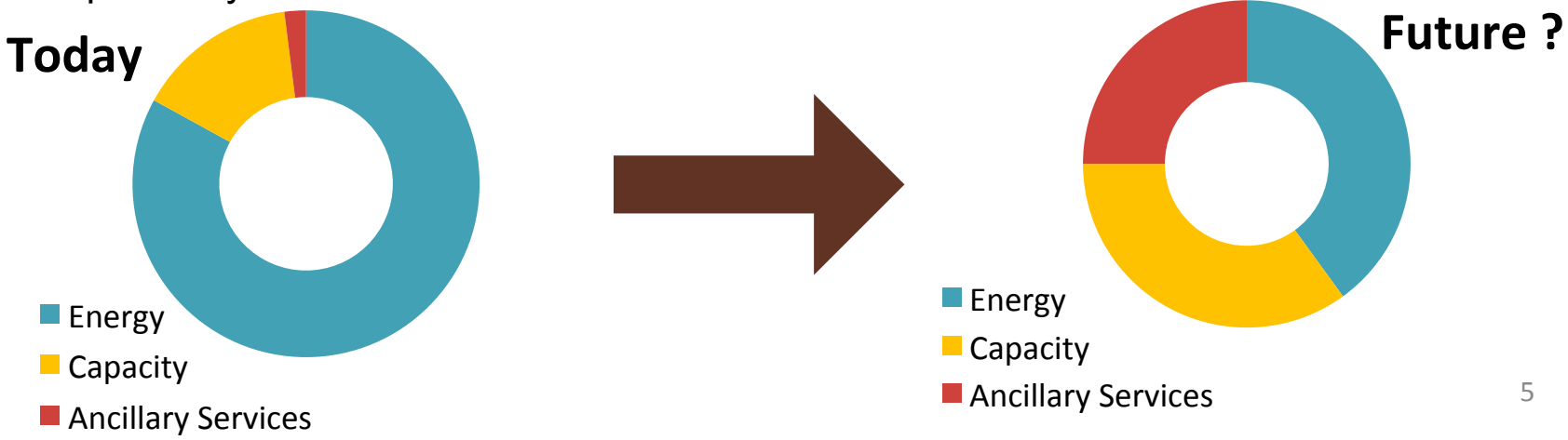
- RENEW does not yet endorse any specific ideas or approaches to integrating the New England wholesale electricity markets with public policy
- RENEW offers this presentation of principles and concepts that it believes are important in the consideration of any ideas considered as part of this IMAPP process
- The members of RENEW are still developing their own views and perspectives on this important topic and the views and perspectives expressed in this presentation should not be attributed to them

RENEW Principles

- Short term markets are not the only markets; historically, long-term contracts were standard feature of electricity markets
- Deregulated markets, while they have many benefits, have not created an environment conducive to the vigorous, competitive, long-term bilateral contracting that can provide great benefits to consumers and financial certainty to suppliers
- New renewable energy projects need long-term commitment for project finance; short-term energy markets simply do not create sufficient certainty of long-term capital cost recovery
  - With no fuel cost, economics of CapEx v. OpEx are very different
- Long term commitments must have low regulatory risk to be financeable. This has historically meant contracts rather than tariff rates.
- To achieve the greatest efficiency and productivity, any long-term commitment mechanism should incorporate production incentives

RENEW Principles

- Market mechanisms should not fight state policies. States have legitimate desire to foster clean energy resources and reduce emissions.
- Today, states favor long-term PPAs to get new renewable resources built.
  - An ISO-administered market mechanism to provide stable long-term revenue for new clean energy generation could work alongside state-mandated PPAs – even reducing PPA prices.
- Legacy and off-contract clean energy generation needs to have adequate revenue to stay economic
- Sufficient balancing resources (including fossil) need to have adequate revenue to stay economic to maintain system operability
  - This may not necessarily come from the energy market as capacity factors diminish and energy prices are reduced as a result of robust non-fossil supply. The capacity and ancillary services markets will need to provide enough revenue to maintain system operability in that environment.



RENEW Principles

- Ongoing efforts to address interconnection and transmission issues must proceed apace either as part of IMAPP or separate, but in no event should they be interrupted by consideration of market rule changes

Potential Reforms to Existing Markets

- Competitive centralized market for long-term commitments to renewable resources (whether capacity or energy based), with resulting contract between ISO and winning resources, similar to an Interconnection Agreement.

- Long term commitment to cover minimum annual revenue requirements (if availability/production standards are met), with a portion of the revenue from production returned to load. Ensures sufficient revenue to service debt and fixed operating costs, provides appropriate incentive to maximize highest-value production, alleviates risk of stranded costs.

- These concepts work for both new and legacy resources

Integrating Markets and Public Policy:
Using Competitive Markets to Achieve New England's Energy Decarbonization Goals

Bradley Campbell
President
Conservation Law Foundation
August 11, 2016

clf
conservation law foundation

- **Goal of the IMAPP effort**
- **Preliminary Step(s)**
- **Potential Solution Set**

Goal: Align Markets and State Climate Policies

- Region-wide adoption of 80% by 2050 GHG reduction
- 70% of regional load (CT and MA) mandates reduction
- Markets dictate the nature of new resources
- Designed to reward traditional fossil generators

Do energy markets undermine environmental goals?

clf
conservation law foundation

Goal: Fundamental Market Reform

- Markets produce resource mix that undermines state public policy
- Misalignment results in “unjust and unreasonable” rates
- Reform must remedy undue discrimination being caused by ISO/Markets
  - “*benefits to some customers at the expense of others*”
- Failure to remedy risks susceptibility to FPA § 206 complaint

A compliant market must account for climate costs and benefits.

Preliminary Step(s)

- **Develop understanding of what we want the markets to deliver**
  - Emissions-compliant, reliable mix trajectory through 2050

- **Comprehensive, cross-sector 2050 roadmap modeling**
  - Roadmap to inform trajectory of carbon price and help identify market-based approaches for achieving state policy goals
  - Tested, peer-reviewed, open-source model exists (initial results ~ 4 months)

Potential Solution Set

- **Cost-effectively procure & reliably operate an emissions-compliant Grid**
  - Energy Market (*e.g., shadow / actual carbon pricing and dispatch*)
  - Capacity Market (*e.g., full compensation for all resources necessary to meet emissions laws*)
  - Other Existing/New (*e.g., Forward Reserve, balancing, storage*)

Carbon-Intensity Dispatch Framework

- **Establish Carbon Shadow Price (CSP)**
  - Stakeholder agreement needed
  - Start low to moderate cost impact
  - Steady growth to high target to guide investment & retirements
- **ISO MMU calculates Carbon Shadow Cost (CSC) for each generation block**
  - Deduct RGGI price (if applicable) from CSP
  - CSC = (CSP – RGGI) × Heat Rate × Fuel carbon content
- **ISO MMU adds CSC to energy offers (as-bid or mitigated)**
  - Dispatch Cost = Offer price + CSC
- **ISO commits and dispatches system based on Dispatch Cost**
  - LMPs reflect CSC of marginal unit(s)

Settlements in Carbon-Intensity Dispatch

- **Suppliers paid LMP less unit-specific CSC**
  - Creates a settlement surplus
- **ISO credits sum of CSC to load**

Example of Carbon-Intensity Dispatch
CSP = $20/ton CO2

Hypothetical Bid Stack

Unit	Unit Type	Capacity (MW)	Bid Cost ($/MWh)	Emissions Rate (Tons CO2/MWh)	CSC ($/MWh)	Dispatch Cost ($/MWh)
A	Wind	1000	$-	0	$-	$-
B	Nuclear	1200	$10	0	$-	$10.00
C	Coal	1500	$30	1.035	$20.70	$50.70
D	Gas CC	3000	$35	0.427	$8.54	$43.54
E	Oil	500	$40	0.88	$17.60	$57.60
F	Gas CT	800	$42	0.61	$12.20	$54.20

Example of Carbon-Intensity Dispatch
Load = 5,000 MW

As-Bid Dispatch						
Unit	Bid Cost ($/MWh)	Dispatch	Emissions (tons CO2)		Payment ($)	Gross Margin ($)
A—Wind	$-	1,000	-		$35,000	$35,000
B—Nuke	$10.00	1,200	-		$42,000	$30,000
C—Coal	$30.00	1,500	1,553		$52,500	$7,500
D—CC	$35.00	1,300	555		$45,500	$-
E—Oil	$40.00	-	-		$-	$-
F—CT	$42.00	-	-		$-	$-
System	$35.00	5,000	2,108		$175,000	$72,500

Carbon-Intensity Dispatch						
Unit	Dispatch Cost ($/MWh)	Dispatch	Emissions (tons CO2)	CSC Charge / Credit	Payment (+/- CSC)	Gross Margin ($)
A—Wind	$-	1,000	-	$-	$43,540	$43,540
B—Nuke	$10.00	1,200	-	$-	$52,248	$40,248
D—CC	$43.54	2,800	1,196	$23,912	$98,000	$-
C—Coal	$50.70	-	-	$-	$-	$-
F—CT	$54.20	-	-	$-	$-	$-
E—Oil	$57.60	-	-	$-	$-	$-
System	$43.54	5,000	1,196	$23,912	$193,788	$83,788
Change	24%		-43%		11%	16%

Bid stack shifts

Renewable margins up

Conventional margins down

Coal displaced, dropping emissions

conservation law foundation

Total Stakeholder Impacts

- Zero- and low-emissions supply resources
  - LMPs with carbon adder improves energy market margins
- Conventional supply resources
  - Energy margins now depend greatly on carbon intensity
  - Capacity revenues likely decline, as new units set clearing price
- Consumers
  - Some increase in energy prices, partly offset by CSC rebate
  - Expected decline in capacity prices
  - Expected decline in cost of existing renewables support programs

Preferred Outcomes: How we Achieve Them

Outcomes:

- Market comes to reflect realistic cost of carbon
- Dispatch prioritizes low and no-carbon generators
- Firming resources adequately compensated

Achieving Them:

- Transparent process
  - Post all documents on state, NESCOE, NEPOOL and ISO websites
  - Provide portal for public comment
  - Meetings for non-NEPOOL participants
- Independent modeling and analysis for ISO-NE
  - Access to supporting data and analysis

Three approaches for integrating markets and policies

NEPOOL Forum: Integrating Markets and Public Policies

August 11, 2016

Synapse NEPOOL Team

Synapse Energy Economics

- Founded in 1996 by CEO Bruce Biewald.
- Leader for public interest and government clients in providing rigorous analysis of the electric power sector.
- Staff of 30 includes experts in energy and environmental economics and environmental compliance.
- Representing NEPOOL stakeholders since 2001.

Issues to address

- Every New England state has some form of climate policy, target, or goal, often in addition to renewable energy or energy efficiency targets or goals.
- These policies, targets, and goals do not interfere with the reliable operation of the system. However, they are inconsistent with New England wholesale markets that are designed to be resource neutral.
- Synapse suggests this group consider the following three potential approaches for enabling states to meet their goals.
- These three topics are not fully developed and do not represent a specific proposal by any of our clients. At present they are ideas that warrant further investigation.

Options to discuss

Carbon fee

Develop a carbon fee ($/ton) based upon each unit's CO_2 emission rate per megawatt-hour that is added to each resource's bid. Resources are paid the new clearing price but carbon-emitting resources receive the clearing price minus the relevant fee and a pool of money is created from the payment of the fee by those resources.

Generation PPAs

Develop a FERC-approved mechanism that will allow and encourage states and distribution companies to enter into short or long-term power-purchase agreements with renewable generation and other generation as appropriate. A state power authority is one option.

Storage at substations

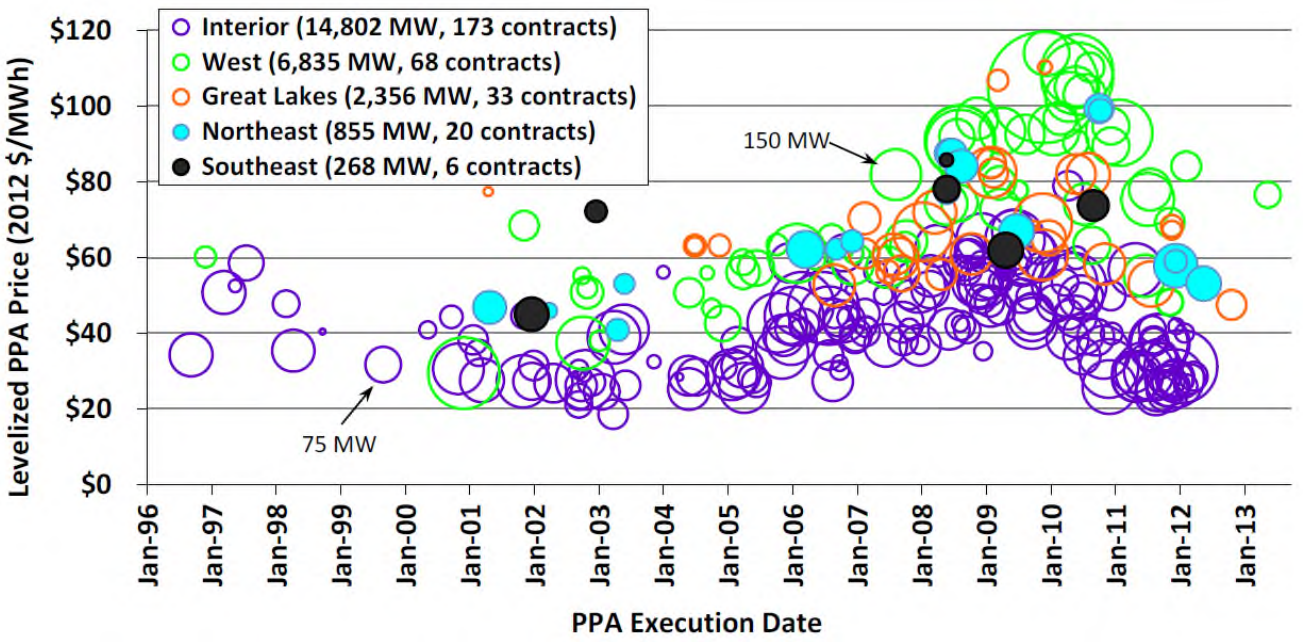
Site battery storage units at substations throughout the ISO-NE footprint. This will enable integration of more renewables and provide system operators a mechanism to quickly and reliably respond to abrupt changes in supply and demand.

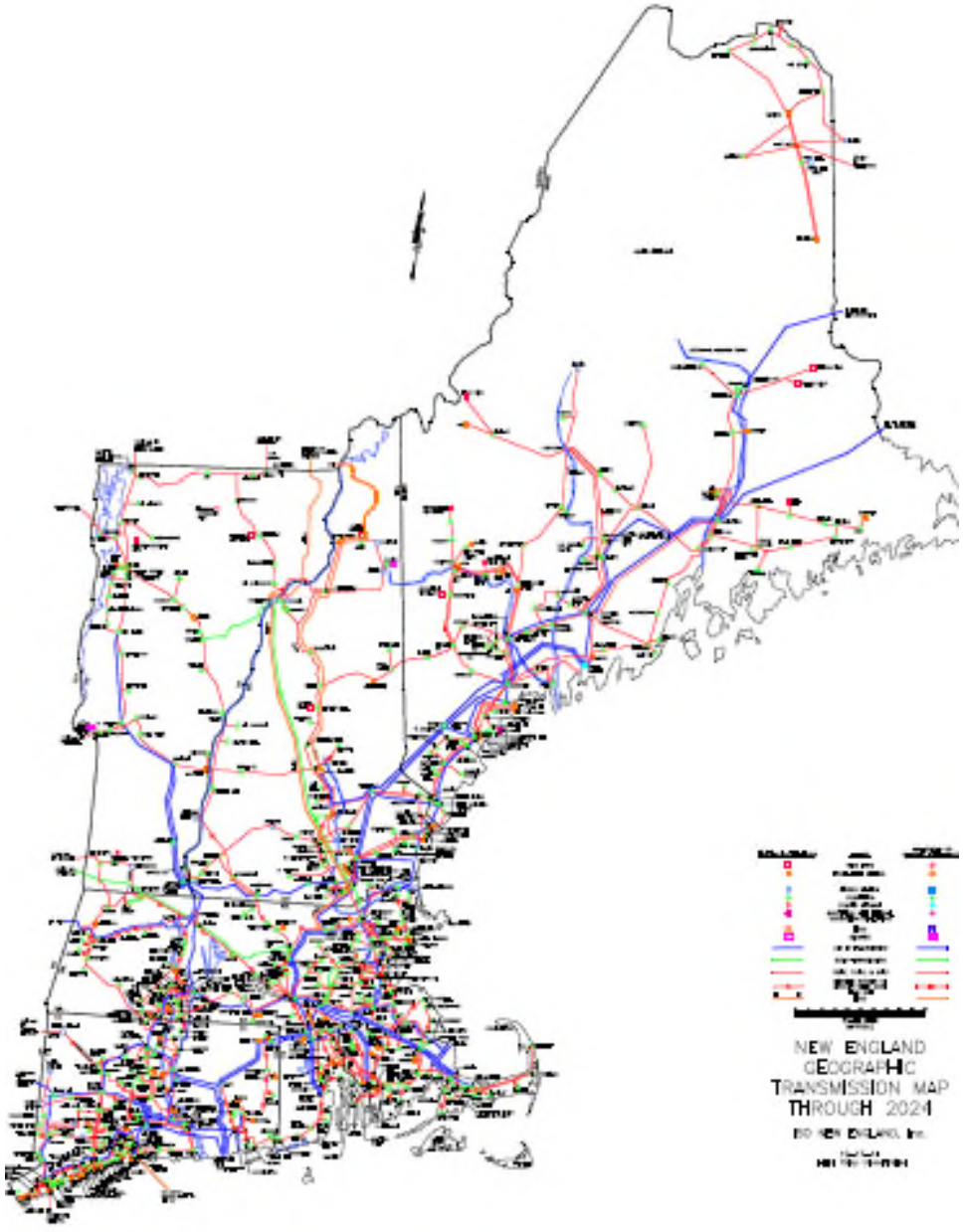
Carbon fee for emissions

- A carbon fee is a relatively straightforward way to value carbon reductions in order to support the resources needed to achieve states' long-term carbon reduction goals.
- The fee would be included in every energy bid based upon unit-specific CO_2 emission rates.
- Inclusion of the fee would cause the clearing price to increase due to New England's current reliance on fossil generation. This higher clearing price would be paid to all resources. Carbon-emitting resources would be paid the clearing price but be charged the fee.
- The fee collected from carbon-emitting generators would create a pool of money that could be used in a number of ways to further advance state goals.
- Setting the appropriate carbon fee and the details for settling the market, including the use of the pool of money, will be critical elements.

Generation PPAs

- Renewable power-purchase agreements are utilized throughout the US as shown in the figure below. http://www.awea.org/Resources/Content.aspx?ItemNumber=5547
- Provide a mechanism for recognizing power-purchase agreements in New England markets that will allow states to realize the full-value of PPAs that advance state policies.





Storage at substations

- To enable integration of zero-carbon generation with the existing fleet, install battery storage facilities at substations throughout the grid.
- Storage units would be appropriately sized depending on the size of the substation and upstream and downstream constraints.
- Dispatched to maximize delivery of zero-carbon generation.
- Fund the investments through the RNS rate. ISO can operate these facilities similar to other reliability infrastructure to address sudden changes in supply or demand

Questions?

Using a carbon price to cost-effectively meet clean generation goals in New England

August 11, 2016

Wholesale Market Designs to Address State Public Policy Initiatives

An regional wholesale market solution that incorporates the price of carbon into the energy market is sufficient to meet state carbon policy goals and attract new and retain existing zero emission resources.

- A price on carbon is technology-neutral, and provides value to different technologies based consistently and solely on their carbon emission characteristics, including recognizing the carbon mitigation value of low, but not zero, emission technologies such as highly efficient gas generation.
- A price on carbon automatically incents carbon mitigation from all potential sources, including low-cost source such as coal/oil to gas redispatch and demand-side efficiency, which will allow states to meet carbon goals in the most cost-effective manner
- A price on carbon fully internalizes the costs and benefits of state carbon mitigation goals into a transparent wholesale energy price signal

Depending on the level of the price on carbon, it may not be sufficient in the short term to support all needed investments in clean energy resources. As a result, some existing clean energy incentives may need to persist while an adequate price on carbon phases in, albeit at lower levels. Even with a phase-in, a price on carbon in the energy market will achieve the states' emission reduction goals at lower total cost to consumers.

An energy solution based on a carbon price is relatively simple

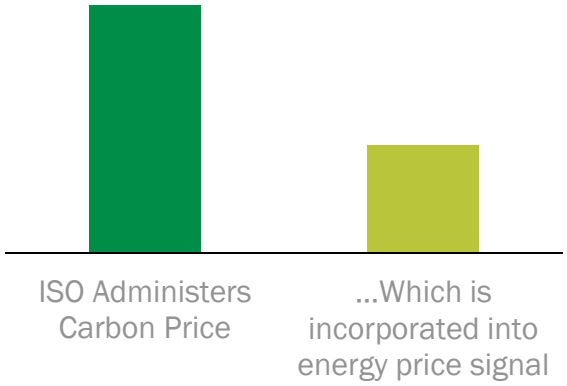
- ISO and states work together to translate state carbon reduction goals into a schedule of year-by-year carbon emission goals for the ISO-NE footprint
- ISO determines carbon price necessary to meet carbon emission goals
  - Year 1 carbon price set at U.S. Interagency Working Group social cost of carbon (~$42/short ton in 2017)
  - Following year 1, ISO compares actual realized emissions to year 1 goals. If goals are met, carbon price for year 2 left unchanged. If goals are not met, carbon price is increased by an agreed-upon fixed increment (e.g. $5/ton)
  - This iterative process continues indefinitely
  - While carbon price will increase through time, feedback loops will dampen impact
    - Pass-through rate of carbon prices to wholesale energy prices will fall as low/zero carbon resources are increasingly on the margin, reducing consumer impact and mitigating "windfall profits" concern
    - Existing capacity and reserve markets will provide price signals necessary to maintain reliability and ensure a sufficient amount of fast-ramping and load-following resources
- ISO incorporates carbon price into energy market dispatch via an ISO-administered resource-specific, energy bid adder for carbon emitting resources
  - Carbon bid adder = carbon price ($/ton) x emission rate for resource (tons/MWh)
  - Emitting resources pay the bid adder to the ISO, and the ISO remits the proceeds to LSEs, using an agreed-upon allocation approach that could accommodate differences in state goals
  - States may direct LSEs to use proceeds to offset customer costs or for other purposes (i.e., LIHEAP)

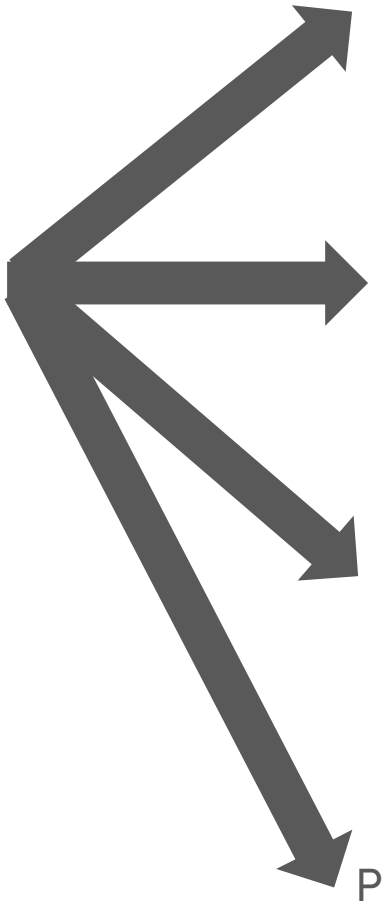
A carbon price drives multiple types of carbon reductions in a fully market-based fashion

Illustrative

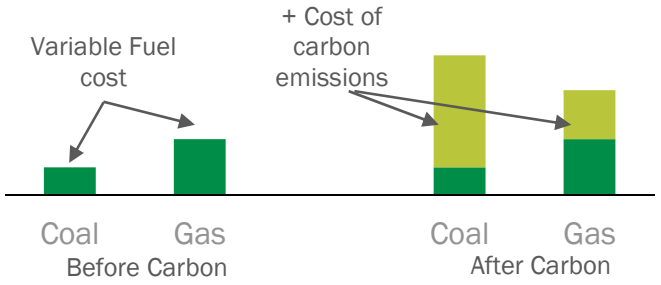
...Which drives multiple carbon-reducing processes, via the same market-based price signal

ISO Administers Carbon Price...

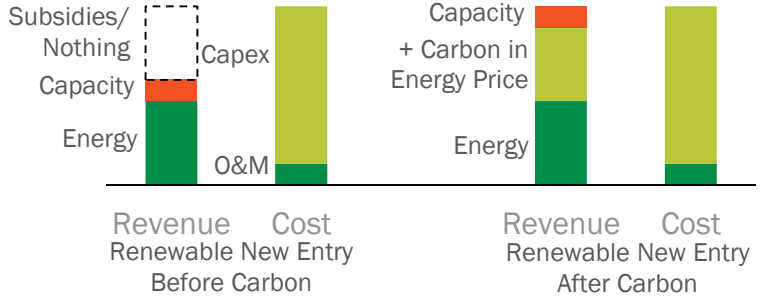




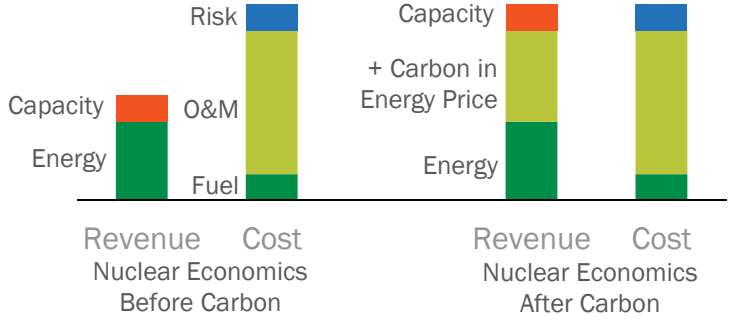
...Redispatch



...Renewable Entry



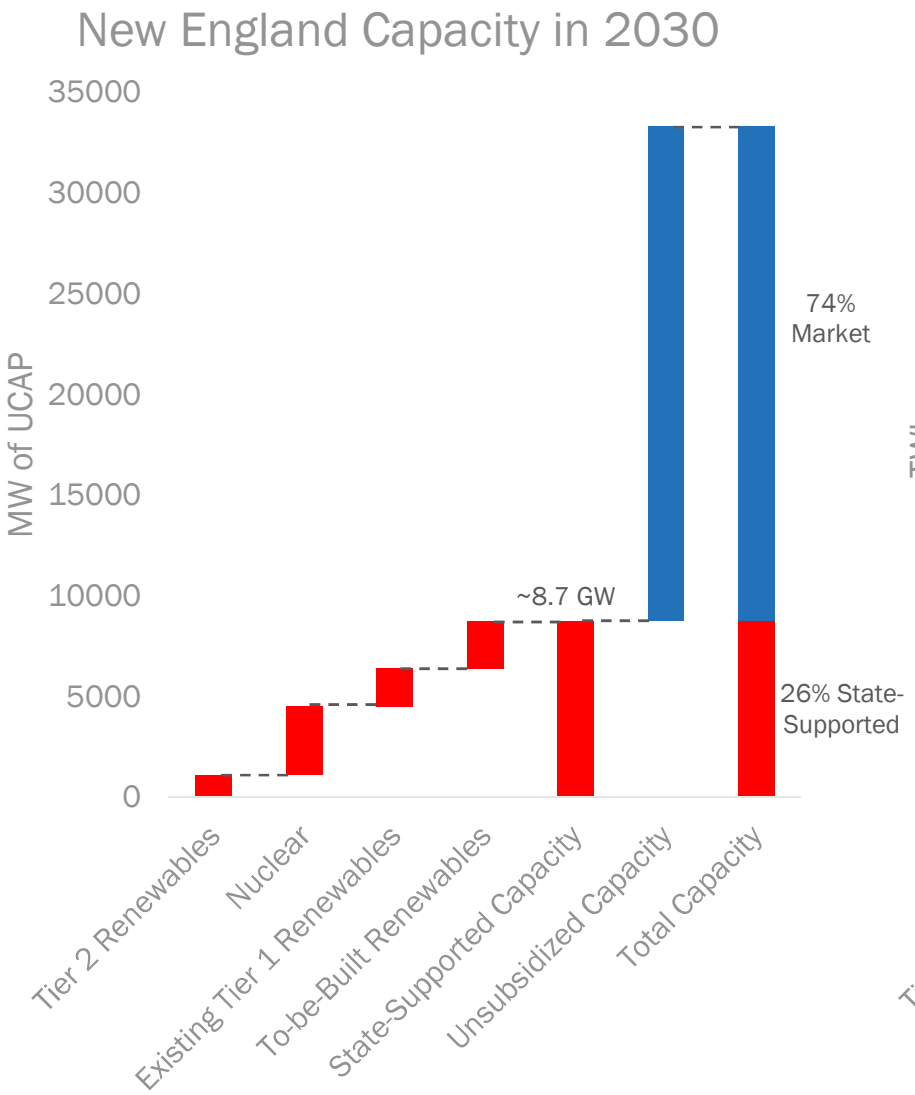
...Nuclear Retention

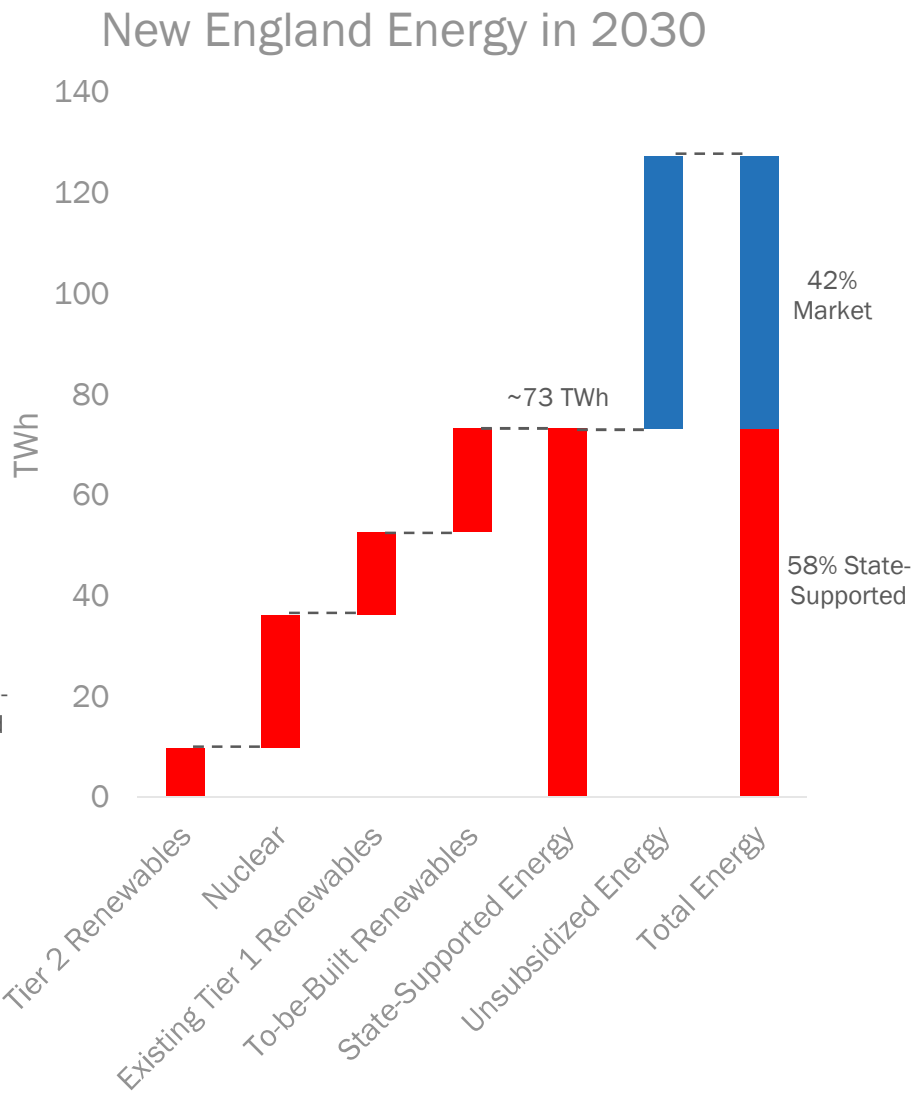


Plus Energy Efficiency and other Demand-Side

Exelon.

Under the current status quo about 25% of New England Capacity and 60% of Energy will require state support by 2030

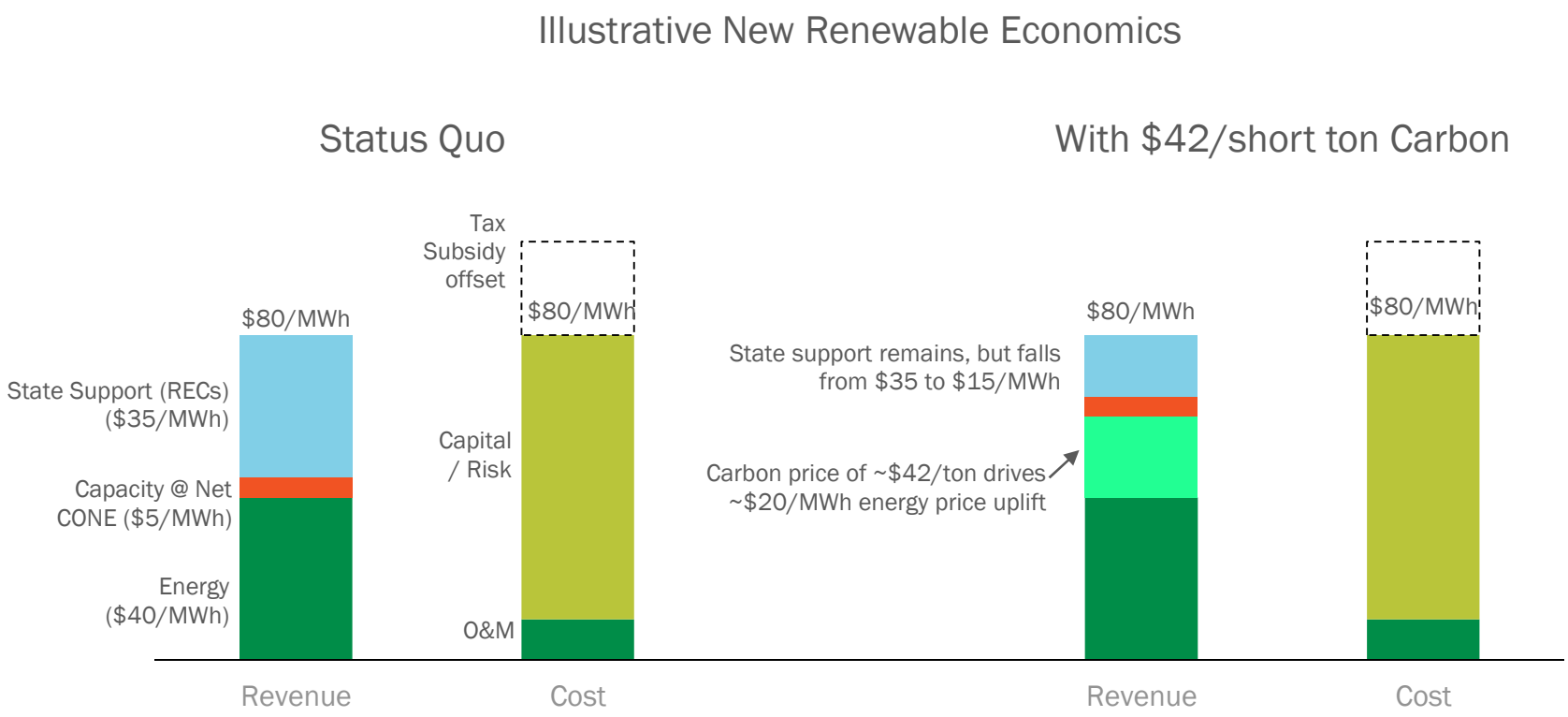




Note: To-be-built renewables includes 9.45 TWh of incremental clean generation specified in MA H. 4568

Exelon.

A $42/ton carbon price is likely sufficient to transition nuclear to market support, while reducing cost of renewable state support

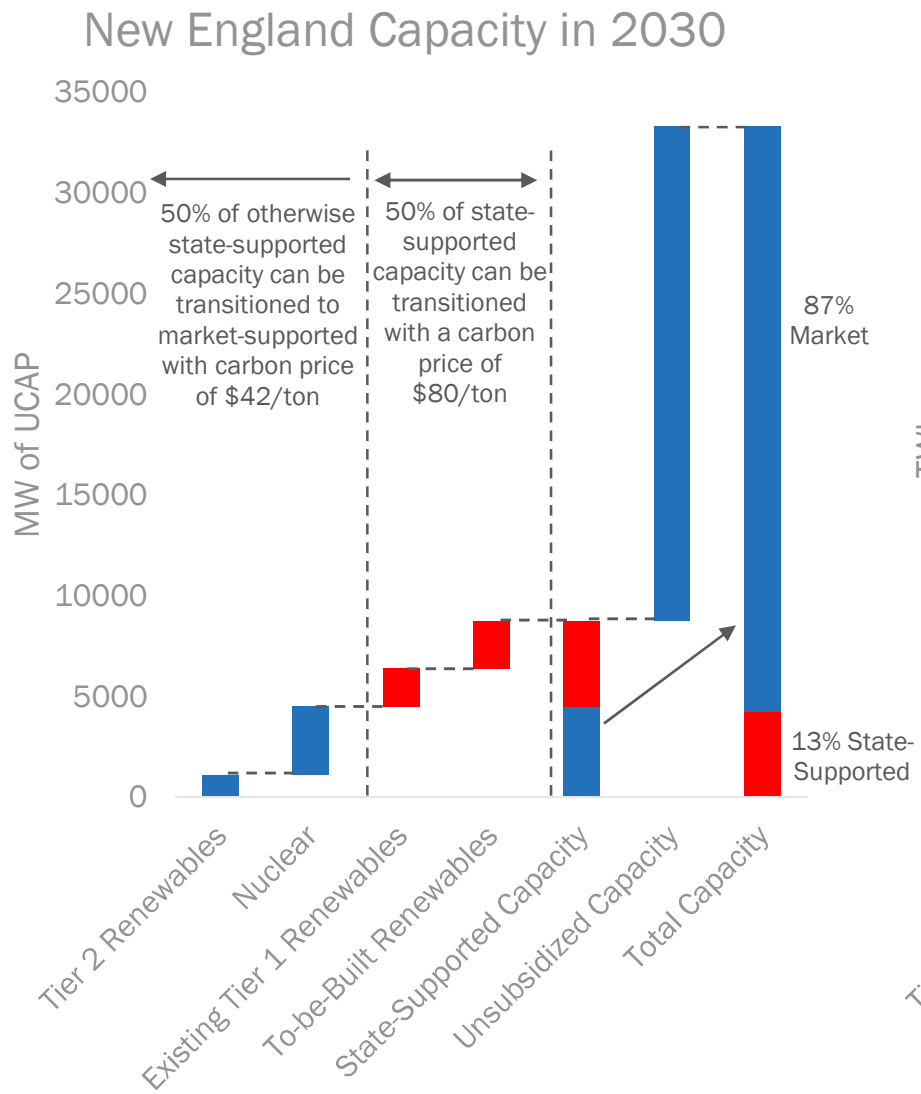


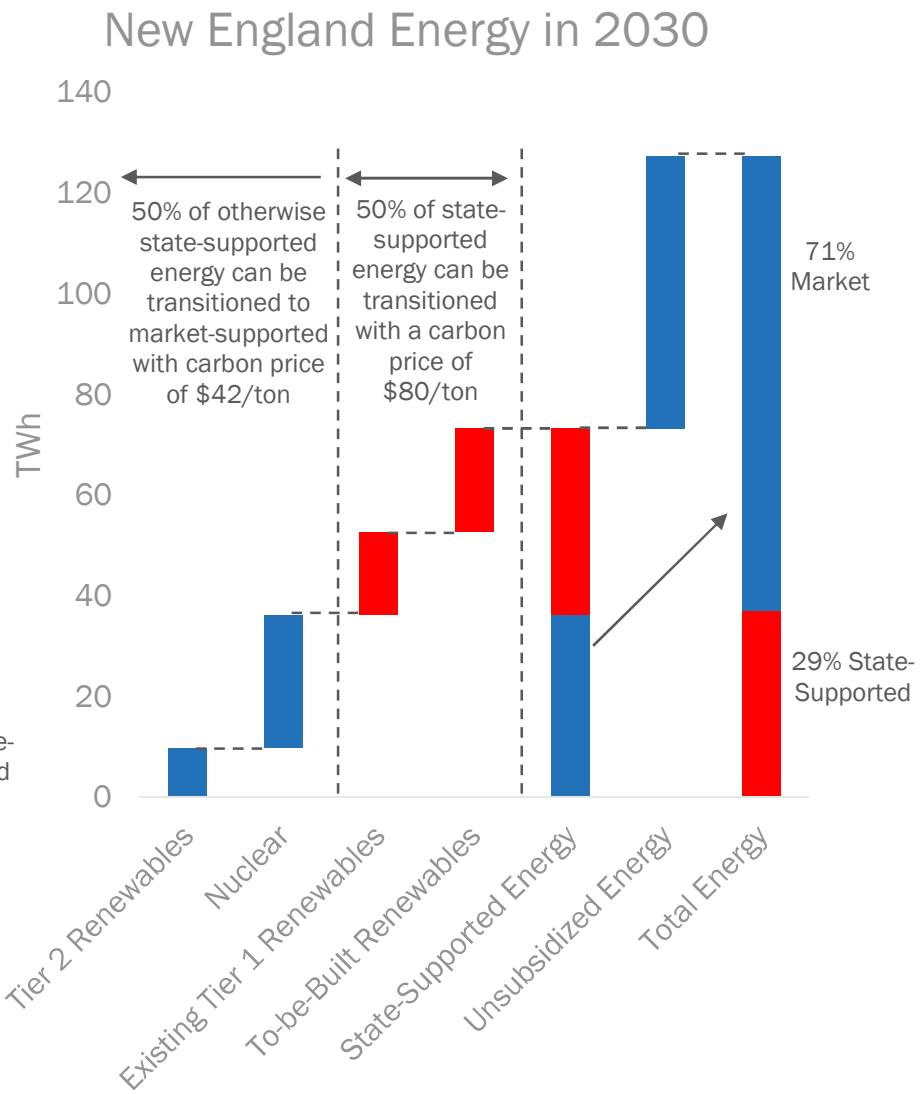
New Entrant renewables are provided state support which allow them to continue to enter even with depressed energy prices

A $42/ton carbon price reduces, but does not eliminate, the amount of state support needed to induce renewable entry

Exelon.

More broadly, a $42/ton carbon price would transition about half of state-supported energy and capacity to market

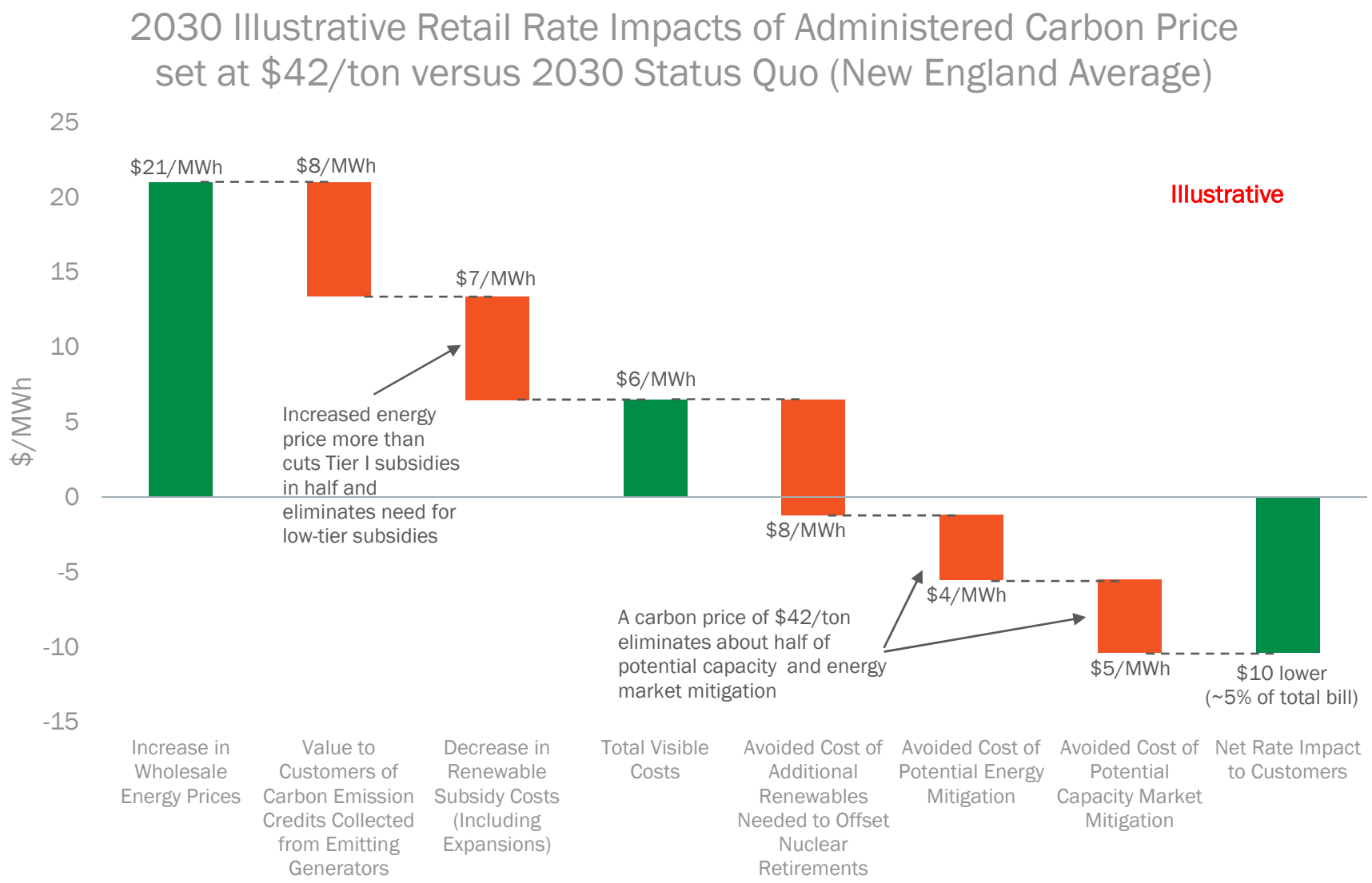




Note: To-be-built renewables includes 9.45 TWh of incremental clean generation specified in MA H. 4568

Exelon.

With the overall result that a carbon pricing solution is actually much cheaper for customers over the long run



Assumptions: 0.47 short ton per MWh marginal emission rate; 0.17 short ton per MWh average emission rate; baseline REC price of $35/REC; capacity market mitigation requires that additional non-subsidized capacity resources equal to UCAP value of subsidized resources be purchased.

Exelon.

Proposal Meets State Goal Posts

State Goal Post	Carbon Adder
Flexibility to meet short and long-term goals and react to changing market conditions Achieve State RPS requirements	The carbon adder is reviewed annually Adder may be increased or decreased as necessary to meet state goals based on carbon reduction mandates and technologies available
Consider mechanisms to ensure consumers in any one state do not fund the public policy requirements mandated by another state's laws.	Revenues collected from the adder may be allocated to account for differences in state laws
Proposal should not imprudently increase costs to consumers over the costs that they would incur under the status quo/current market design.	Carbon adder in the energy market is a lower cost solution than the state's current bilateral contract approach.
Must not compel or assume state legislative action nor include out of market actions	Carbon adder will not require out of market or state legislative actions as it will be implemented through an ISO FERC filing.
Move risk to market participants	Proposal sends appropriate market signals incenting competitive market responses

Meeting the Region's Carbon Goals: IMAPP Presentation

August 11, 2016

Any reforms to the ISO-NE markets and/or tariff to accommodate state public policy goals should meet three guiding principles

Three Guiding Principles

(1) IMAPP Process must be outcome-driven to actually work

- **Clear definition of state public policy goals is key**
- **Requires input of the finance and development communities to confirm workability**
- **Independent expert review of final proposals should be considered**

(2) Competitive markets must be preserved with as minimal disruption as possible

- **Preserve value of the existing investments in the market**
- **Create a smooth transition to a cleaner region**

(3) Non-discriminatory

ISO-NE markets may provide a valuable platform for the region to meet its carbon goals, provided it is done correctly

NEXTera ENERGY RESOURCES

NEER assumes that states will continue to contract, at least for the foreseeable future, for zero emission resources

Overview of NEER's Draft Proposal

- **New Forward Clean Energy Market ("FCEM") distinct from the energy, capacity and ancillary markets**
  - Development of an ISO-NE market platform to help the region manage its state public policies
  - Will likely not replace contracts, at least at first, but over time could possibly incent merchant investment
- **Revisions to FCM MOPR mitigation to permit resources with public policy contracts to clear the FCM, while still preserving price signals for all other resources**
  - Two-tiered "APR" pricing mechanism
- **No changes to the existing energy markets at this time as revisions are not needed with under NEER's proposal**

States will not give up contract rights, as new projects likely need contracts to be financeable in today's market

Eligibility for the FCEM is non-discriminatory and open to all qualifying resources, with and without bilateral contracts

Forward Clean Energy Market

- **Qualifying resources include zero emission resources**
- **Purchase quantities set forth in ISO-NE Tariff to achieve state carbon reduction goals**
- **Payment rate for MWh production set through an auction clearing process similar to FCM**
- **Monthly payments tied to MWh performance**
  - Open discussion on whether to include a fixed or floor component
- **Develop mechanisms to measure performance**
- **Initially, NEER intent is for a one-year term, with further discussions in the IMAPP process on the pros and cons of rate locks of varying amounts**

Tying performance to payments in the FCEM helps ensure that what is being purchased will contribute to carbon reductions

FCEM structured to fit within ISO-NE's existing markets without disruptive effects

Forward Clean Energy Market

- **Annual market**
  - Similar to FCM, can look at composite offers to appropriately value the seasonal attributes of renewable resources
- **Auction run each year prior to the FCM such that the FCEM clearing prices can be factored into the offering and mitigation of resource bids in the FCM**
- **IMM review of offers to determine reasonableness; offers should include costs of transmission**
- **No tariff obligation for a new FCEM-cleared resource to offer in the FCM (although likely expected in a contract)**
  - Could change this in later versions of this market upon improvements to FCM queue process that impact renewables

The FCEM can build upon the knowledge gained in FCM

Adjustments in FCM Mitigation are required to enable a smooth transition to a Forward Clean Energy Market

FCM Mitigation

- **Retention of the existing MOPR review process**
  - Renewable exemption would no longer be needed
- **Contracted resources with a FCEM must offer obligation that have cleared the FCEM and wish to offer in the FCM are defined in the FCM rules as "Clean Energy Agreement Resources" or "CEARs"**
- **CEAR contracts are not considered out-of-market subsidies under ISO-NE's ORTP review**
  - Still mitigated otherwise, including offsetting FCEM revenues
- **FCA is run with two clearing prices, one with all the CEARs and one without the CEARs and non-CEARs are paid the price without**
  - "Two-tiered APR type mechanism" to adjust the pricing

Existing resources remain protected in the capacity market

FirstLight™
Power Resources

Forward Clean Energy Market

Tom Kaslow
August 11, 2016

Overview

- Forward Clean Energy Market (FCEM) proposal
- Impact of clean energy timing
- Needs beyond a carbon shadow price design
- Benefits of FCEM

What are we proposing

Forward Clean Energy Market

- Forward market to procure clean energy delivery commitments to efficiently achieve desired carbon emission reductions.
- Several products –timing of clean energy delivery matters
  - Off-peak (often strongest wind generation)
  - Midday peak (where solar generation most prevalent)
  - Late day peak (where solar generation ramps down).
- Encourage efficient mix of clean generation resources and use of electric storage (including pumped storage hydro) to efficiently achieve carbon reduction goals.

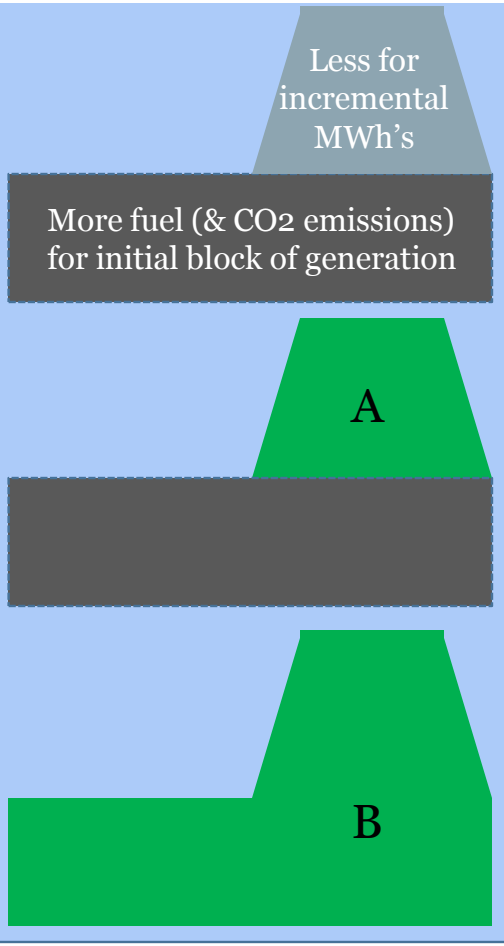
Forward Clean Energy Market (cont'd)

- Product requirements determined based on:
  - States' carbon reduction goals
  - ISO New England insight on clean generation profile that offers the greatest carbon reduction impact to meet those goals
- Auction timing & duration of commitment
  - Open for discussion - operate in parallel with Forward Capacity Auction cycle or shorter lead time and term
- Payment of respective FCEM clearing price for clean energy delivery and a penalty for failure to meet commitment
- Costs could be allocated to load in states with carbon reduction goals driving the purchases

Why we are proposing it

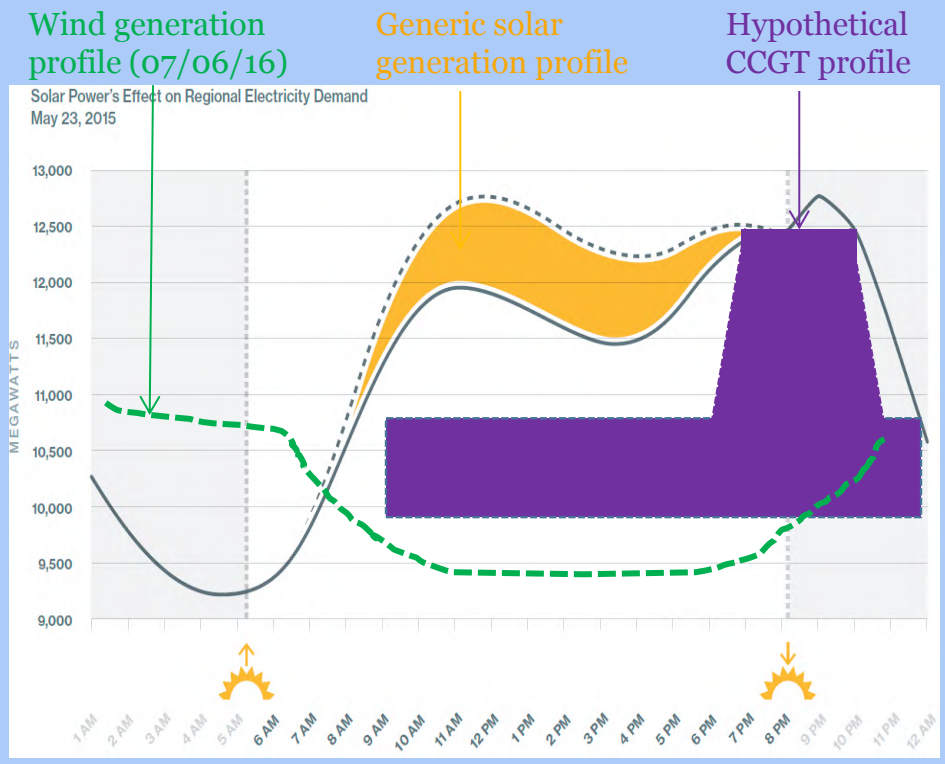
Greatest carbon reduction by avoiding carbon emitting resource start

- Clean generation that does not avoid starting a carbon emitting resource only avoids its less carbon intense incremental generation (A).
- Clean generation that can avoid *starting* the carbon emitting resource avoids the most carbon intensity (B).



ISO unit scheduling considerations

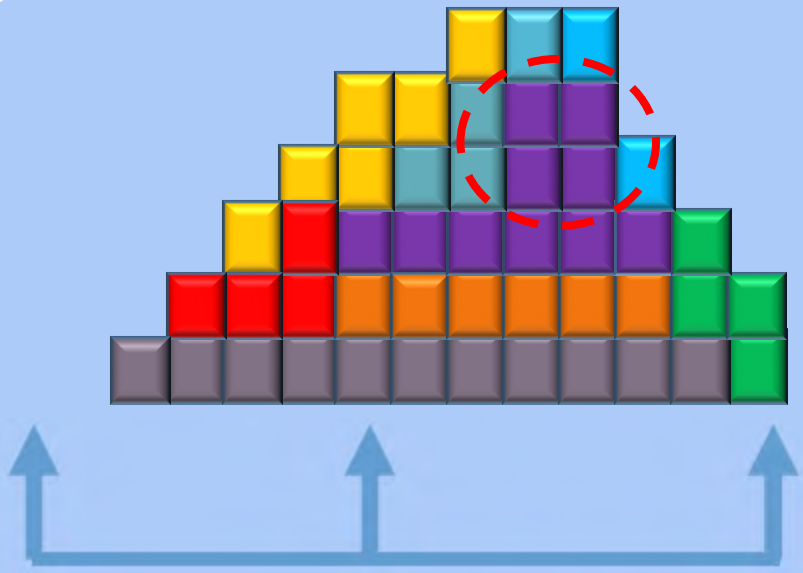
- ISO must commit generating resources day ahead to meet next day electric demand.
- Gaps in meeting the daily demand profile with clean generation requires more carbon emitting resources.
- Clean energy timing matters.



ISO-NE 2015 Regional Electricity Outlook (modified)

Matching clean energy supply to carbon reductions

- ISO scheduling is subject to resource scheduling constraints
- Much like a puzzle, they must fit the pieces together to cover the next day load profile
- Better matches between clean energy puzzle pieces and load shape means less carbon intense resources scheduled

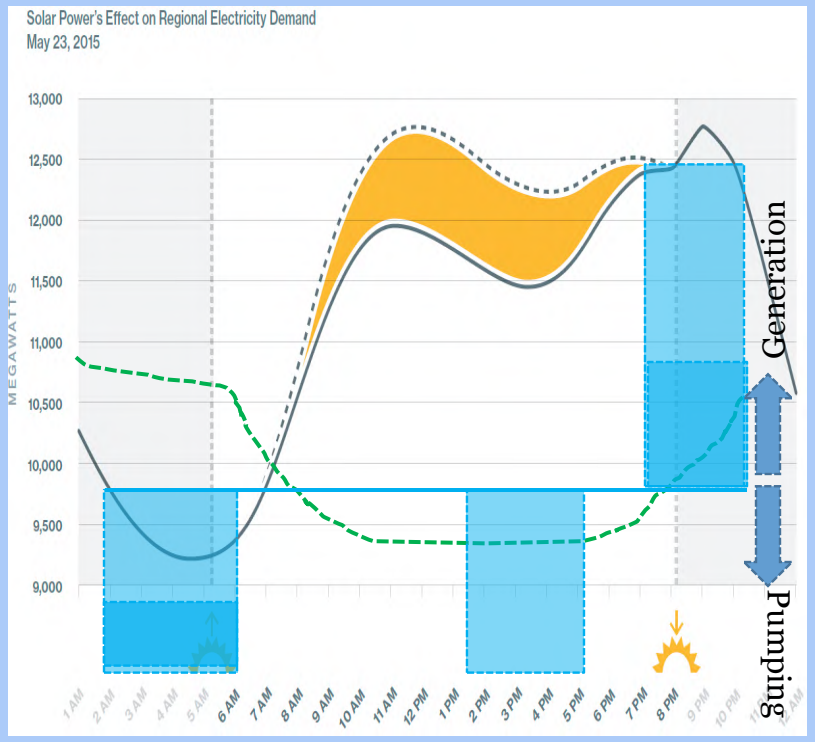


More clean energy in these hours will not prevent the start of the carbon emitting resource (purple shape)

Storage can move clean energy across hours

FCEM will signal an efficient mix of clean energy resources and storage to meet the demand profile.

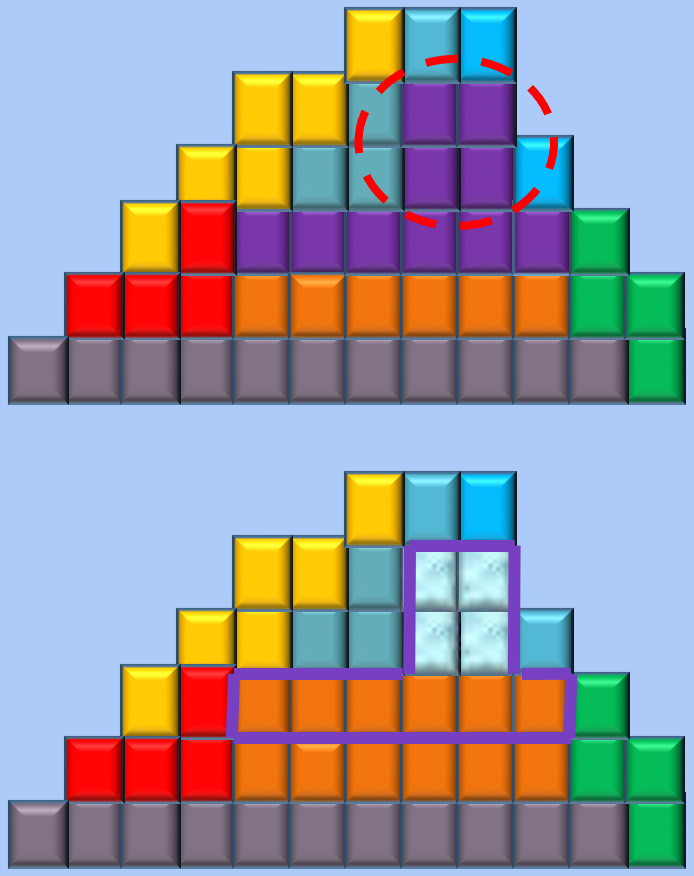
FCEM will value electric storage (including pumped storage) ability to move off-peak (or midday peak) emission-free generation to serve late day peak needs.



ISO-NE 2015 Regional Electricity Outlook (modified)

Clean energy supply tailored to carbon reductions

- Storage for later release permits flexible clean energy dispatch
- Clean energy pieces can now be fit together to displace the start of carbon intense resources
- Greater carbon reduction impacts with storage



Can a carbon shadow price alone achieve this?

A carbon shadow price is helpful but not sufficient

- Energy clearing prices under a carbon shadow price ("CSP") would generally reflect the carbon intensity of the incremental loading of on-line carbon emitting resources (area A on slide 7), *not the higher carbon intensity minimum loading level committed for multiple hours*.
- The result is the full emission-avoidance value of new clean resources or storage may not be fully reflected in CSP energy prices alone.
- Further, the ISO-NE energy market software can miss potential storage economics. It does not couple the charging (storage) and discharge (generation) of storage resources. The storage owner must do that by estimating charge (pumping) and discharge (generation) pricing, levels and timing. The uncertainty involved in these decisions inevitably leads to missed storage opportunities.

Conclusion

- The proposed Forward Clean Energy Market offers:
  - an efficient market signal for clean energy resource developers
  - an efficient market signal for storage, including increased use of existing storage capability
  - an efficient market mechanism to cost effectively achieve carbon reduction goals
  - price discovery for the cost of carbon used in a CSP design

NEPOOL Stakeholder Discussion
August 11, 2016

Capacity markets & efficient renewable procurement in a carbon-constrained world

Pete Fuller

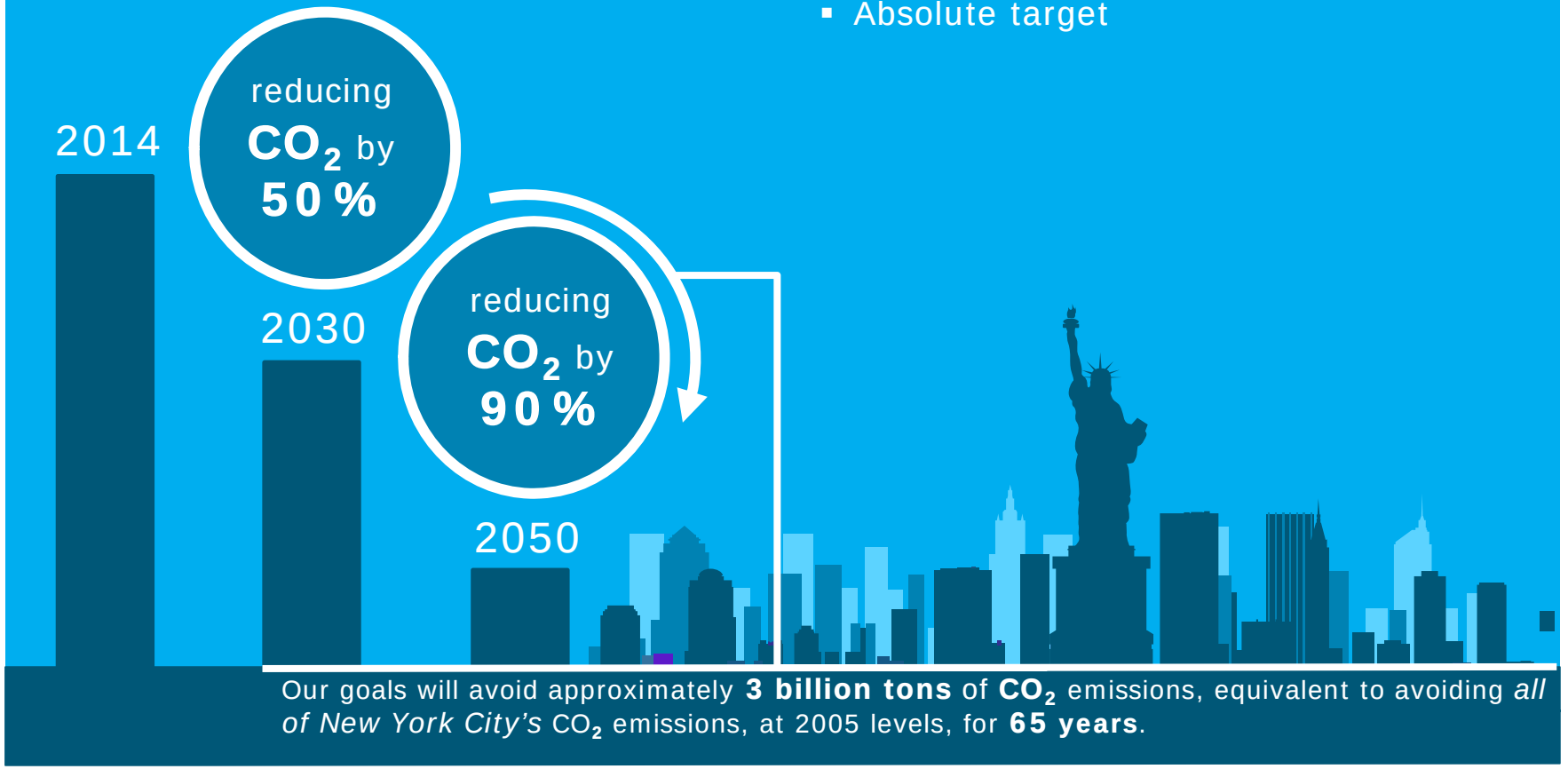
The new context for wholesale electricity markets

- ✓ Wholesale markets were designed to deliver reliability at the lowest cost;
  - o They were <u>not</u> designed to optimize for low carbon emissions;
  - o Our new challenge is to adapt the operation of electric markets to the imperative for lower carbon emissions;
- ✓ We should strive to do so in a cost-effective manner by improving investment incentives for cleaner generation while maintaining the investment role of wholesale capacity markets;
- ✓ We can utilize market mechanisms to achieve the maximum emission reductions at the lowest cost;
- ✓ A major aspect of the challenge is that the foundation of energy pricing has relied on heat rates and fossil fuels to set LMP. With increasing penetration of zero marginal cost energy sources, LMPs will trend down and be less remunerative.

NRG is committed to sustainability & a low-carbon future

NRG's GOAL | **Grow our business while:**

- 2014 baseline –125 million tons of CO_2
- Absolute target



Our goals will avoid approximately **3 billion tons** of **CO_2** emissions, equivalent to avoiding *all of New York City's* CO_2 emissions, at 2005 levels, for **65 years**.

Market & policy design goals

1. Ensure that the Forward Capacity Market continues to support investment in new resources where and when needed, while accommodating State actions to meet carbon goals.

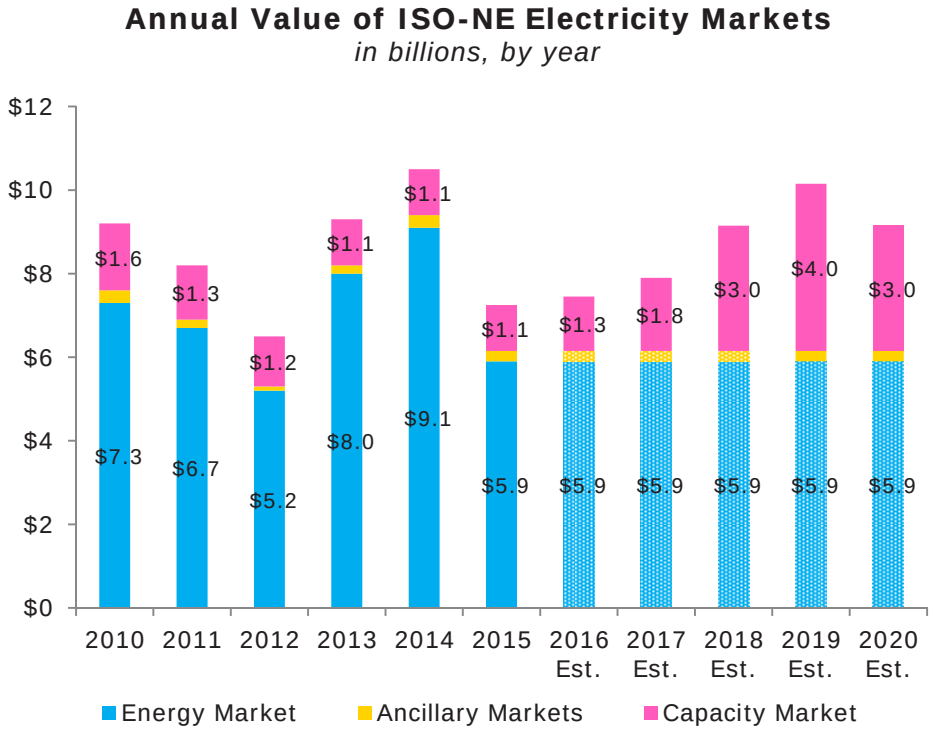
2. Explore a market-based forward procurement strategy for renewable generation resources to improve overall investment efficiency.

Capacity market reform proposal: two-tier pricing

Capacity markets must evolve as energy margins are compressed

We see two long-term trends occurring in the market as renewables penetration increases:

- ✓*Trend 1*: Energy revenues will decrease as more zero-marginal cost renewables come online.
- ✓*Trend 2*: A renewables-centric power system will necessitate the need for high performance, flexible ramping capacity.



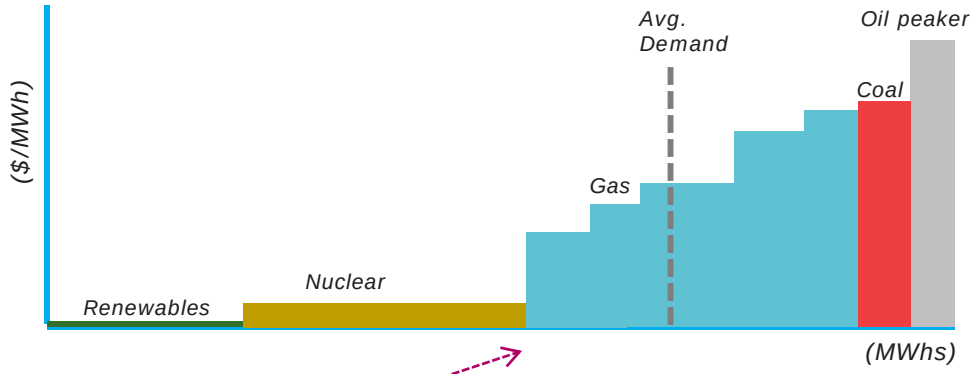
Source: ISO-NE

As energy revenues decrease, capacity market revenues become more important to the investment thesis

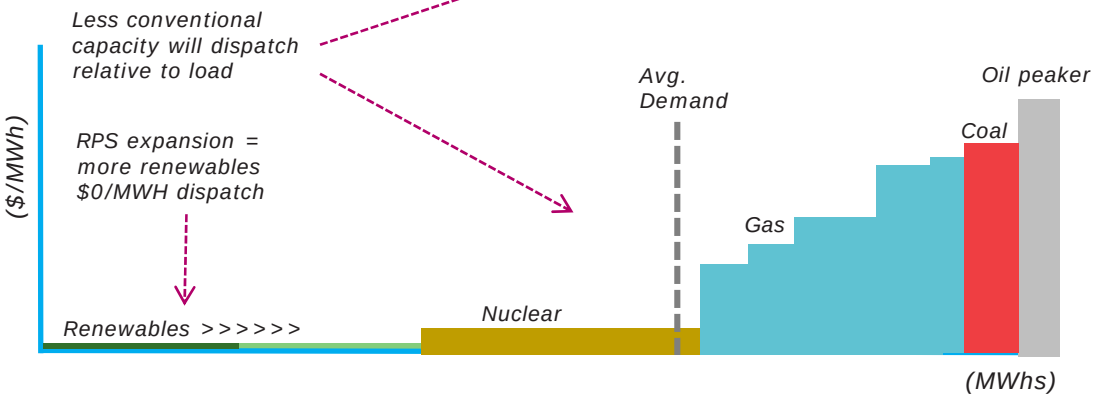
Trend #1: energy revenues generally decrease as renewables penetration increases

Illustration of power generation dispatch in competitive markets with increasingly levels of contracted renewables generation

Today: Status quo daily dispatch



Tomorrow: Ever-expanding RPS 'merit order' impact on daily dispatch

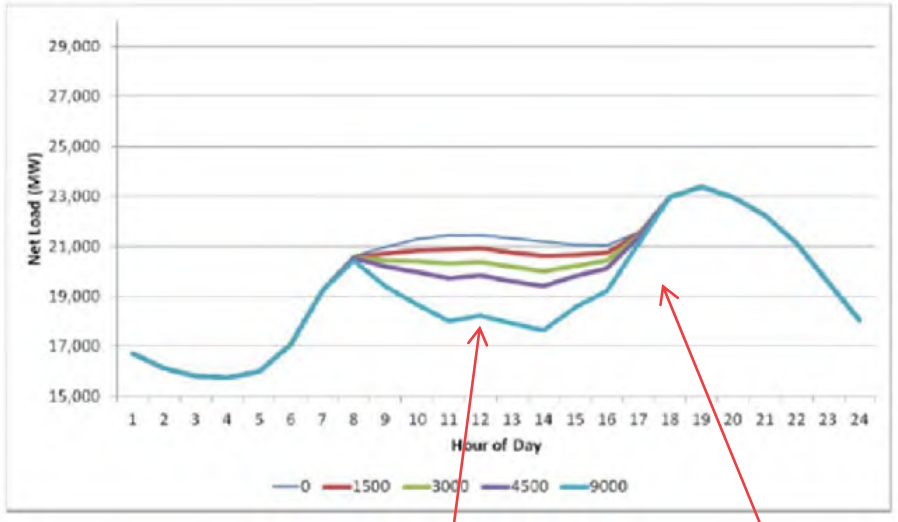


Source: NRG analysis

Trend #2: Successful renewable integration requires new investment in fast-Start, flexible, capacity

- ✓ Increased penetration of renewables will reshape supply-demand dynamics in the power system, such that net load ("load minus renewables") drops during the day and overnight, and relatively peaks during earlier morning and later evening hours.
- ✓ California's renewables-centric load shapes are not exclusively a West Coast phenomenon. The chart shows what an emerging East Coast "duck" curve might look like in New York.
- ✓ Fast-start, flexible capacity resources are necessary for backing-up a renewables-centric power system.
- ✓ A high performance, gas-fired, capacity 'backbone' is a necessary component of a renewables-centric, low-carbon future.

From the "Duck" to the "Platypus":
NY Winter Net Load with Levels of Solar Integration (MW)
(3,000 MW penetration represents NY-Sun 2024 target)



Source: NYISO's Solar Integration Study

Increasing quantities of solar generation relative to load reduces net load, dampening wholesale prices.

Post-sundown solar drop-off, and increased demand, results in fast-start, flexible capacity resources.

Challenge: to create an investment climate that supports the "Four Product Future"

'4 product future'

1 **Renewables**

- ✓ Renewables will provide the vast majority of energy needed by consumers. Utility-scale renewables growth will track strongly along existing (and expanding) state RPS targets. Distributed renewables will also grow, enabled by rate design, state policies, consumer demand and improving economics.

2 **Storage**

- ✓ Utility-scale or commercially-sited energy storage can balance variable renewables generation and manage peak demands while providing critical grid support products (e.g. ancillaries).

3 **Controllable demand**

- ✓ Smart, controllable loads, e.g. connected water heaters, will become pervasive in end-use devices and can address capacity / demand-shift challenges imposed by high penetrations of weather-dependent renewables. This will provide value to customers and the grid.

4 **Fast-ramping gas**

- ✓ Fast-start gas capacity can provide flexible, dispatchable capacity to ramp as needed to balance renewables.

Rationale behind a two-tier capacity market proposal

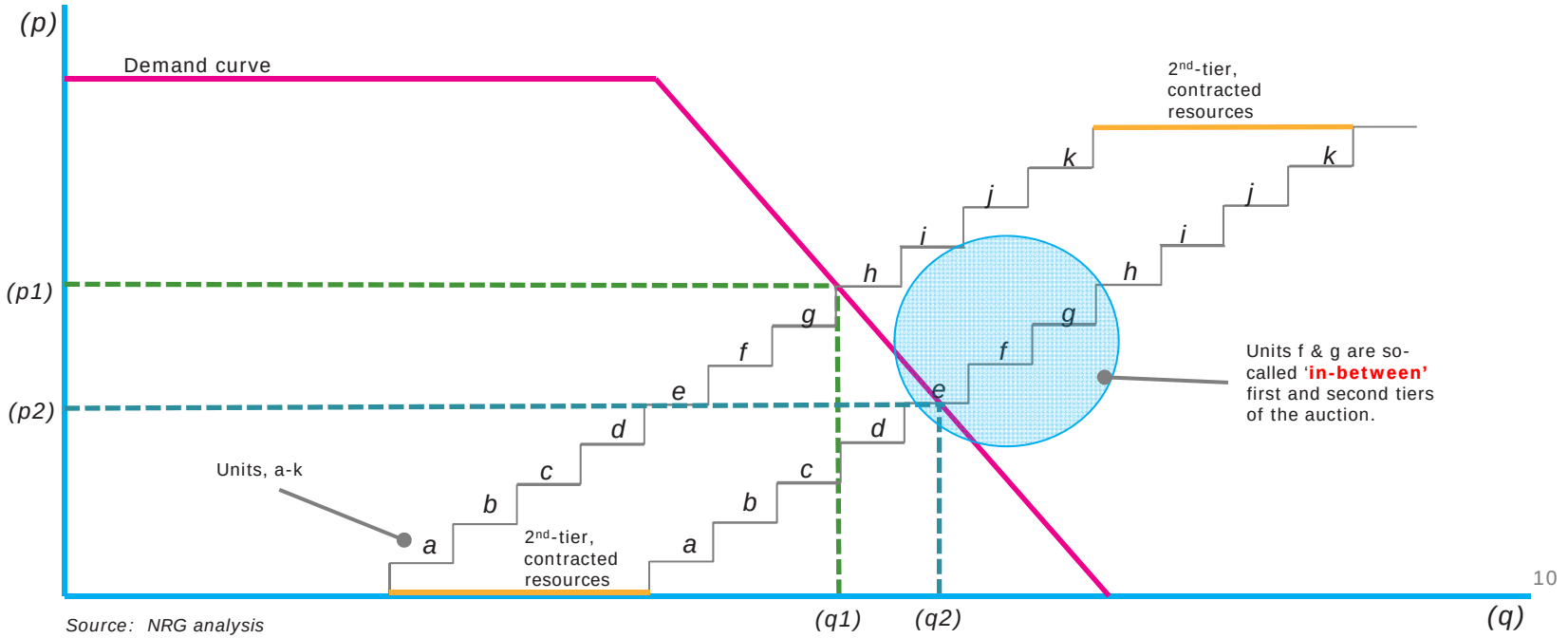
Goals:

- ✓ Create a financeable capacity market structure that continues to incent investment when and where needed, even as state-contracted resources proliferate.
- ✓ Ensure that resources relying on market revenues receive adequate clearing price to maintain reliability.
- ✓ Allow state-contracted resources to assume a CSO, contribute to meeting net ICR, while recognizing that their fixed-cost recovery is coming from outside the market.
- ✓ Ensure that all resources have similar performance obligations.

Two-tier pricing ensures reliability & continued investment, while providing states the flexibility to contract to meet carbon goals

Mechanics of two-tier pricing

- ✓ The capacity auction would occur in two steps. All resources, including resources receiving out-of-market contracts to support state policy goals, would be subject to offer price mitigation in the 1st step. The 1st-step auction would clear a quantity q1 @ price p1 in the diagram below.
- ✓ In the 2nd step, any resources receiving out-of-market revenues and not cleared in the 1st step would be entered into the auction as price-takers. The second step would establish a clearing price p2, using the same bid stack, other than the public policy resources.
- ✓ Resources receiving out-of-market revenues that did not clear in the 1st–step auction would get paid p2; all other resources that cleared the 1st –step auction would get paid p1, including the so-called 'in-between' units.
- ✓ Offer floor mitigation would apply in subsequent years to resources receiving out-of-market revenues until the resource clears in a 1st–step auction.



Source: NRG analysis

A few more thoughts on two-tier pricing

- ✓FERC previously expressed concern that two-tier pricing would procure more than NICR. That concern no longer exists in a downward sloping demand curve environment.
- ✓Resources which clear in the first auction, but do not clear in the second auction, fall 'in-between' the two market clearings. The treatment of so-called "in between" resources is a challenge. These resources represent the marginal resource needed for reliability in a purely competitive environment, but are not under the curve in the second pass.
- ✓If State contracted resources clear in the first auction, the resource then becomes an Existing Resource and is not subject to further mitigation.

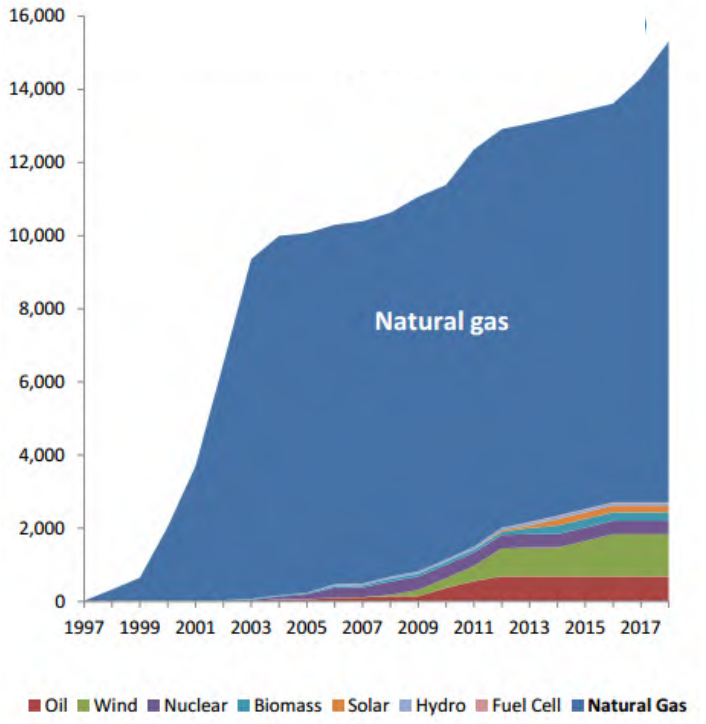
Centralized forward procurement of renewables

Financing New England's four product future

- ✓Two-tier capacity markets will support existing resources and new investment in conventional generation and demand-side resources, but will not finance renewables.
- ✓In the near-term, renewables will be financed based on long-term contracts for renewable attributes.
- ✓To continue the evolution of market-based investment, NRG recommends that New England consider a mix of carbon pricing and a centrally-administered, competitive, forward renewables market.

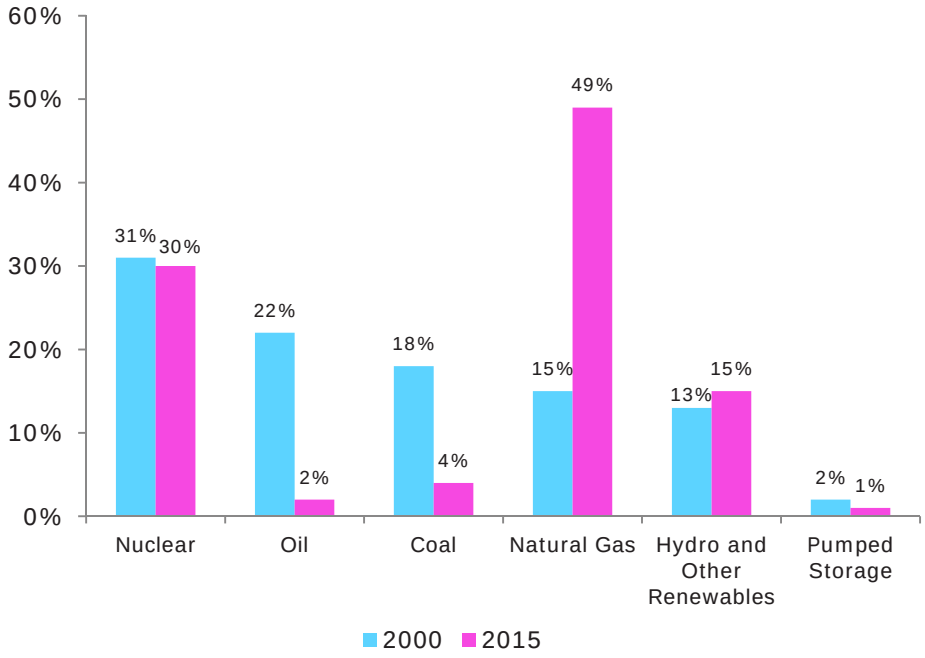
Current market design is successfully driving investment in natural gas resources

Cumulative New Generation Capacity in New England (MW)
1997-2018



Source: ISO-NE

Percent of Total Electric Energy Production by Fuel Type
2000 vs. 2015



Source: ISO-NE

Two-tier pricing reforms are designed to ensure that the capacity market will continue incenting investment in conventional generation, and enabling renewables to enter at their full competitive cost.

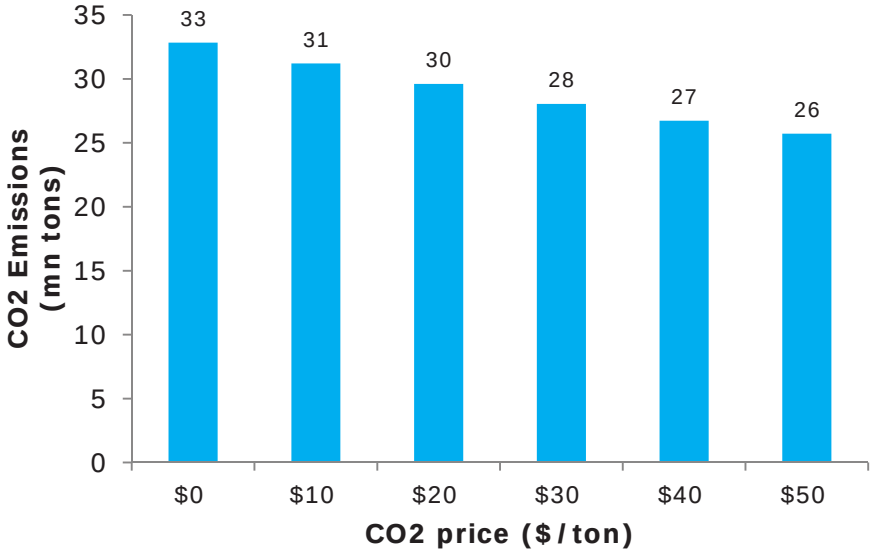
Carbon pricing can help reduce carbon to a point

Carbon pricing in New England:

- ✓ With virtually no coal left in the region's fuel mix, increased carbon pricing has a limited ability to alter the relative cost of fuels in the dispatch stack
- ✓ NRG dispatch modeling shows that progressively higher carbon prices result in, at best, only moderately lower CO2 emissions from the power sector in New England.
- ✓ In a gas-defined generation mix, there are limited marginal benefits to progressively higher carbon prices – even at 10x current RGGI prices
- ✓ Depending on program design, high carbon prices in New England may price the region out of carbon trading programs that emerge under the CPP or other coordinated CO2 mitigation efforts.

Est. Annual New England Power Sector CO2 Emissions

Assuming various carbon prices



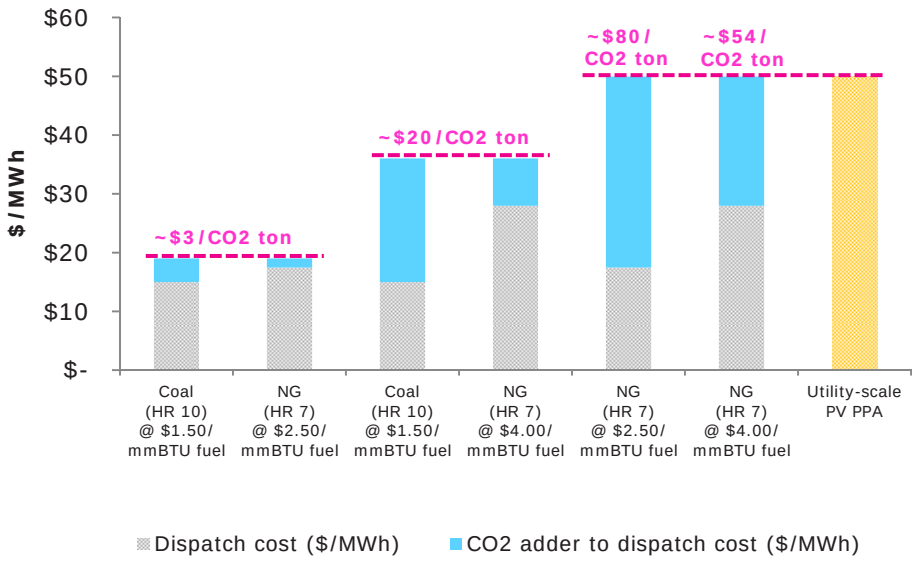
Source: NRG Analysis

Carbon prices much higher than seen to date would be necessary to induce merchant renewables

- ✓MIT's *Future of Solar Energy* study finds that in order for the levelized cost of energy (LCOE) of a utility-scale PV project to be equal to the LCOE of natural gas fired generation, "the CO2 charge would have to rise to **$104** per ton" (see p 109).
- ✓The NYISO IMM found that carbon prices of between **$41 - $115** per ton are needed to incentivize new wind and solar in New York.
- ✓As the grid decarbonizes, CO2 pricing will have less effect on energy prices; CO2 prices will need to rise substantially to maintain any support for merchant renewable investment.

*****Illustrative values only*****

Carbon price required to 'levelize' $/MWH cost among generators



Source: NRG Analysis

A forward market for renewable attributes

- ✓ Traditionally, PPAs have proven to be the most cost-effective means of supporting the deployment of renewable energy infrastructure in MA, CA and overseas (e.g. Germany, Spain, etc.).
- ✓ Renewables projects generally require a 10 – 20 year stream of revenues in order to achieve the best financing terms and allow for project-level financing.
- ✓ A 3-year forward market for renewable attributes *with a 10 – 20 year lock for new resources* could provide an effective financing mechanism.

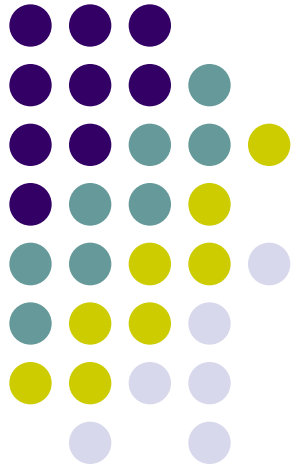
Forward Clean Energy Market framework

- ✓ Three-year forward procurement open to all renewable energy sources (as defined by each State, *with as much uniformity as possible*).
- ✓ New resources could elect a price lock (of between 10-20 years) to facilitate financing and construction.
- ✓ Existing resources would bid into the auction at their going-forward costs.
  - o So long as RPS standards increase, price would be set by new entry, which decreases over time as the renewable cost curve declines.
- ✓ Auction would procure commitments to deliver MWh targets.
- ✓ Downward sloping demand curve would allow procurement of excess renewables, if available at lower cost.
- ✓ Some questions:
  - o How would forward renewables interact with FCM for obligations and pricing?
  - o Could the renewable attributes be integrated into FCM?
  - o And many others

Questions?

Proposal for clean power plant solicitation

William P. Short III



Integrating Markets and Public Policy ("IMAPP")
August 11, 2016

The Problem

- Energy market revenues are insufficient
- Existing non-carbon emitting resources cannot operate profitably

What's needed?

- Competitive market mechanism to increase revenues for qualified resources.

How to?

- **Qualified** generators competitively bid based on reduction in FCM payments
- **Selected** generators awarded payments equal to operating cost less energy & REC revenue
- **Give Back** payments by generators as energy prices increase

Qualified Generators

- Day-ahead bidder for 100% production at $0.00/MWh
- FCM Participant w/CSO for 100% of unit capacity
- Located on PTF & built to full integration standard
- Located in ISO-NE Control Area
- No actual carbon emissions

The Terms of the Deal

Duration	3-year minimum; 1-year renewal option (max. 7 years)
Give back	50% of the energy revenues above the operating costs until all subsidy payments are repaid
Selection Criteria	Greatest percentage reduction in FCM payments on a MW basis over the term of the agreement
Source of Funds	Payments to winning generators collected by ISO-NE from network load. Repayments from to winning generators paid back to network load by ISO-NE
RFP Size	Up to 4,100 MW

Potential Costs

Plant Size (MW)	Annual Operating Cost ($/MWh) (a)	Average Energy Cost ($/MWh) (b)	Subsidy[1,2] (a-b)	Annual Production (TWh)	Subsidy[3] ($'mil)
700	$46	$25	$21	5.0	$105
1,250	$35	$25	$10	9.5	$95.0
2,150	$30	$25	$5	17.5	$87.5
4,100				32.0	$287.5

[1] Less FCM reduction
[2] If $0 or negative, generator initiates Give Back
[3] Cost per MWh to network electric load ~ $2.25/MWh

The Benefits

- Preserves 4,100 MW of existing non-carbon emitting resources yielding annually:
  1) 32 million MWh of price suppression electrical energy (~25% region load)
  2) Reduction of 12.9 million RGGI allowances (43% of New England usage for 2016)
- Short-term policy with payback requirement
- No apparent need for State legislative or regulatory action

The Alternatives

Replace these EXISTING resources with:

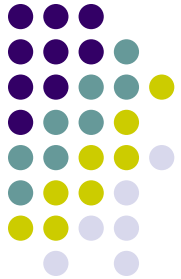
WIND: 12,200 MW (30% CF)

-or-

SOLAR: 25,000 MW (14% CF)

High costs include *(NEWIS report)*:

- Miles of new transmission
- Above-market rates “locked-in” long-term
- Possible added capacity payments to reliable generators



Questions

Regional Greenhouse Gas Initiative: Getting (at least) Half Way to IMAPP

NEEPOOL

August 11th, 2016

Peter Shattuck
Director, Clean Energy Initiative

Context

Deep Decarbonization Commitments

- State Requirements

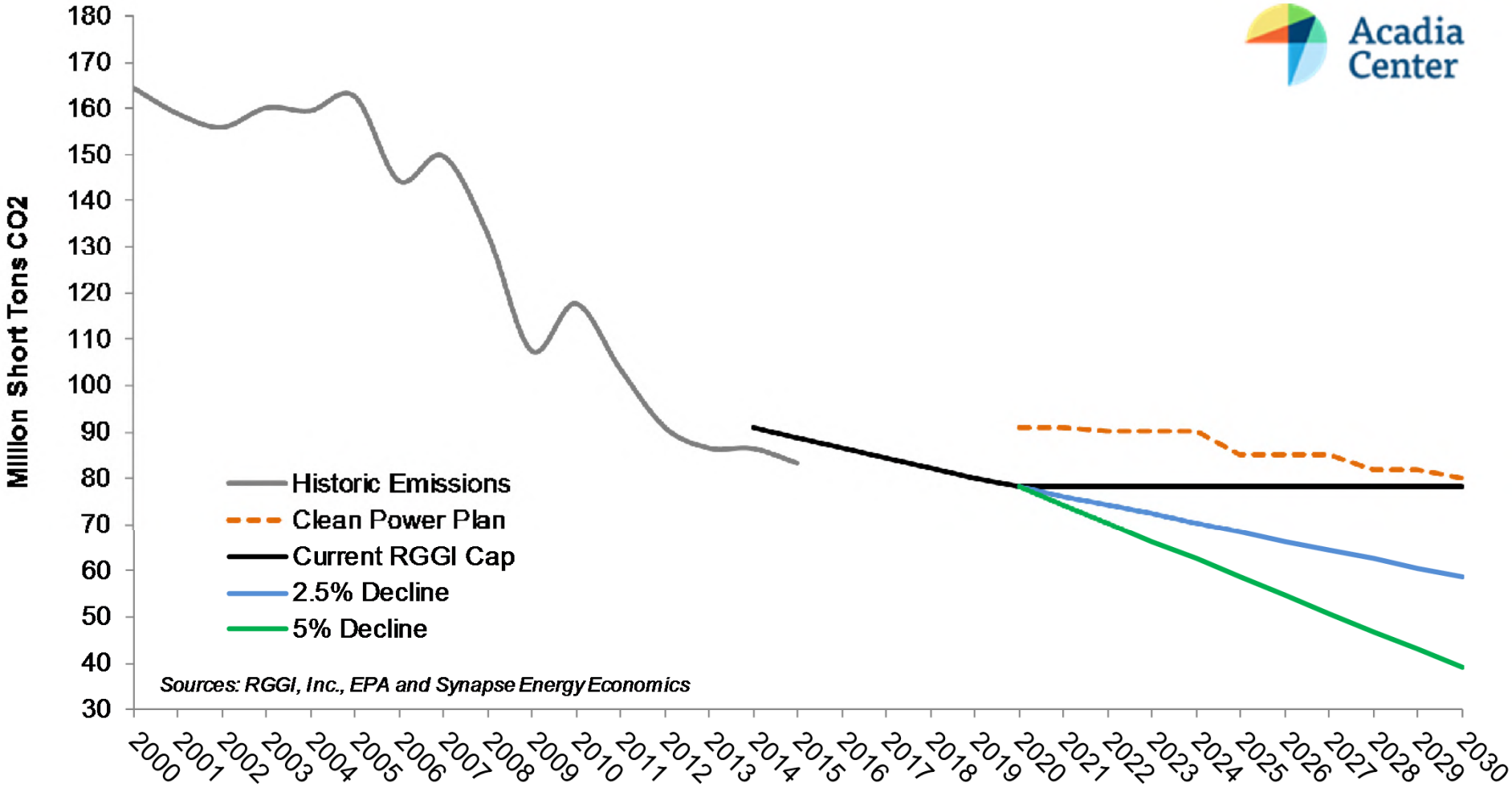
RGGI State	2030 Economy-Wide GHG Target	2050 Economy-Wide GHG Target
Connecticut	35-45% below 1990	80% below 2001
Delaware	30% below 2008	-
Maine	35-45% below 1990	75-85% below 2003
Maryland	40% below 2006	90% below 2006
Massachusetts	35-45% below 1990	80% below 1990
New Hampshire	35-45% below 1990	80% below 1990
New York	40% below 1990	80% below 1990
Rhode Island	35-45% below 1990	75-80% below 2002
Vermont	35-45% below 1990	75% below 1990

- Massachusetts GWSA ruling

2016 Program Review

- Cap
  - Decline
  - Duration
- Allowance supply
  - Adjustment for bank
  - Cost containment
- Timeline
  - Final rule by year-end
  - Stakeholder presentation in Fall
  - Near-term decision point…?

Cap Options


Million Short Tons CO2
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
2000
2001
2002
2003
2004
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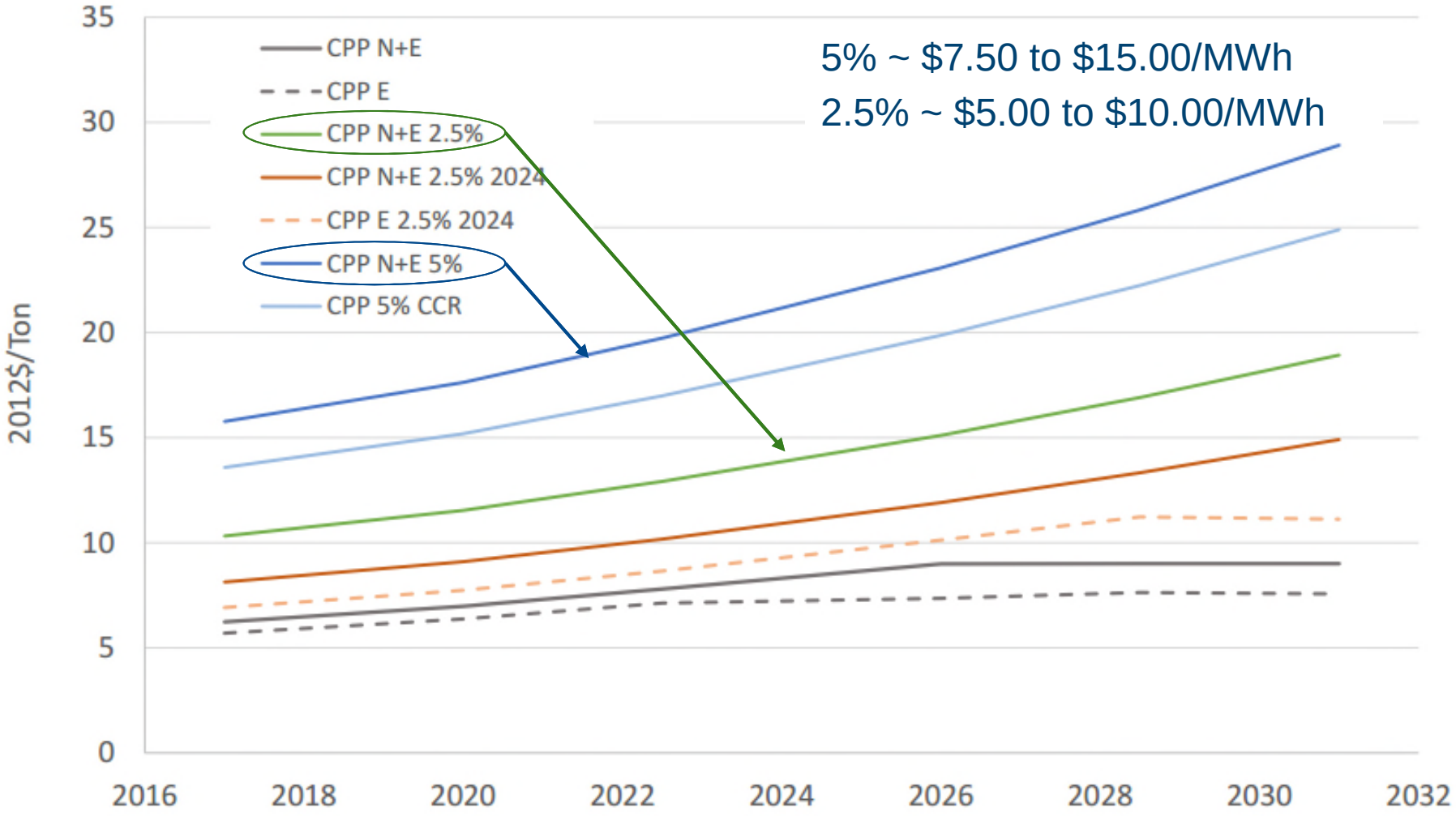
2022
2023
2024
2025
2026
2027
2028
2029
2030
Historic Emissions
Clean Power Plan
Current RGGI Cap
2.5% Decline
5% Decline
Sources: RGGI, Inc., EPA and Synapse Energy Economics

Allowance Supply

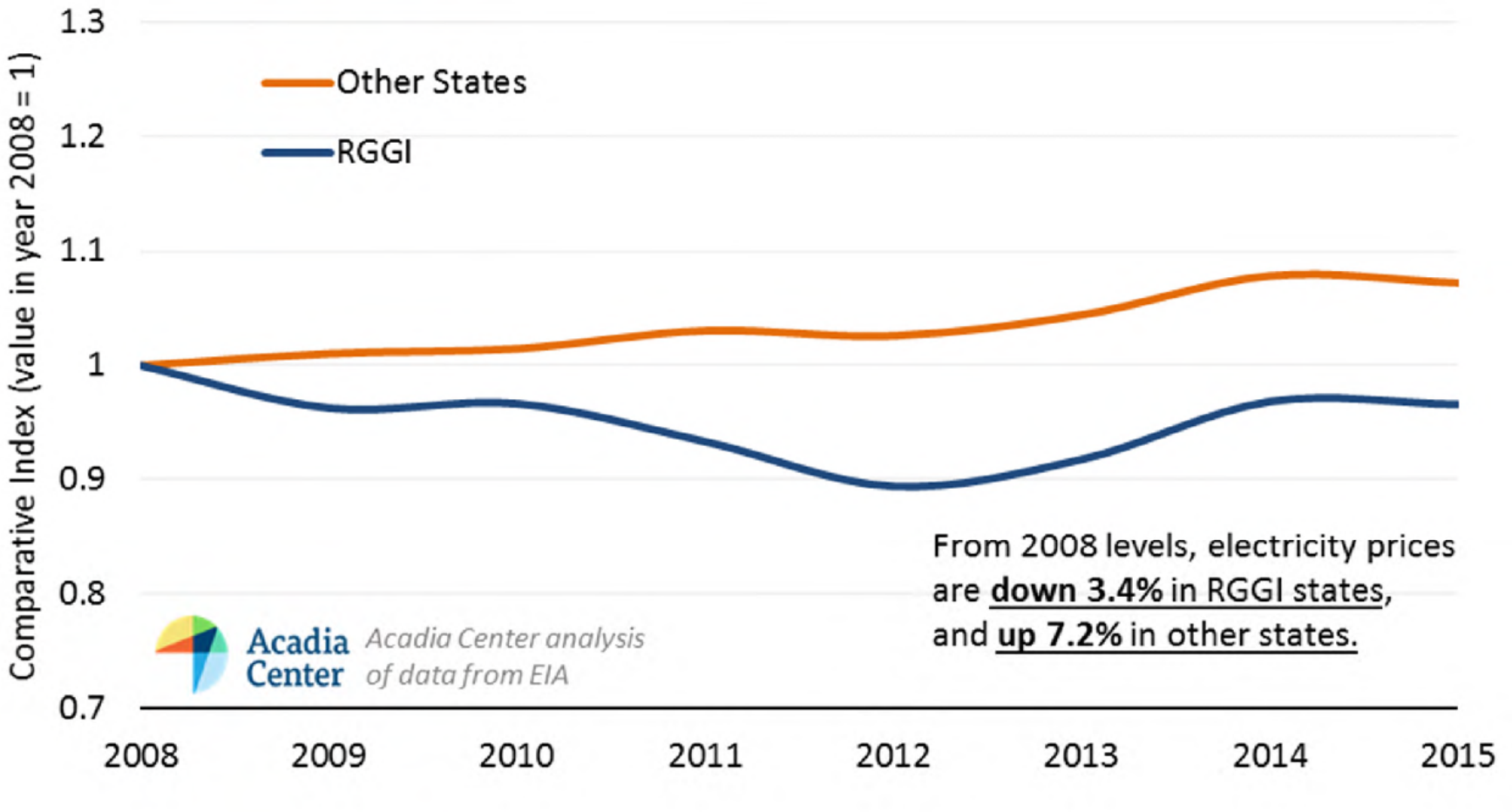
- Adjustment for Bank – 2012 Program Review
  - 140 million ton bank => 140 million ton cap reduction
- New Bank Accumulating
  - Emissions below cap: 4.7 million (2014), 5.6 million (2015)
  - Cost Containment Reserve: 5 million (2014), 10 million (2015)
  - Current total = 25.3 million
  - 50 million Reserve allowances available to 2020
- Cost Containment
  - Reserve @$8/ton
  - Proposed increase to $15-$22 in 2021, $24-$36 in 2031

Allowance Price Impact



Viability

Electric Prices



http://www.rggi.org/docs/ProgramReview/2016/06-17-16/2016_PR_IPM_Modeling_Draft_Results_Overview.pdf

Economic Benefits

The report, "The Economic Impacts of the Regional Greenhouse Gas Initiative on Nine Northeast and Mid-Atlantic States," found that implementing RGGI from 2012-2014 adds $1.3 billion in economic value to the nine-state RGGI region, leads to the creation of more than 14,000 new jobs, and cuts electricity and heating bills, saving consumers $460 million. Each individual state sees economic benefits as the region cuts annual carbon emissions by more than a third from 2008 (133 million tons) to 2014 (86 million tons).

http://www.analysisgroup.com/news-and-events/press-releases/new-data-show-states-that-limit-carbon-emissions-through-markets-are-seeing-economic-benefits/

Take-aways

- Strengthen RGGI
  - Successful, existing mechanism
  - Prevent greater challenges (i.e. more carbon-intensive generation)

- Appeal of cap and invest
  - Market-based
  - Flexible
  - Funding for complementary programs

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Integrating Public Policy Goals into Energy Markets

Gas/Electric Harmonization and Price Formation

New England Power Pool

August 11, 2016

EDF
ENVIRONMENTAL
DEFENSE ACTION FUND
Legislative arm of Environmental Defense Fund

Context for EDF's Perspective

- Fundamental belief that environmental goals can be achieved through properly structured and functioning energy markets
- The ongoing FERC dockets: (e.g., Nat Grid 7/28)

  "However, the industry restructuring of recent decades, while creating many advantages for customers, has also had the unintended side effect of rendering dysfunctional the linkage between natural gas infrastructure and electric systems in the region. The failure of market forces to stimulate expansion of gas pipeline infrastructure under current industry conditions is now beginning to be urgently felt."

Market Perspective on Gas/Elec Harmonization

Gas and electric wholesale markets should be economically and operationally coordinated so that products and services in each market generate effective and actionable price signals in and across these two markets, and so that appropriate, right sized, investments are called forth in a timely manner.

Regulations, wherever possible, should be aimed at establishing self-correcting market structures that will further serve to support the generation of appropriate price signals to incentivize market players to meet established policy goals.

Market Incompatibility

- **Vast majority of Gas-fired electric generation does not run at the same level of output every hour of the day.**
- Only 6% of Gas-fired Plants and 10% of Gas-fired output is from Plants that run at >80% load factor (Avg is 85%),
- 49% of Plants and 68% of output is from Plants that run at 40% to 80% Load-factors (Avg is 59%); and
- 45% of Plants and ~20% of output is from Plants that run at an average load factor of only 17%

- Skipping Stone (From EIA data for Plants that ran in the period Jan thru Nov 2015)

Market Incompatibility

Since Order 636:

Virtually all contracts have been ratable flow contracts.

- Ratable flow has meant 1/24th of nominated and scheduled daily quantity every hour.

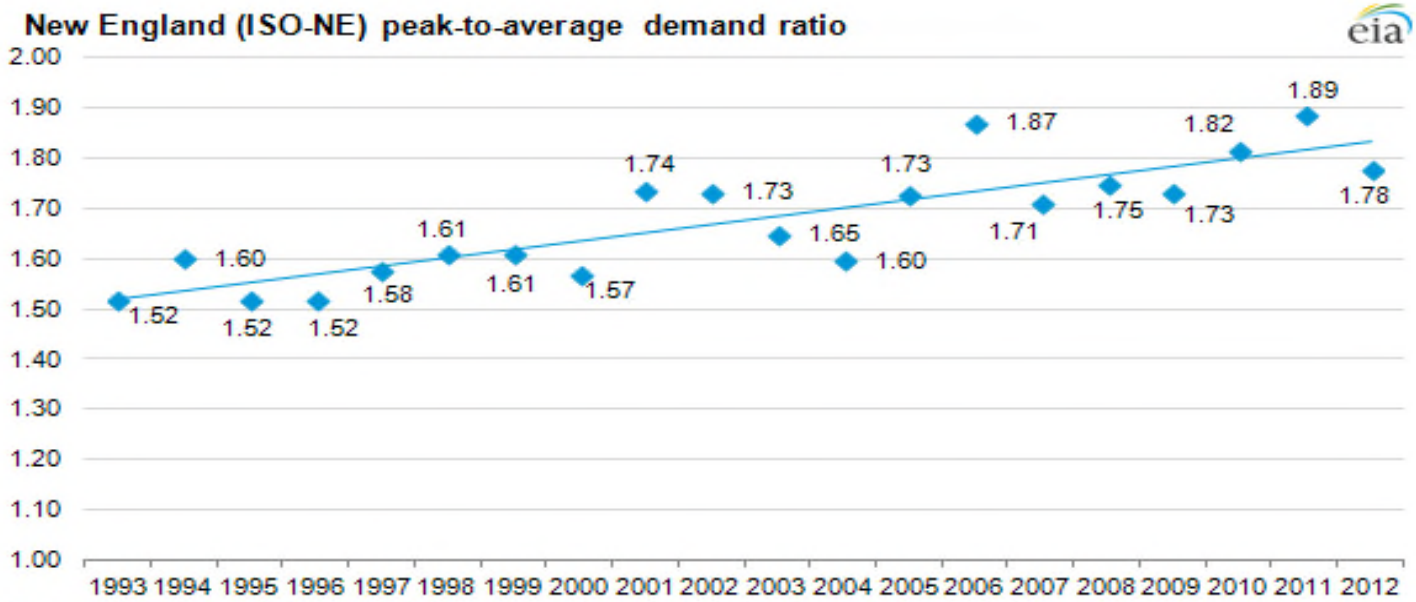
There is some carry over No-Notice on Pipelines that have these services.

- Comprises less than 15% of contracted transport service on Pipelines with No-Notice / Enhanced Services (i.e., non-1/24th hour services)
- Comprises ~17 Bcfd of the ~230 Bcfd of Total US contracted Transport services

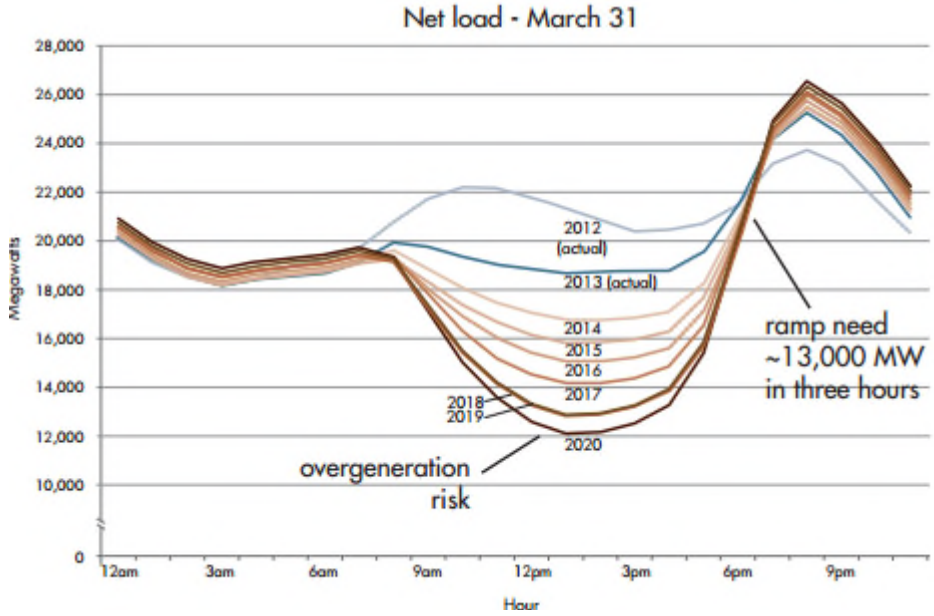
In essence, more frequent scheduling enables Shippers to achieve Intraday non-ratable flows versus the ratable flows that are associated with Day-Ahead scheduling

Source: Skipping Stone

Peak-to-average electricity demand ratio rising in New England and many other U.S. regions



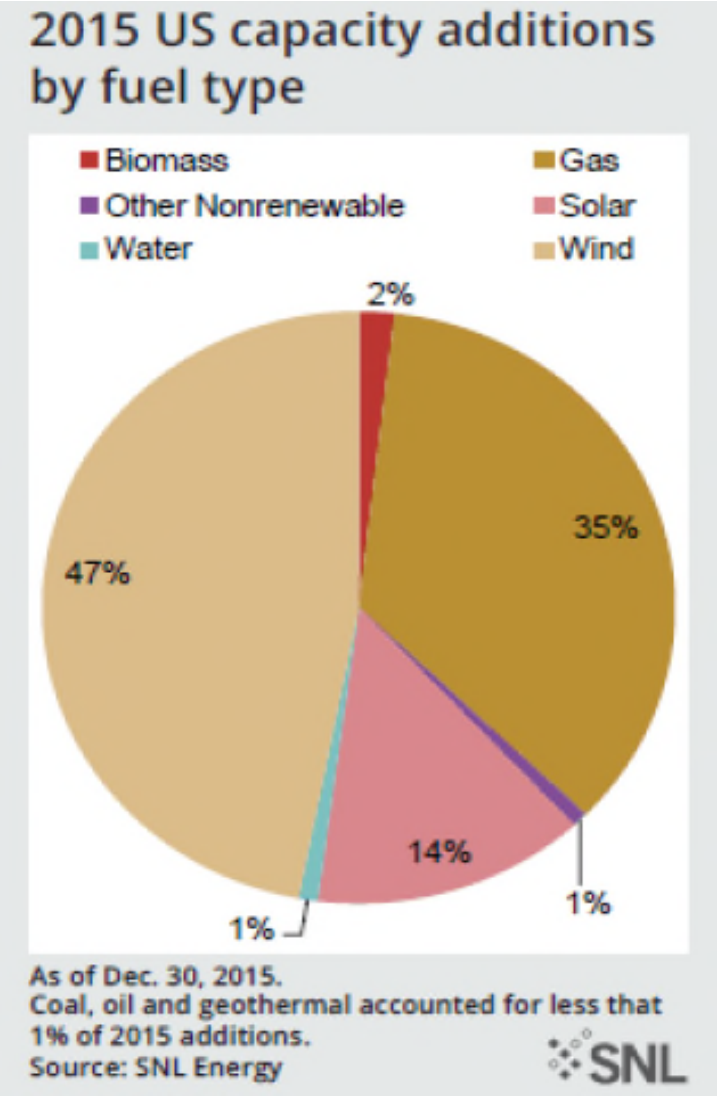
See also,
CAISO Duck Chart



Proposed standards for provision of "special efforts scheduling for natural gas pipeline transportation that is: a) scheduled outside of the standard grid-wide nomination cycles, b) permits flow changes outside of standard schedule flow periods; and/or c) involves Shaped Flow Transactions (as defined in the proposed standard)." Note: shaped flows would allow generators to schedule varying flow quantities of gas for delivery the next day that correlate to their anticipated output levels.

-pending before NAESB

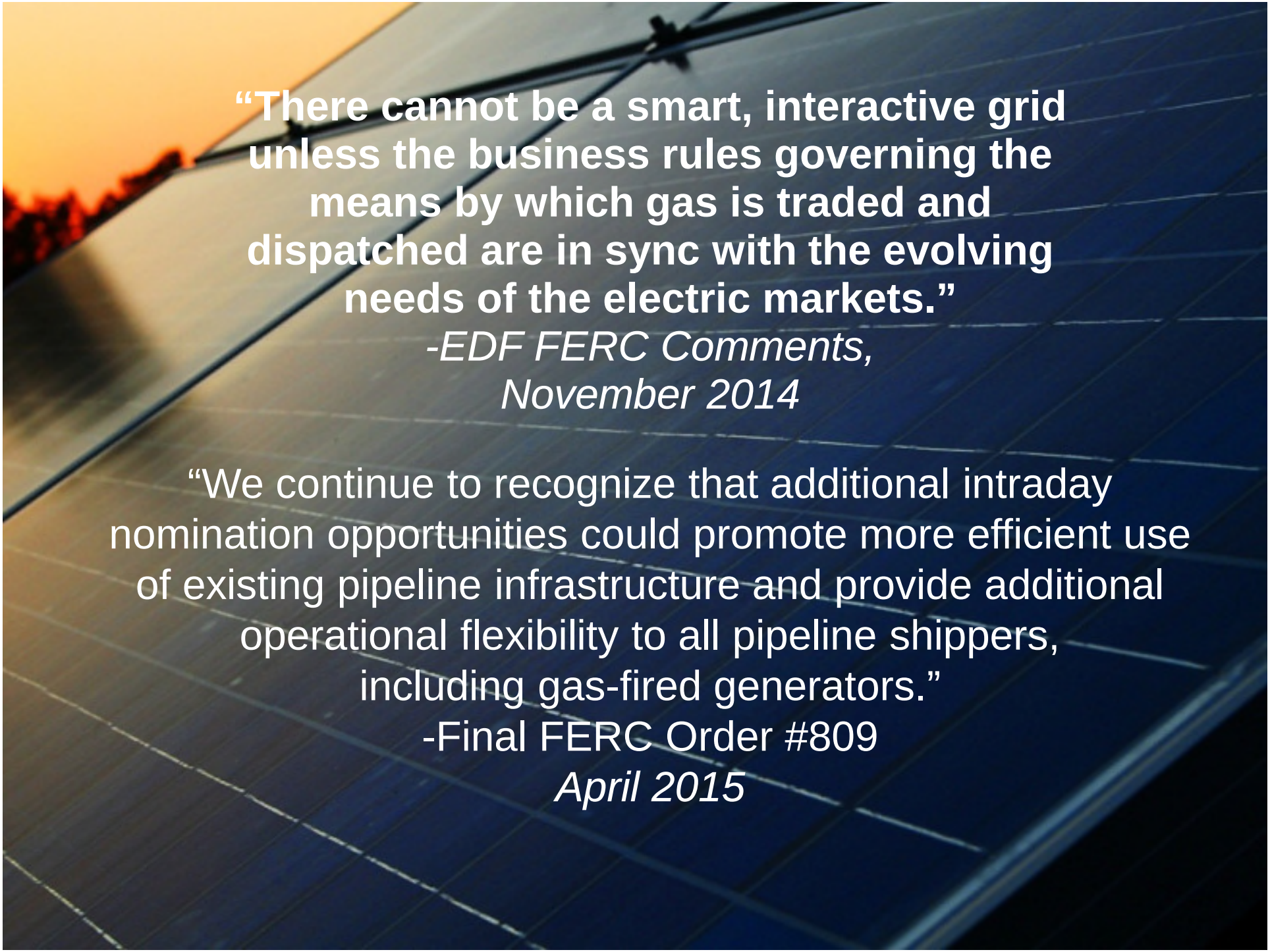
Optimized Market Design Considerations



- As the peak-to-average ratio rises, generators called on to meet peak-hour demand are running fewer hours and/or at lower output levels the rest of the year.
- As more renewables and DERs are added to the grid, ancillary services needs and values will increase.
- Efficient price formation and capturing that value require more scheduling cycles and sub-day services from the wholesale gas market (e.g., Cal-ISO FRP, Duck curve).
- A more dynamic, data driven grid will price based on the value of services.
- Electric – sub-hourly pricing and balancing; Gas ??

Pipeline Flexibility Pilot Program
(prepared by Skipping Stone 1/25/16)

The 3-year pilot program is designed to continue market design enhancements for coordination between the natural gas pipelines and electric generators. It will delineate and price new services for scheduling non-ratable flows and call forth competition in the provision of such services. Participation in the pilot would be voluntary.


“There cannot be a smart, interactive grid unless the business rules governing the means by which gas is traded and dispatched are in sync with the evolving needs of the electric markets.”
-EDF FERC Comments, November 2014
“We continue to recognize that additional intraday nomination opportunities could promote more efficient use of existing pipeline infrastructure and provide additional operational flexibility to all pipeline shippers, including gas-fired generators.”
-Final FERC Order #809
April 2015

Building the Bridge from Natural Gas to Clean Energy: Challenges and Opportunities

N. Jonathan Peress – EDF 8/5/16 **(Draft)**

Natural gas is widely viewed as a bridge to a low carbon energy future, particularly in the domestic electricity sector. This short paper considers the role of natural gas in the current policy and economic context including natural gas, first as a displacer of coal-fired power plant output, and, then increasingly as a provider of flexible services to balance and facilitate increasing deployment of intermittent and variable renewable energy capacity.[1]

According to a July 2016 analysis by EIA, "the most important [electricity system] trends over the past few years have been large increases in natural gas, solar and wind generating capacities along with a significant decline in coal generating capacity."[2] Due in large part to the cost advantages created largely by the abundant shale gas supply, natural gas-fired power plants are rapidly becoming the dominant source of electric power in the US. In 2016, natural gas is expected to supply 34.3% of electricity generation, and coal is forecast to supply 30.2% of electricity generation.[3] Assuming implementation of the Clean Power Plan, natural gas's market share lead over coal is projected to continue to grow, as is the deployment of renewable energy.[4] EIA's most recent projection would have renewable market share growing from 13% in 2015 to 23% in 2025.[5]

Numerous data points and projections suggest that as renewable penetration increases, output from natural gas-fired power plants, particularly baseload, combined-cycle, plants, will fall.[6] MIT's Future of Natural Gas Study observes that increased renewable deployment will result in market and economic uncertainties as gas-fired baseload power plants experience reduced output and patterns of electricity production are altered. The study predicts market and operational challenges and notes that (as of 2011) "there is no consensus on a suitable regulatory responses which could include enhancements of capacity mechanisms such as those already in place in most U.S. wholesale markets, new categories of remunerated ancillary services or other instruments."[7] These operational and market challenges are now occurring, particularly in regions where distributed and renewable generation is becoming a substantial market participant.

More recently, it is also becoming apparent that commercial incentives for natural gas infrastructure deployment are somewhat misaligned with the ongoing transformation of the electric grid to a more renewable, dynamic and lower carbon grid. Current investment signals are weighted towards building somewhat inflexible pipeline capacity which are being deployed

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[1] See, *The Future of Natural Gas, An Interdisciplinary MIT Study,* June 2011
[2] EIA, *Electricity Monthly Update*, July 2016.
[3] EIA, *Short Term Energy Outlook*, July 12, 2016.
[4] EIA, http://www.eia.gov/todayinenergy/detail.cfm?id=26712
[5] EIA, http://www.eia.gov/todayinenergy/detail.cfm?id=27332
[6] See, e.g., 2016 California Gas Report (filed by California gas companies to the CPUC), August 2016 (California gas demand for electric generation is expected to decline at 1.3 percent per year for the next 20 years due to more efficient power plants, statewide greenhouse gas policies and renewable deployment)
[7] *The Future of Natural Gas, An Interdisciplinary MIT Study* at 94.

with largely static financial and physical designs that will likely be incompatible with GHG reductions beyond the Clean Power Plan and substantial additional renewable deployment. The current natural gas market design is not targeting the right types and amounts of natural gas infrastructure -which will impose unnecessary costs on captive retail ratepayers, strand long-term investment that becomes uneconomic long before its useful life, unnecessarily increased costs for further GHG reductions beyond the Clean Power Plan, and lower cost renewable resource lockout.[8]

The California Duck Curve illustrates some of the operational considerations relevant to natural gas and renewable integration by in particular, highlighting the value of flexible resources in the system.[9] But pipelines are not being built to serve the variable load profiles of electric generation, which increasingly experience rapid swings in output over the course of a day. Pricing and incentivizing investment in flexible services, including those powered by natural gas, is an imperative as more renewables are deployed.

Natural gas pipeline capacity is critical to getting expanding gas supply to markets and end users including electric generators. The current market design rewards pipelines with 12-14 percent annual return on equity for the value of that capacity. Consequently, pipeline operators and developers earn profits based almost entirely on take-or-pay contracts with their customers paying for capacity. One consequence is that pipelines operators are largely indifferent to the extent to which pipelines are used. They make money based on obtaining contracts for and building capacity, which provides a powerful incentive to overbuild - and which appears to be underway in many areas of the country. Overbuilding creates the risk of stranded investment particularly insofar as captive retail ratepayers are obligated for long term contracts, which is typically the case.[10]

Commercial rewards based simply on capacity, rather than deliverability, foster incompatibility between the natural gas and electric sectors because pipelines operators have a diminished financial interest in whether delivery services conform to generator needs such as the flexibility discussed above. In general they do not.[11]

The market refinements we propose are designed to channel investment and innovation towards energy infrastructure, whether natural gas or other alternatives, by providing new commercial opportunities that are better aligned with contemporary energy trends – starting with flexibility -- the new paradigm of the energy system which must be properly valued and compensated.

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[8] A recent study conducted for the Massachusetts Attorney General found that new gas pipeline capacity would be a more expensive solution to address reliability challenges than alternatives and would raise the long term cost of meeting regional GHG reduction policies. See, http://www.mass.gov/ago/doing-business-in-massachusetts/energy-and-utilities/regional-electric-reliability-options-study.html

[9] http://www.caiso.com/Documents/FlexibleResourcesHelpRenewables_FastFacts.pdf

[10] See Peress Testimony before the US Senate Energy and Natural Resources Committee (June 14, 2016) discussing market reviews by FERC staff and industry analysts, as well as utilization analysis by USDOE.

[11] The need for gas pipelines to offer services better geared to generation has been a reoccurring theme of market participants before at FERC. See, e.g., Comments of PJM Interconnection, Docket AD 14-19-000 (October 1, 2014)(stating, "today's natural gas market appears to lack sufficient tools and services to dynamically respond to the reliability needs of gas-fired units servicing electric load.")

They are structured to build from the current market design, improve market efficiency, foster investment and save energy customer money.

In general, the FERC is supportive of efforts to better coordinate the gas and electric industries. Those efforts need to be accelerated and go farther. In its April 16, 2015 Final Order No. 809, *Coordination of the Scheduling Processes of Interstate Natural Gas Pipelines and Public Utilities*, the Commission found "that additional intraday nomination opportunities could promote more efficient use of existing pipeline infrastructure and provide additional operational flexibility to all pipeline shippers, including gas-fired generators." It directed the North American Energy Standards Board (NAESB), which is an industry consensus standards-setting body, to explore new options and standards for faster more flexible pipeline scheduling. EDF's proposal for standards in the docket are designed to foster new scheduling services that would align with evolving generator needs now, and provide more variable flows to accommodate rapid and dramatic load swings as the system becomes more renewable and dynamic.[12] [13]

The objective of the proposed standards is to provide new revenue streams for natural gas delivery services based on the system value they provide including for flexibility. Achieving price formation and compensation for that value will foster competition and innovation from market participants (on both the gas and electric sides) that can provide those services. As Skipping Stone and EDF suggested to FERC,

> Gas and electric wholesale markets should be economically and operationally coordinated so that products and services in each market generate effective and actionable price signals in and across these two markets, and so that appropriate, right sized, investments are called forth in a timely manner. Regulations, wherever possible, should be aimed at establishing self-correcting market structures that will further serve to support the generation of appropriate price signals that will incentivize market players to meet established policy goals.

We suggest that because natural gas is a robust resource for providing key system services and attributes for a more renewable and dynamic grid, delineating and pricing those services in the energy markets is critical to calling forth investment through the energy markets. Price signals that arise in and between the natural gas and electric markets will over time call forth the most efficient mix of generation, fuel supply, gas pipeline and electric transmission infrastructure, demand response, renewable energy, energy storage (gas, electric, and other) and distributed energy resources as well as provide accurate price signals for increased energy efficiency deployment.

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[12] EDF, working with Skipping Stone (a gas system/market consultancy), proposed standards for provision of "special efforts scheduling for natural gas pipeline transportation that is: a) scheduled outside of the standard grid-wide nomination cycles, b) permits flow changes outside of standard schedule flow periods; and/or c) involves Shaped Flow Transactions (as defined in the proposed standard)." Note: shaped flows would allow generators to schedule varying flow quantities of gas for delivery the next day that correlate to their anticipated output levels.

[13] A complete and recent report of the ongoing NAESB deliberations is accessible at https://www.naesb.org/pdf4/ferc072916_naesb_order809_status_report.pdf.

With respect to natural gas pipelines specifically, valuing and creating price signals for flexible delivery services can begin the process of evolving away from a market design weighted towards valuing capacity between supply and delivery locations in favor of one that compensates for the value of services and throughput. The day is rapidly approaching when the value of moving gas from place to place will dissipate, as gas supplies are increasingly produced proximate to consumption markets. This will have the effect of devaluing place to place transportation services. Moreover, this change in market dynamics will be largely contemporaneous with ever-increasing demand for tailored load following services, those that put a premium on matching variable deliveries to receipts.

Although the pipelines, as an industry, are content with the current market design, it is a fact that certain pipeline systems are losing revenues from services that are based on the differences between prices of gas between two places, as well as losing demand for throughput as flow patterns change and thus are struggling to earn sufficient revenue. For many incumbent pipeline systems, providing new revenue streams for the value of receipt and delivery services – including variable hourly and sub-hourly transportation services as opposed to depending on fixed rate contracts for capacity (i.e., firm transportation) – will be a tool for continued economic viability.