# Market Design 3.0

## A Vision for the Clean Electricity Grid of the Future

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PRESENTED TO

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THE Brattle GROUP

# Agenda

Introduction to Wholesale Electricity Markets

State Decarbonization Initiatives

Market Design 3.0

New York ISO Carbon Pricing Initiative

ISO New England Integrating Markets and Public Policy (IMAPP) Proposed Clean Energy Market

# A Brief History of Wholesale Markets

## Traditional utility model

- Vertical integration of generation, transmission, and distribution
- Operate as a monopoly

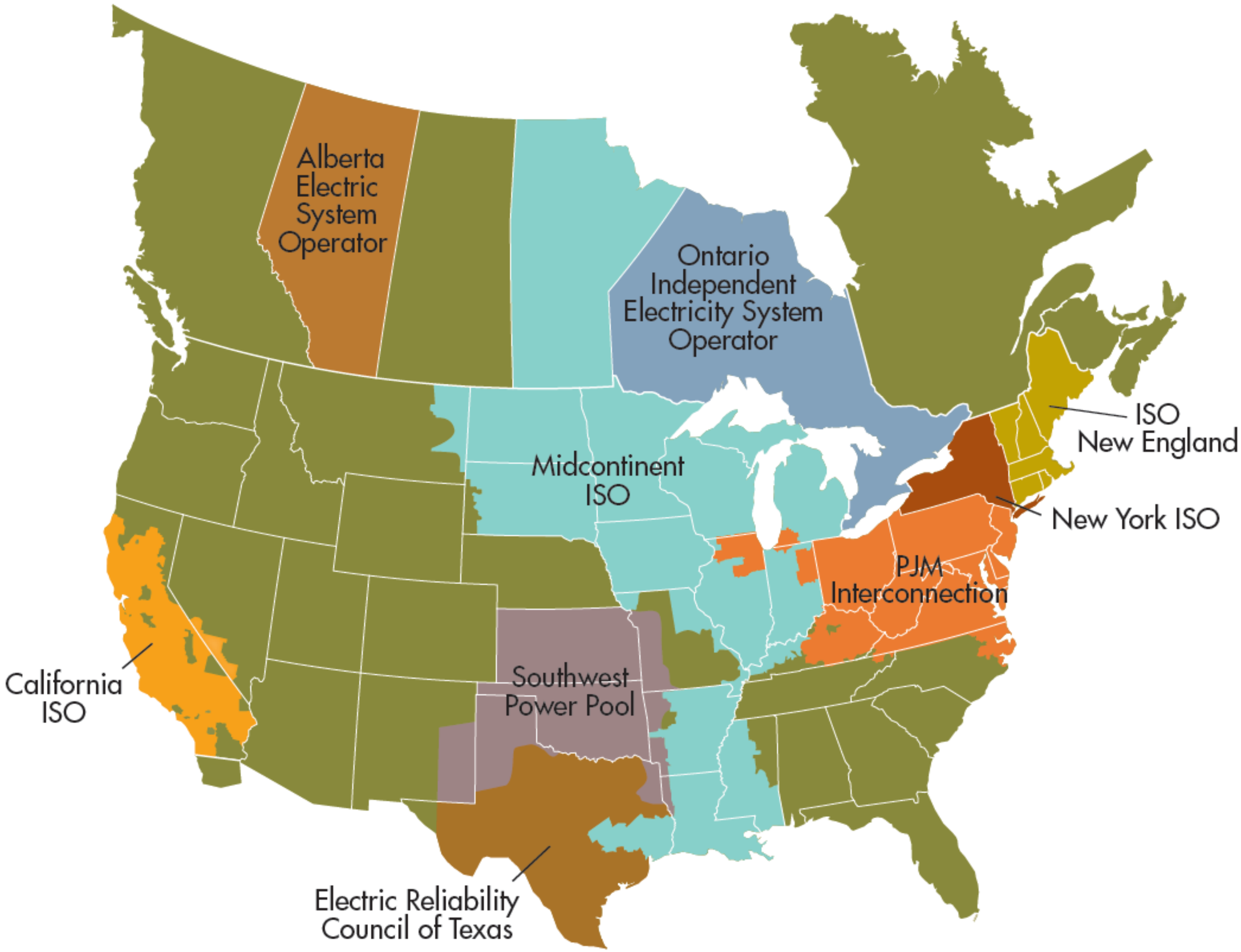
## Restructuring of late 1990s

- Recognition that “generation” is not a natural monopoly and competition may benefit customers

## Wholesale market structure today

- Competitive generation
- Regional Transmission Operator (RTO) or Independent System Operator (ISO) schedule all power flow on their transmission network
- Network operation and electricity prices based on economic principles, *i.e.*, prices reflect marginal cost of serving load

# North American Wholesale Electricity Markets




Source: ISO/RTO Council

# "Standard" Market Design

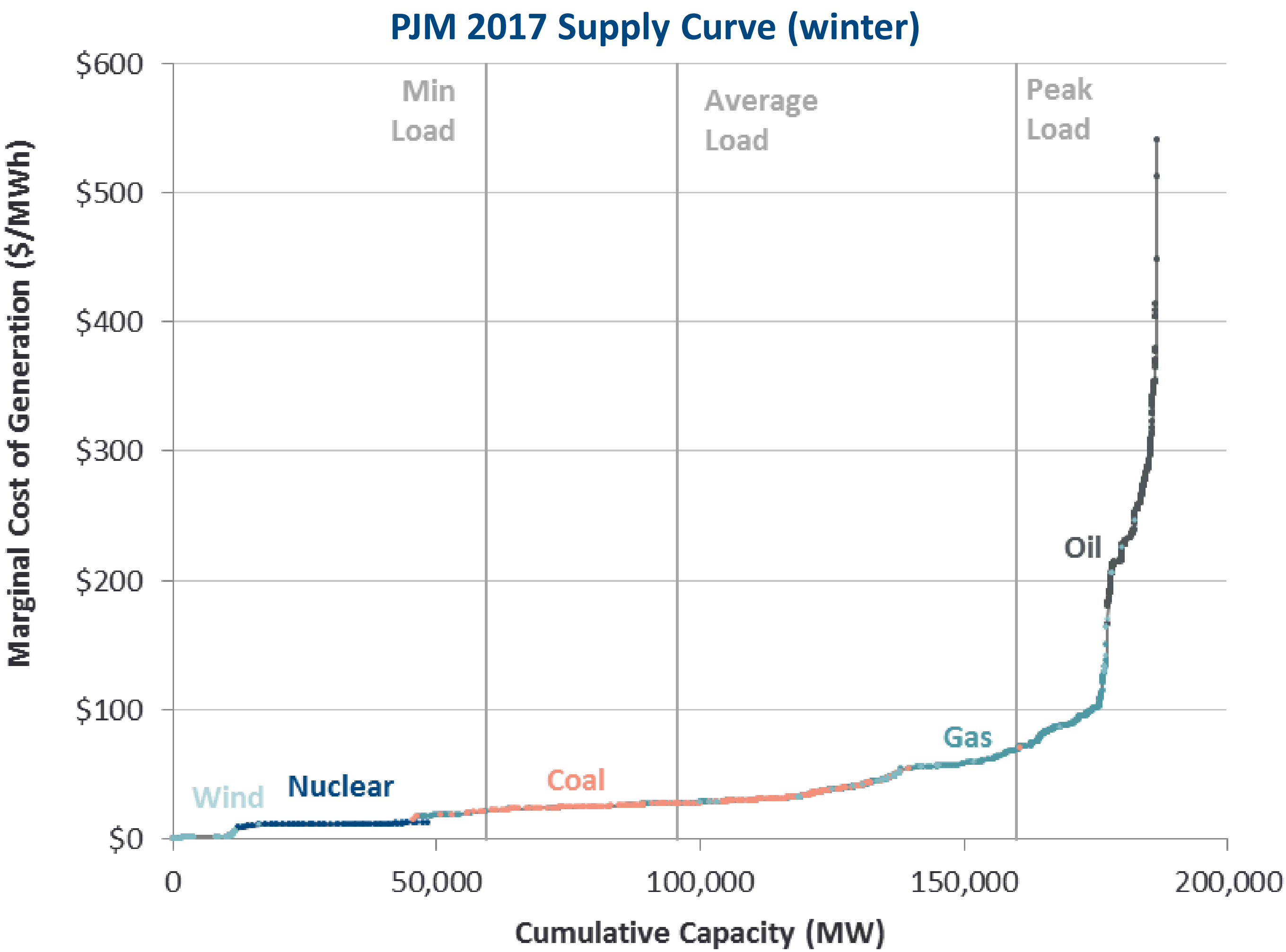
**Energy Market:** Resources submit $/MWh offers based on variable costs. Lowest-cost mix of resources clear

**Ancillary Service Markets:** Additional products needed to reliably balance the electric system

**Capacity Markets:** Additional payment needed to attract sufficient supply to meet resource adequacy standards

**The objective of Standard Market Design is to maintain system reliability at least cost. Environmental objectives are not considered.**

# Energy Supply Curve and Marginal Cost Pricing




*Notes:*
Average Coal Price is $2.78/mmBtu. Average Oil Price is $20.83/mmBtu. Marginal cost is the sum of Fuel, Variable O&M, and Emissions cost for each unit (pulled from Ventyx Generating Unit Capacity dataset). Summer cumulative capacity is represented for both seasons. For gas plants, fuel price is the average summer and January forwards respectively for 2017. Minimum, Average, and Peak Load shown for 2017. In Summer and Winter curves the RGGI CO2 price from March 2015 auction has been considered. Wind and solar installed capacity derated by capacity credit levels. Retirements and new builds that are currently under construction are accounted for. Oil price is inflated from current prices to 2017 prices.

# State Initiatives to Reduce Carbon Emissions

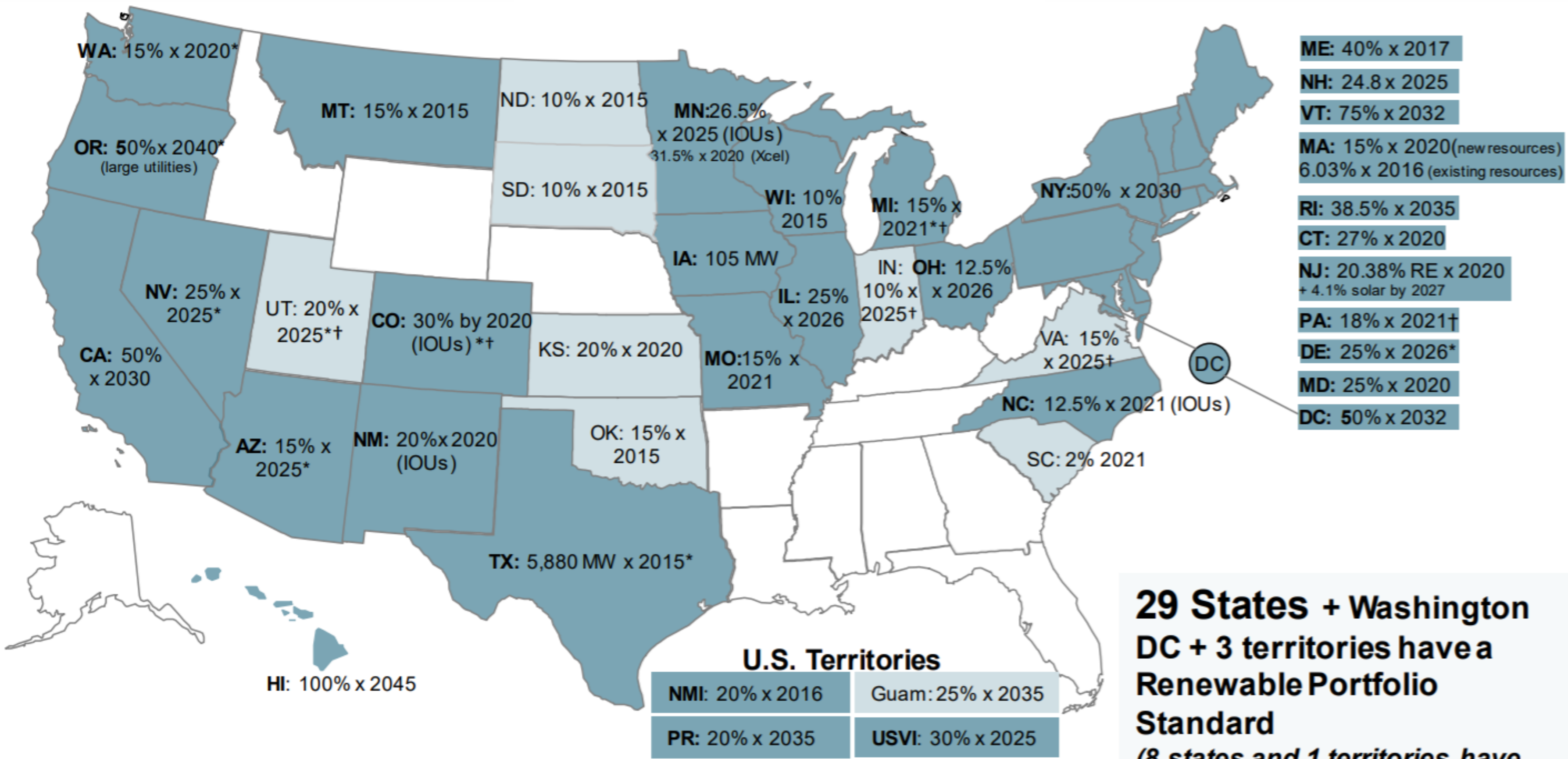
**States are pursuing a variety of polices that reduce electric sector emissions**

- Renewable portfolio standards
- Decarbonization goals
- Energy efficiency standards
- Nuclear support policies

**Typically implemented as payments to target resources outside of the wholesale market**

## State Decarbonization Initiatives

# State Renewable Portfolio Standards




**29 States + Washington DC + 3 territories have a Renewable Portfolio Standard**

***(8 states and 1 territories have renewable portfolio goals)***

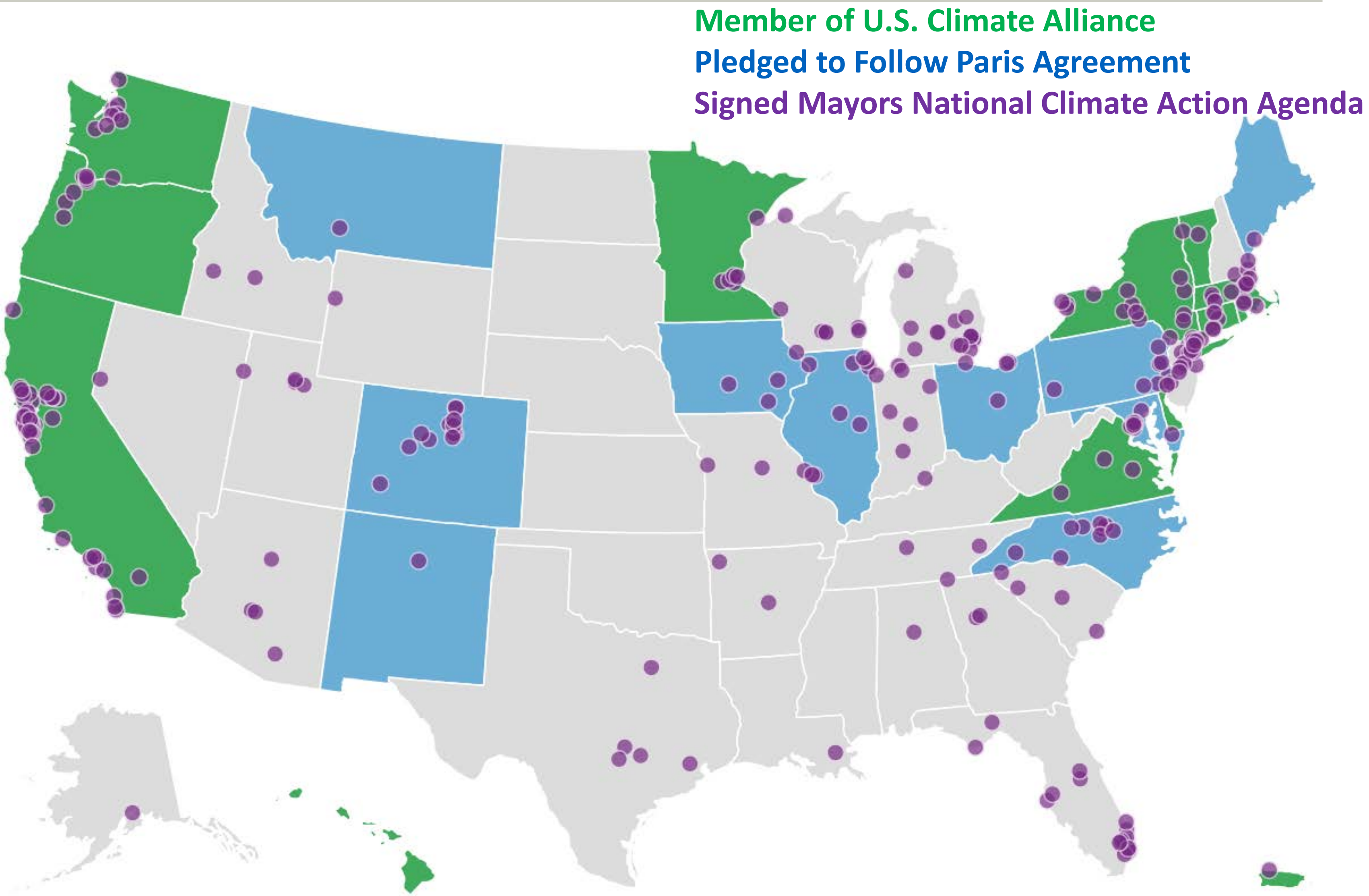
- Renewable portfolio standard
- Renewable portfolio goal

* Extra credit for solar or customer-sited renewables

† Includes non-renewable alternative resources

*Source and Notes:* dsireusa.org. As of February 2017

# States and Cities with Decarbonization Goals




*Source:* https://news.nationalgeographic.com/2017/06/states-cities-usa-climate-policy-environment/

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# Aligning Policy and Market Design Objectives

- Originally, markets were designed to do one thing: maintain reliability at lowest system cost
- Today, policymakers are increasingly looking to implement policies to decarbonize the power sector
- This creates tension, as decarbonization policy objectives are not yet reflected in market designs

**Can markets be reformed to achieve both reliability and carbon objectives at least cost?**

# Value Creation is Shifting with Market Design 3.0

## Markets designed for a clean grid will focus value on the need for clean and flexible supply, shifting away from fossil and baseload

| Market | Value | Market Implications |
|---|---|---|
| **Energy** | ↓ | ▪ Lower energy prices on average and in most hours<br>▪ But much higher on-peak prices, driven by $CO_2$ pricing for remaining fossil, scarcity pricing, and demand response/storage |
| **Flexibility** | ↑ | ▪ Need for greater quantities and new types of flexibility products<br>▪ Higher price volatility and spikes reward flexibility |
| **Capacity** | ↓↑ | ▪ Value may go up or down<br>▪ Down if additional clean energy contributes to excess supply for a period, or if new capacity sellers are attracted by other value streams<br>▪ Up if new fossil plants are needed for capacity, but only a small portion of their capital costs can be recovered from other markets |
| **Carbon and Clean** | ↑ | ▪ Some form of $CO_2$ pricing and/or clean energy payments introduced to meet policy and/or customer demand<br>▪ Value must be large enough to attract new clean resources |
| **Adjacent Customer & Distribution Markets** | ↑ | ▪ Technology and consumer-driver demand for adjacent products and services (smart home, electric vehicles)<br>▪ Participation may overlap with wholesale, clean, and retail/distribution markets |

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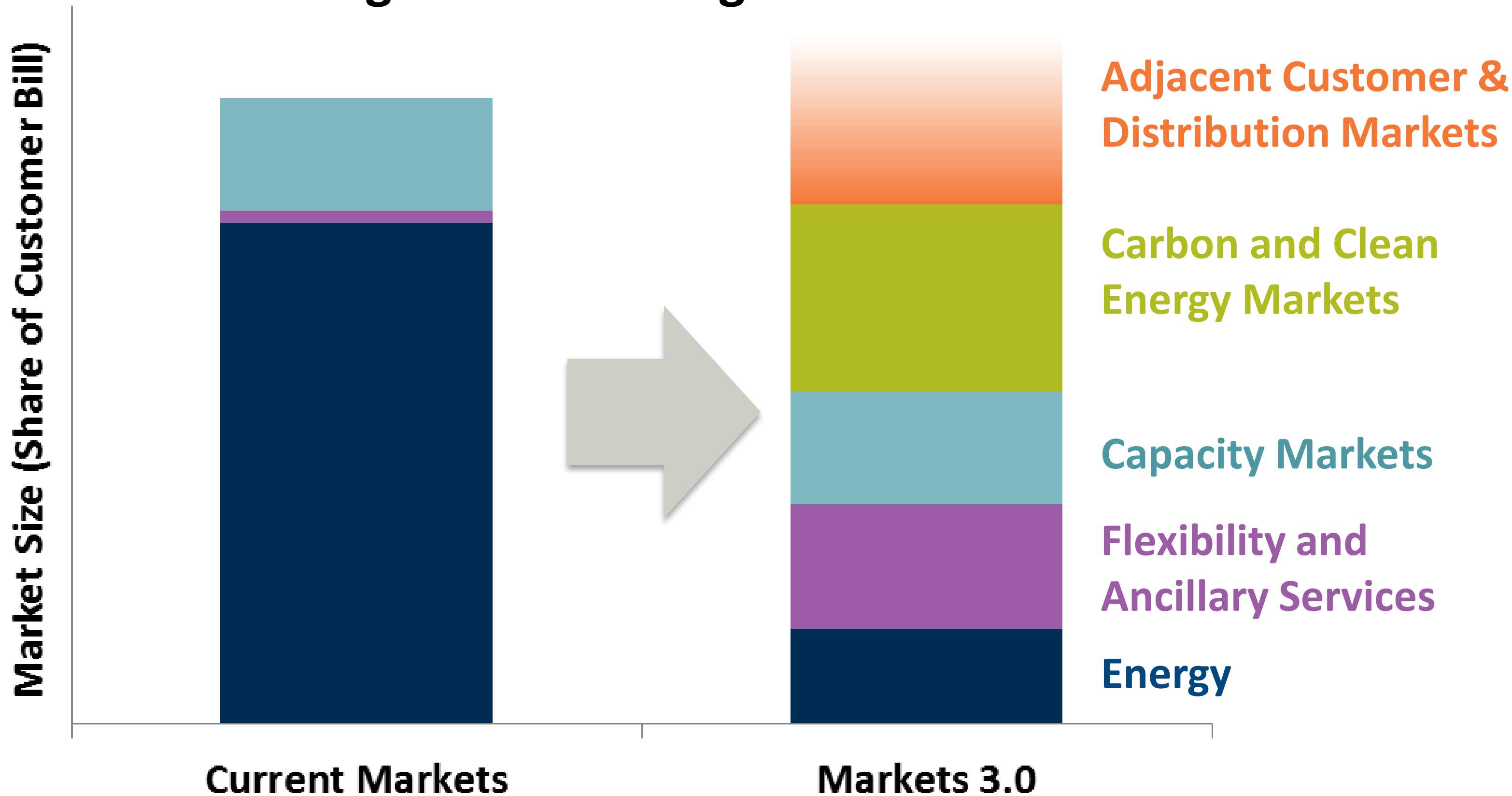
# What is the Future of Markets in the Clean Grid?

**"Market Design 3.0" will need to support competition and innovation under the fundamentally different resource mix, demand drivers, and economic forces that govern a clean grid**




***Designed for ….*** *Dispatchable thermal plants, inelastic demand* | *Intermittent wind & solar, storage, interties, engaged customers*

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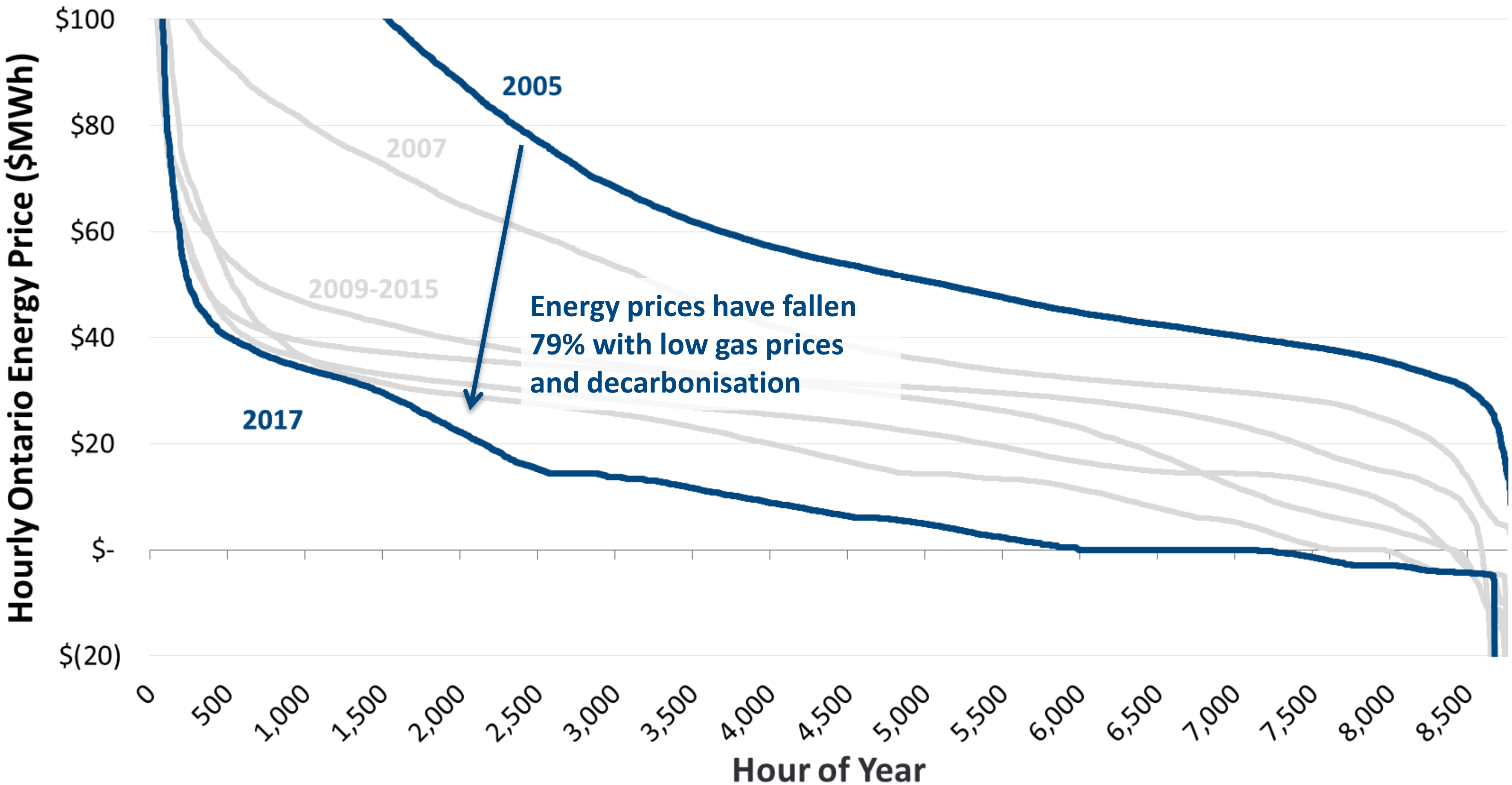
# Energy Market "Bottoms Out" with a Clean Fleet

**Ontario experience shows very low/negative prices with a 90% clean fleet & highlights the need for focused incentives for delivery when and where needed (currently missing from prices)**



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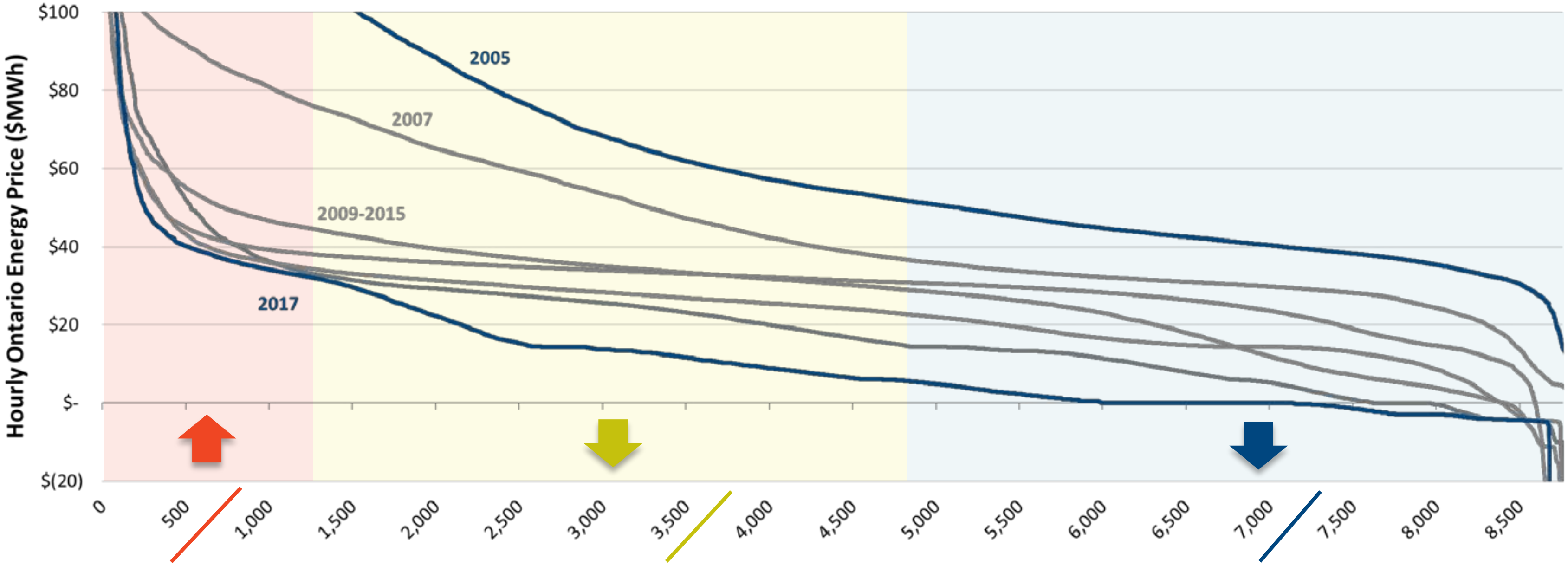
# "Non-Traditional" Resources Are the New Normal

**Marginal cost based pricing is still the fundamental driver of good energy market design. So what does "marginal cost" mean in a market dominated by clean and emerging resources?**




### Scarcity and Peak Hours

*Prices will increase (w/ design reforms)*

- Focused scarcity pricing w/ cooptimization & 5-min settlement
- DR & storage fully integrated
- CC & CT commitment costs reflected in peak hours (avoids uplifts off peak)

### Intermediate Hours

*Prices are decreasing*

- Hydro, storage, & interties fully integrated into price formation (including opportunity cost)

### Baseload and Surplus Hours

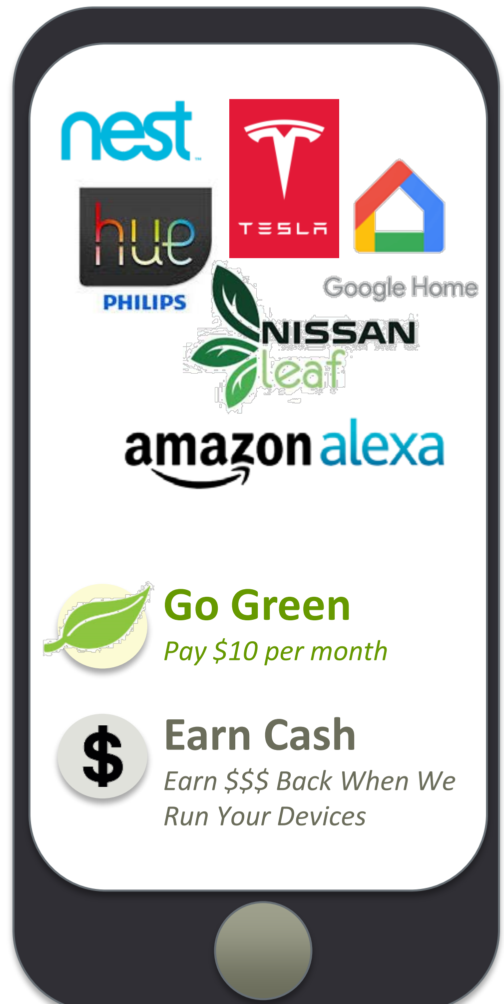
*Prices are decreasing*

- Wind and solar zero or negative (some absorbed by storage)
- No uplifts to baseload plants at min generation (costs must be recovered in higher-price hours)

# On the Horizon: Adjacent Consumer Markets

**A proliferation of consumer devices and smart home inroads have ever greater potential to upend electricity**

- Driven by customer demand for new, different, and better
- Even if electricity consumption is an afterthought for most customers, smart homes could package participation in wholesale, green energy markets, and distribution/retail markets




Examples of Device Controls Already on Phones Today

Coming Soon?

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# Carbon and Clean Attribute Markets

**Resource-neutral carbon and clean attribute markets are badly needed to resolve conflicts with wholesale markets and guide efficient investments to meet policy and customer demand for clean**

| | Carbon Pricing | Clean Energy Markets |
|---|---|---|
| **Already Working** | ✓ Integration to achieve energy market redispatch<br>✓ Influences investment mix | ✓ Attracting investment (under contracts)<br>✓ Attribute tracking |
| **Needs Reform** | ✗ Border pricing and leakage<br>✗ Multiple $CO_2$ prices in one RTO system<br>✗ Quantity-correction mechanisms to address excess allowance bank and low prices<br>✗ Regulatory uncertainties that drive investment risk | ✗ Resource neutrality<br>✗ Negative energy offers (caused by attribute product definition)<br>✗ Product definition aligned with $CO_2$ abatement<br>✗ Centralized procurement of standard products<br>✗ In-market treatment in capacity market prices |

# New York ISO
# Carbon Pricing Initiative

# New York has Goals, Mandates, and Mechanisms to Substantially Reduce $CO_2$ Emissions

## State Energy Plan

- Reduce economy-wide greenhouse gas emissions 40% by 2030 and 80% by 2050, relative to 1990 levels
- 50% of electricity from renewables by 2030

## Clean Energy Standard

- Renewable Energy Credits (RECs)
- Zero-Emission Credits (ZECs)

## Numerous other policies

- Participation in the Regional Greenhouse Gas Initiative (RGGI)
- Reforming the Energy Vision
- Energy efficiency standards
- Governor's proposal to eliminate coal-fired generation by 2020

*Source:* For more details, see https://www.nyiso.com/public/committees/calendar/index.jsp

# Process to Evaluate Feasibility of Carbon Pricing

**NYISO and NY State staff convened a stakeholder process to evaluate ways to incorporate the cost of carbon emissions into wholesale energy markets**

**Straw Proposal**

- NYISO wholesale markets incorporate a cost of carbon emissions
- Suppliers pay additional $/MWh charge reflecting the carbon embedded in their energy
- Carbon charge would be set by the State; reflect social cost of carbon (~$49/ton in 2025, net of RGGI)
- NYISO would charge importers and credit exporters to avoid leakage
- NYISO would return carbon charge residuals to customers

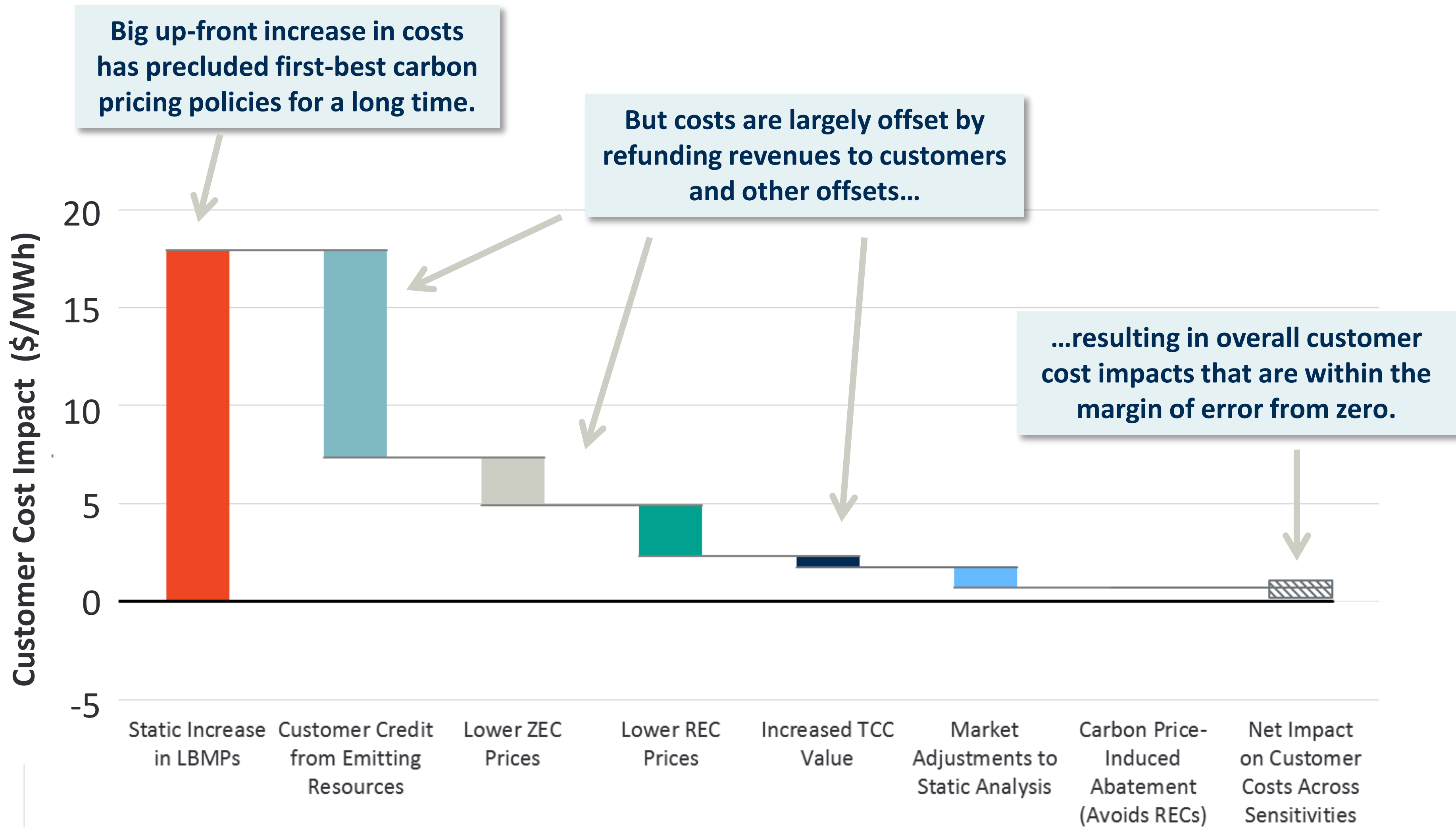
# Underlying Questions

**What are the incremental carbon reductions possible with a carbon charge?**

**How much of the economic gains are enjoyed by consumers vs. clean energy producers?  Do customer costs rise?**

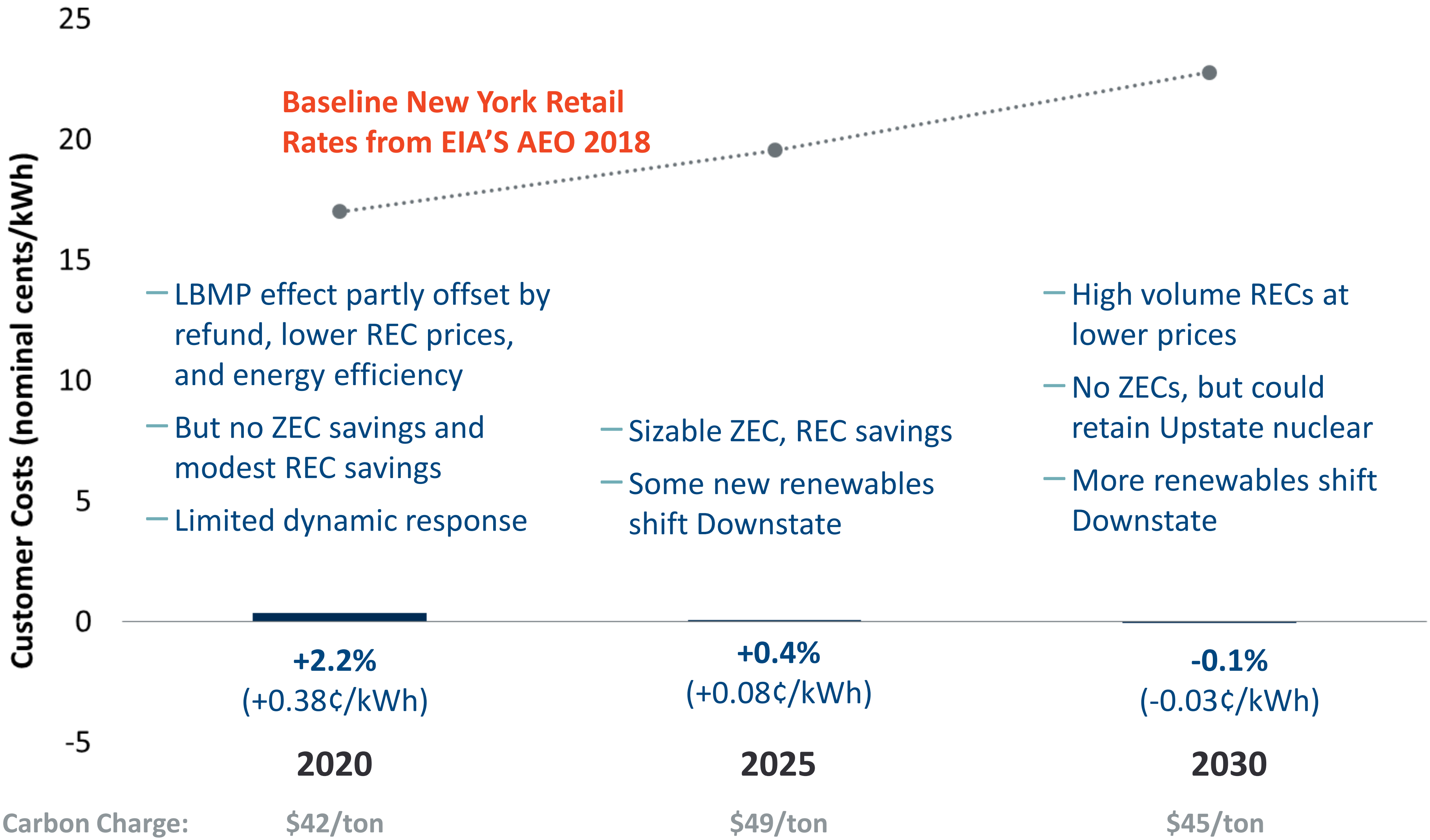
**How can implementation challenges be overcome?**

# Customer Cost Impacts of $49/ton Carbon Charge



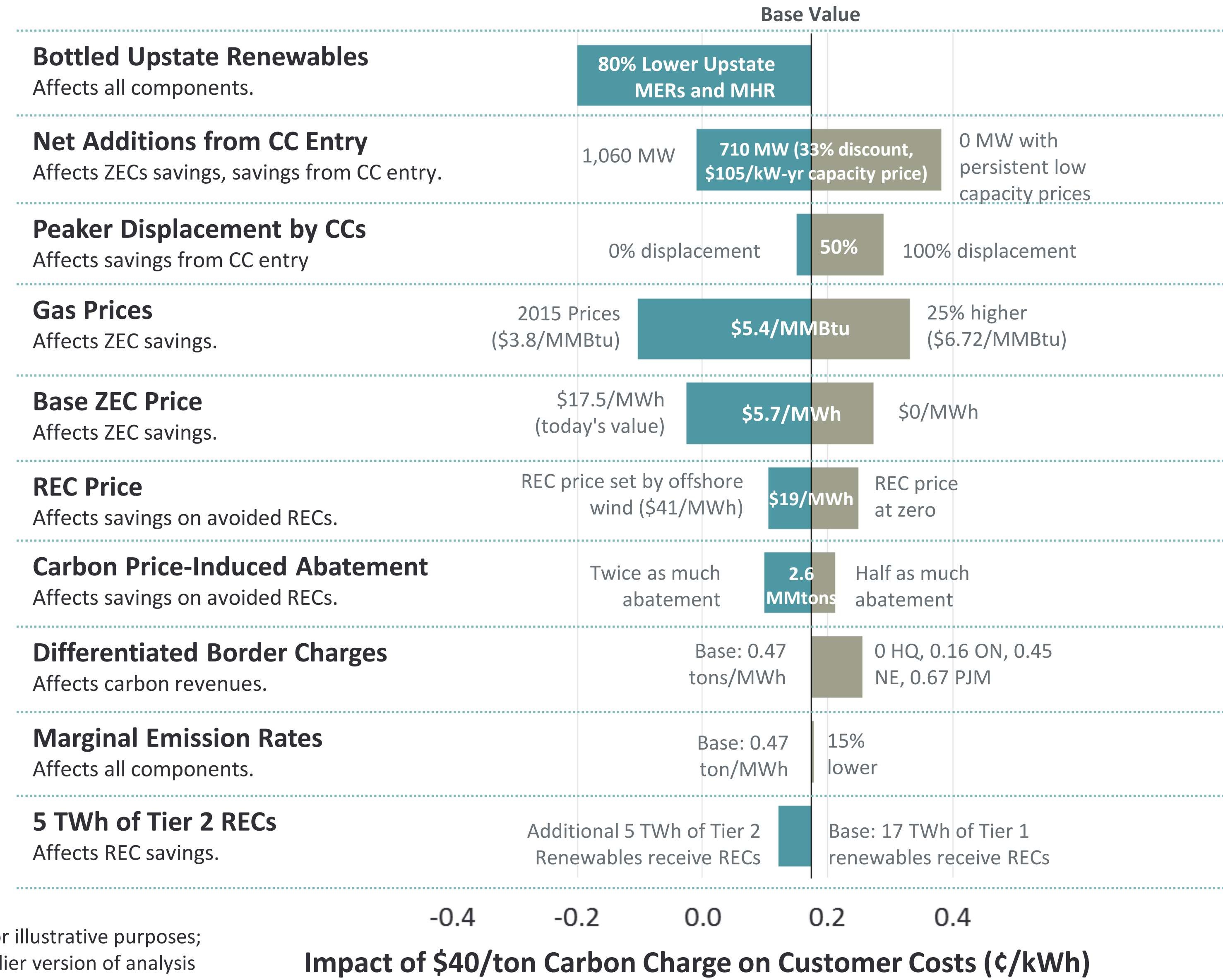
# Effect on Customer Costs

*As compared to existing policies alone*



## NYISO Carbon Pricing

# Major Sources of Uncertainty

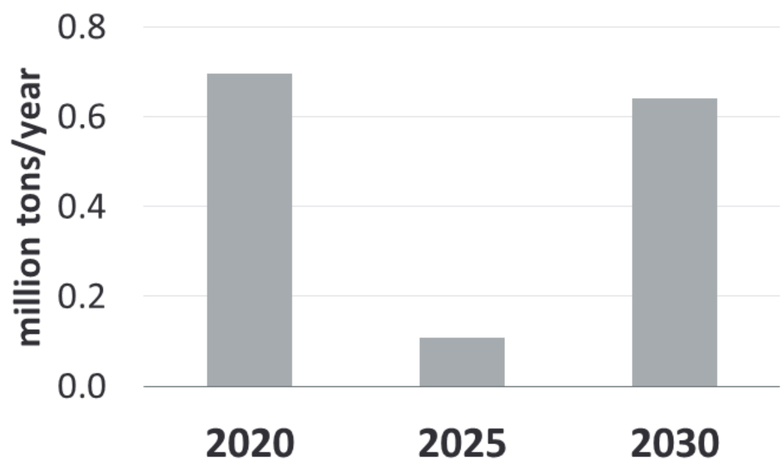



*Note:* For illustrative purposes; from earlier version of analysis

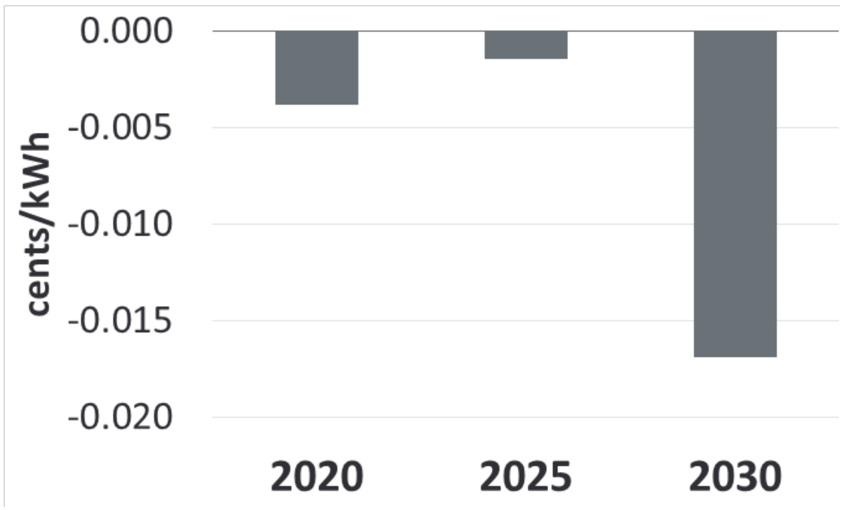
# Incremental Emissions Reductions

- Carbon charges lead to incremental internal emissions reductions of 3% by 2030 (-0.6 million tons from a baseline of 21 million tons internal emissions)
  - Limited fuel switching
  - Increased efficiency and conservation
  - Renewables shift to high-value locations
  - Possible nuclear retention
  - Possible additional renewable builds
- Translates into customer savings if offsets need to buy RECs

Emissions Reductions from Carbon Charge



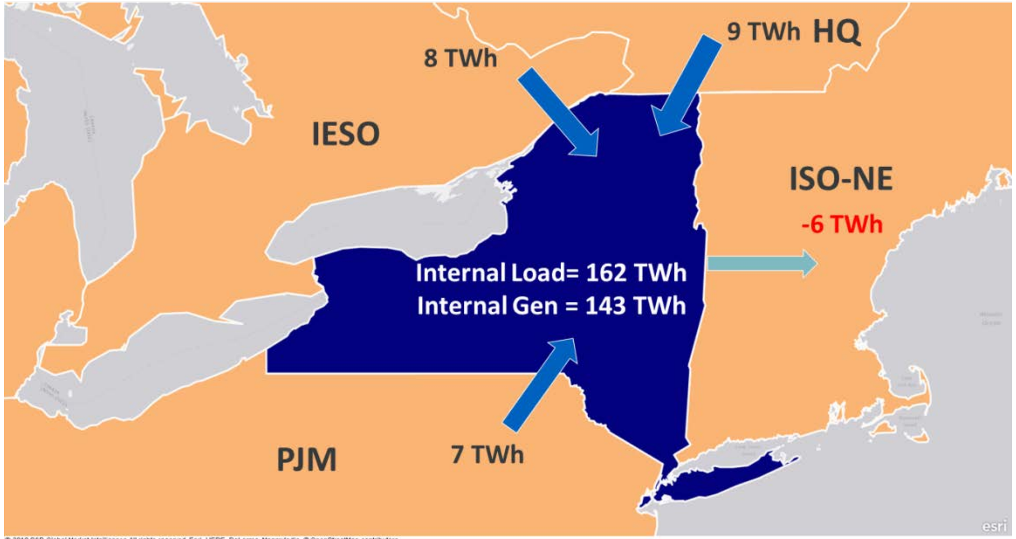

Customer Benefit from Reduced RECs



NYISO Carbon Pricing

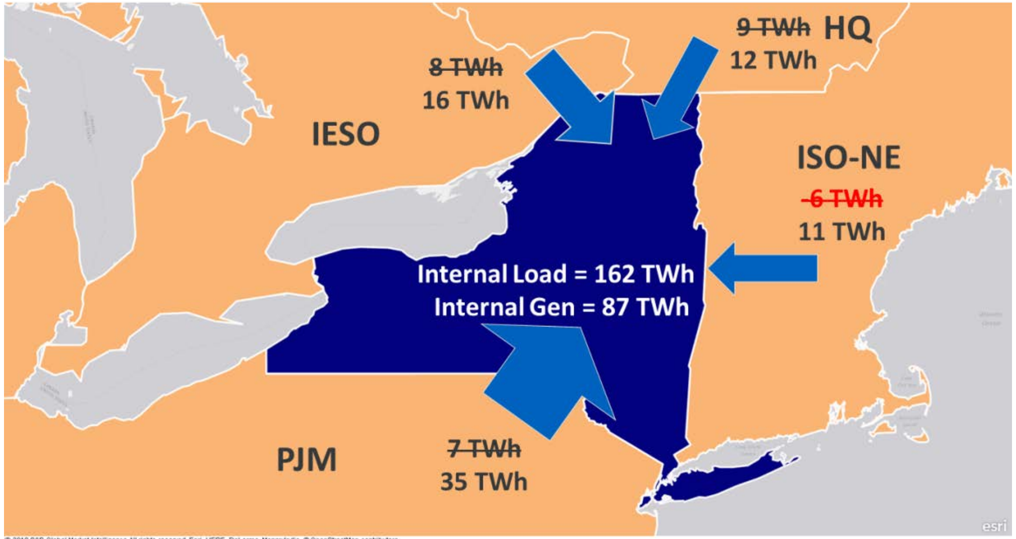
# Implementation Challenge: Leakage

**NYCA had net imports of 19 TWh in 2015, serving 12% of NYCA load**





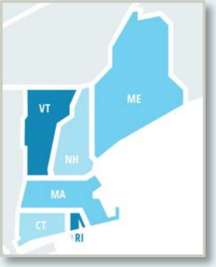

**Absent border adjustments, internal carbon pricing could dramatically increase imports to serve almost half of New York load**



# ISO New England
# Integrating Markets and Public Policy Initiative

# Integrating Markets and Public Policy Forum

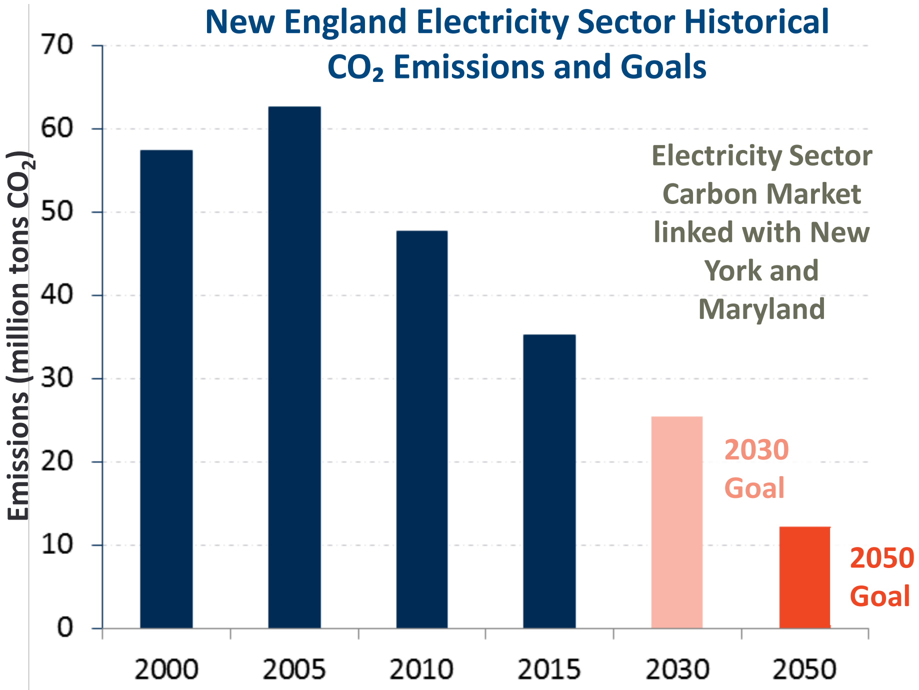
- New England states are members of the RGGI cap and trade market, though prices are too low to achieve decarbonisation goals
- Decarbonisation largely achieved via:
  - Efficiency programs
  - Renewable portfolio standards
  - Recent and planned large-scale clean energy procurements to procure renewables, Canadian hydro, and offshore wind
  - Potential nuclear plant interventions
- Integrating Markets and Public Policy (IMAPP) initiative aims to address growing disconnect between carbon policy and market design




**Carbon Goal:** 75-95% below 1990* levels by 2050 (state-specific, economy-wide)

**Renewables Goal:** 50% by 2030

* Relative to 2003 levels for Maine, 2001 levels for CT.




*Sources and Notes:* EIA Annual Utility Sales, EIA Emissions. Assumes electric sector meets equal share of economy-wide emission target. Map from ISO-NE.

ISO-NE IMAPP Clean Energy Market

# Proposed Design and Objectives

**Brattle, Conservation Law Foundation, Brookfield, and Nextera proposed a clean energy market to achieve decarbonization goals within the market**

**Key Design Elements:**

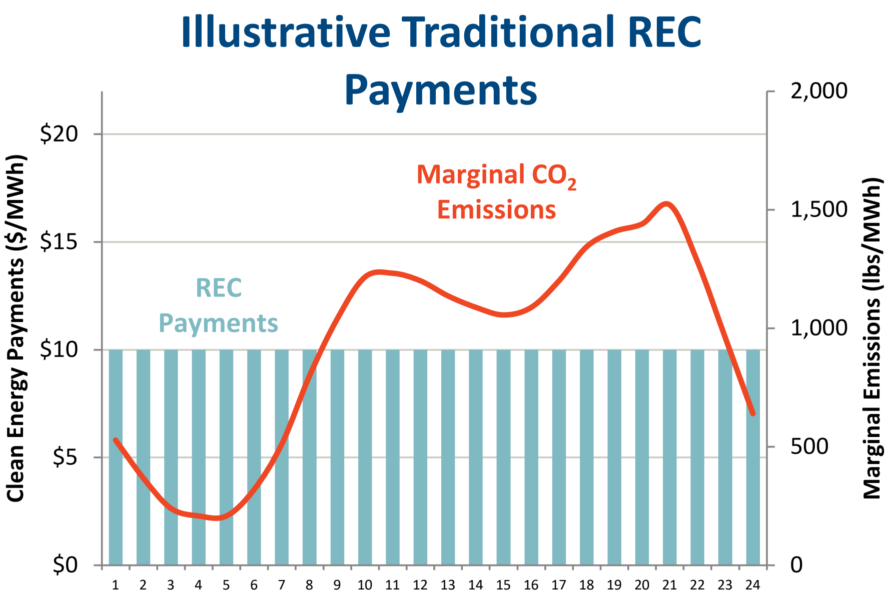
- Auction procures the **clean energy attribute only** (not bundled with energy)
- Award clean energy payments in proportion to **marginal carbon abatement**
- Purchases via this market **fulfill majority of states needs**, but possibly less than 100%
- Enable **competition among *all* clean energy resources** to yield least cost portfolio to meet the states' policy goals

A note on carbon pricing: The coalition recommend enhanced $CO_2$ pricing as a means to efficiently contribute to achieving decarbonization goals. This clean energy market can work well alongside enhanced $CO_2$ pricing, or on a stand-alone basis

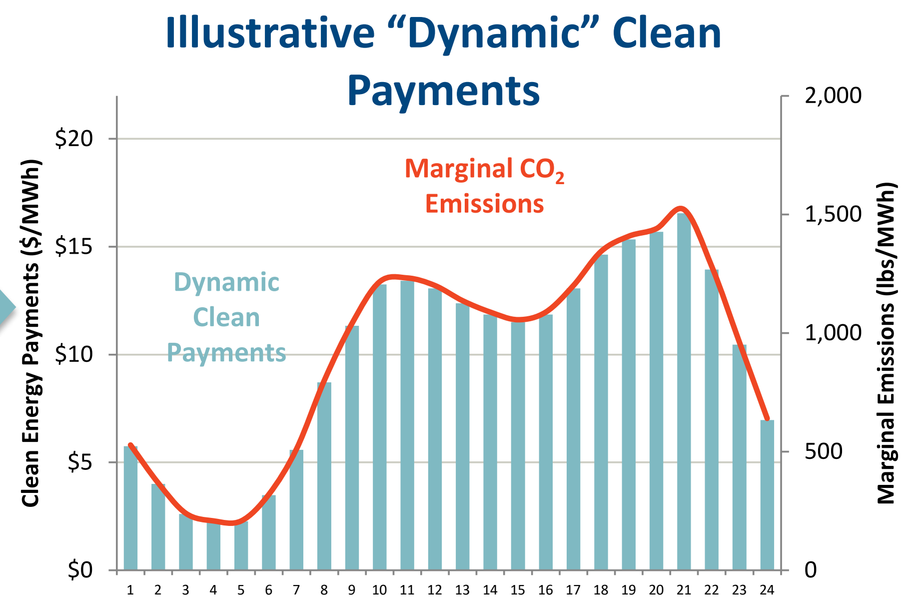
*Sources and Notes:*
See the full design proposal here: http://www.nepool.com/uploads/IMAPP_20170517_LT_Straw_Dynam_Clean_Energy_Market.pdf

## ISO-NE IMAPP Clean Energy Market

# Align Clean Payments with System Needs




- Flat payments over every hour
- Incentive to offer at negative energy prices during excess energy hours




- Payments scale in proportion to marginal $CO_2$ emissions
- Incentive to produce clean energy when and where it avoids the most $CO_2$ emissions
- No incentive to offer at negative prices

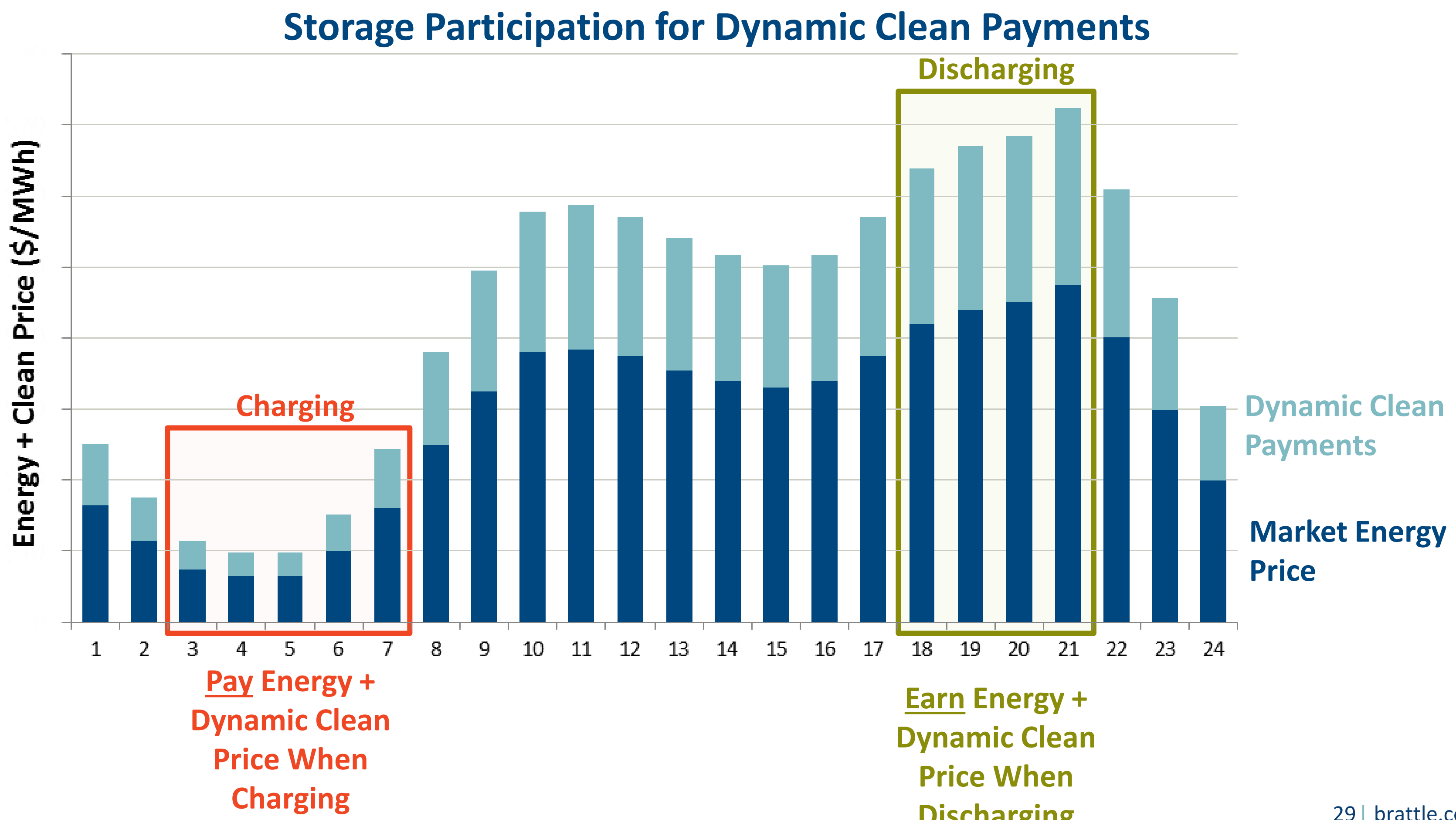
*Sources and Notes:*

See the full design proposal here: http://www.nepool.com/uploads/IMAPP_20170517_LT_Straw_Dynam_Clean_Energy_Market.pdf

ISO-NE IMAPP Clean Energy Market

# Incentives at the Right Times (Including for Storage)

**Dynamic payments incentivize clean energy at the right times to displace the most $CO_2$ emissions, enabling storage to compete with other technologies**

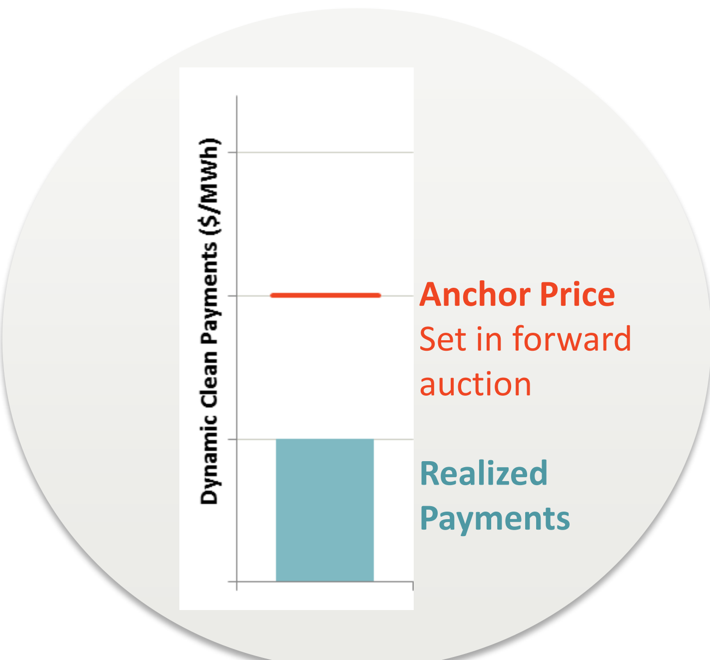


# Incentives for Clean Energy in the Right Locations

**Location-specific payments will focus incentives to develop new clean energy where they will displace the most $CO_2$ emissions**

## Low-Emitting Location

Generation pocket that is already saturated with wind. New clean energy will mostly displace the generation of existing wind resources (and will earn fewer payments)




## High-Emitting Location

Load pocket where high-emitting steam oil units are often called on. Clean energy will displace more emissions (and earn more payments)

# Takeaways

**Markets have demonstrated that they can achieve their design objectives at low cost by harnessing competition and innovation.  This successful approach can be applied to decarbonization.**

- Carbon prices are the gold standard
- Resource-specific procurements tend to be higher cost and less competitive
- Extensive out-of-market policies can have unintended consequences
- Technology-neutral, market-based mechanisms can achieve well-defined decarbonization policy objectives
- Leakage is a concern in a non-uniform carbon price world

# Presenter Information

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**Dr. Roger Lueken** is an Associate in The Brattle Group's Washington DC office with expertise in with expertise in wholesale electricity market modeling, market design, and energy storage.

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- Market Design
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