# An Economic Perspective on Reliability

## RETHINKING SYSTEM NEEDS AND IN A FUTURE DOMINATED BY RENEWABLES, NEW TECH, AND ENGAGED CONSUMERS

**PRESENTED TO**

Electricity Consumers Resource Council

**PRESENTED BY**

Kathleen Spees

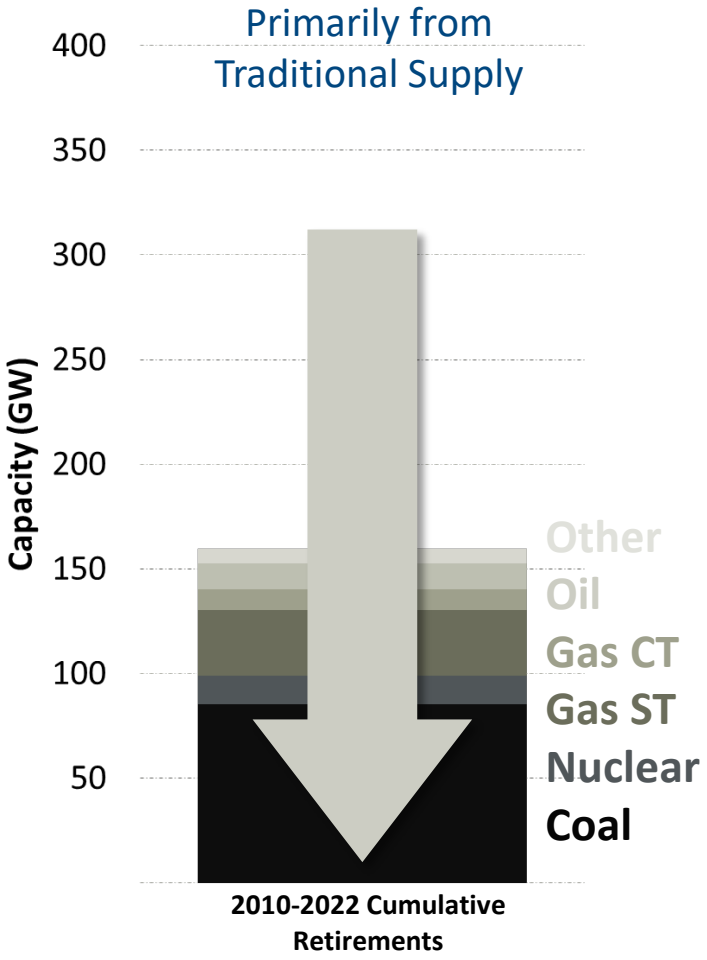
November 28, 2018

THE Brattle GROUP

# New Technologies & Engaged Customers Are Rapidly Overtaking Traditional Supply

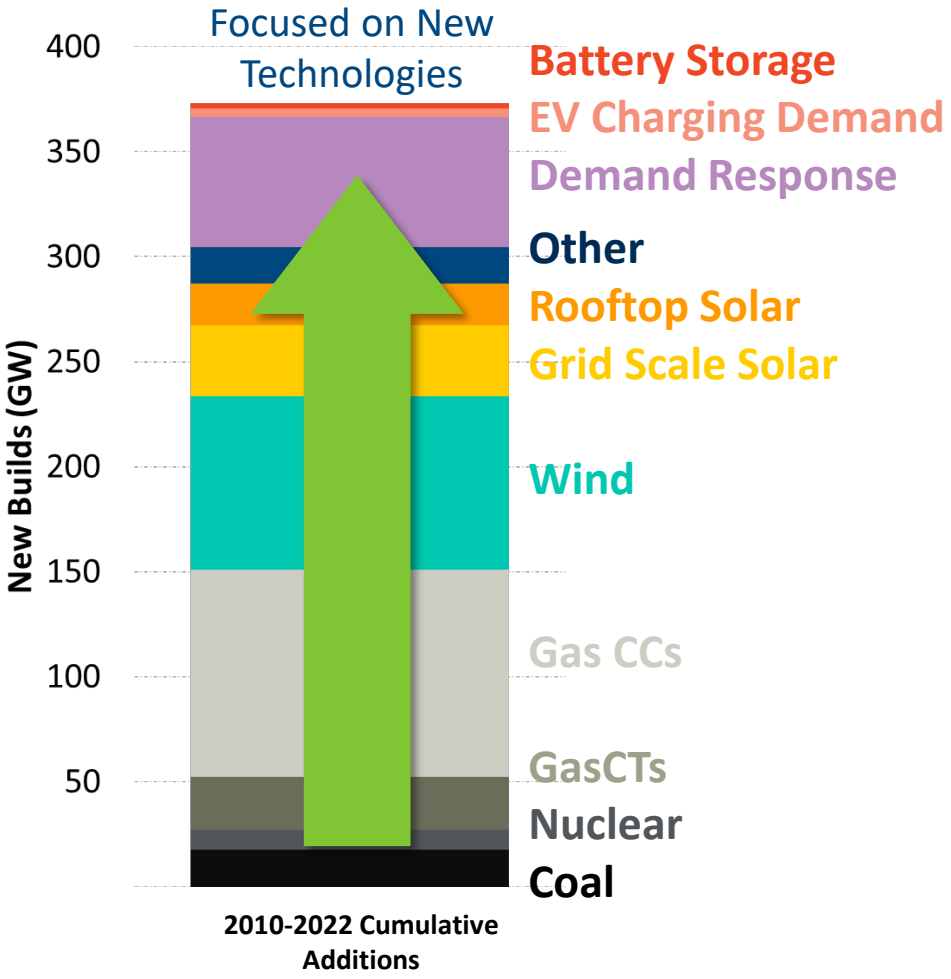
## Retirements

Primarily from Traditional Supply




## New Builds

Focused on New Technologies




*Data Source:* Energy Velocity Suite (US and Canadian generation) and Brattle research (US-only distributed resource and storage).

Question:

# How Do We Maintain Reliability & Enable the Clean Energy Transition at Reasonable Costs?

# Transition to a Cleaner Grid: Are We Headed for Blackouts When the Sun Goes Down?

## Myths

**Intuition may give us a false sense that the grid won't stay reliable unless we….**

- Save baseload plants from retirement (or coal, or nuclear, or gas)
- Save a specific "favored" plant
- Stop building renewables
- Build a gas pipeline
- Impose on-site fuel requirements

## Realities

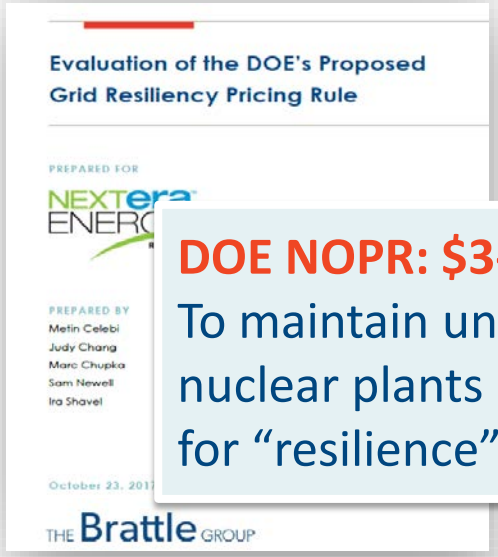
**It's not all hype. It will be a big challenge maintain reliability while going clean…**

- Customers & states want to go clean. "Reliability card" will not stop them
- Intermittent renewables do not provide the same bundle of reliability services as thermal plants
- Grid services we used to get "for free" will need to be defined and paid for
- Grid operators must learn to rely on non-traditional resources to provide these grid services
- Customers may prefer to save money by allowing some outages

# Trump Administration & Some States' Policies to Support Failing Plants Could Cost Billions

**Proposed policies illustrate several common problems in reliability discussions (usually played out on a much smaller scale):**

- Reliability concern is not clearly specified
- Implicit assumption that a specific resource or resource type is the only solution
- Lacking benefit-cost analysis
- Lacking mechanisms for competitors to identify cheaper solutions to the problem




**DOE NOPR: $3-$11 Billion/year**
To maintain uneconomic coal & nuclear plants in RTO regions for "resilience"


**DOE Memo: $10-35 billion/year**
To maintain uneconomic coal & nuclear plants nation-wide for "national security"

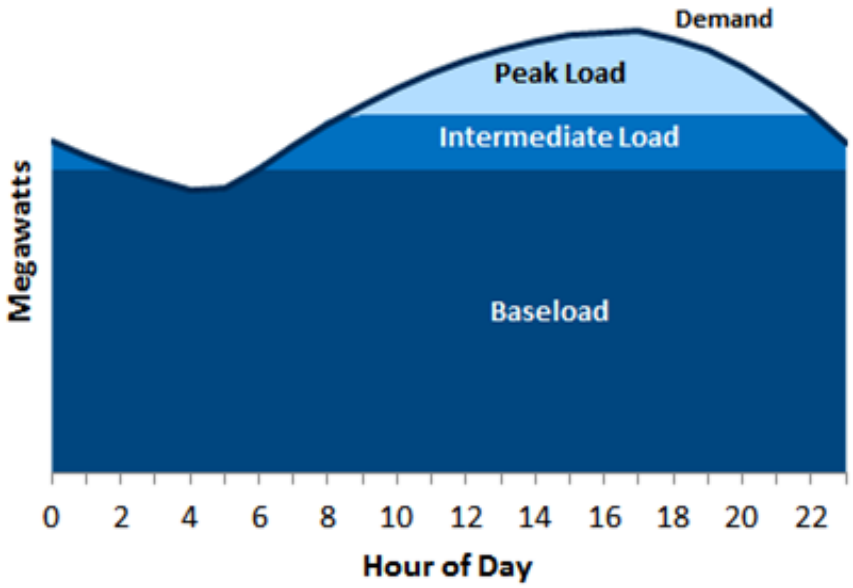
*Sources:* Celebi, *et al.* Evaluation of DOE's Proposed Grid Resiliency Pricing Rule, October 2017; and Celebi, *et al.* The Cost of Preventing Baseload Retirements, July 2018.

# To Clarify: Why Do We Need "Baseload" Plants Again?

**…..We don't. We can drop "baseload" from our vocabulary.**

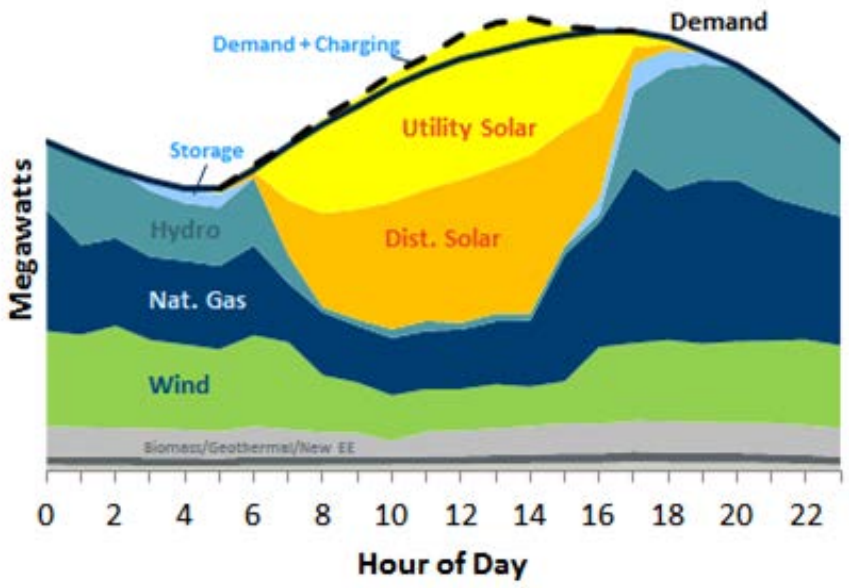
## Traditional Planning

**Concept: Baseload plants contributed to a cost-effective resource mix and provided many grid services "for free" as a byproduct of producing energy.**




## Future Supply Mix

**Concept: Equation is flipped. Energy will be "free" most of the time. Flexibility and other grid services have to be defined and paid for.**




*Source:* Chang, Geronimo-Aydin, Pfeifenberger, Spees, Pedtke. Advancing Past "Baseload" to a Flexible Grid. June 2017.

# Markets and Utility Planning/Procurement Processes Need to Rethink Reliability Needs

- **Easy (but wrong):** First instinct of RTOs & utilities may be to continue relying on traditional thermal plants even as they become uneconomic
- **Harder (but right!):** Do the hard work of fully specifying a comprehensive suite of unbundled grid services… *before* the problem becomes an emergency requiring costly interventions

**How Do You Maintain Reliability at Low Cost in a Rapidly Decarbonizing Grid?**

# Properly Decomposing Reliability Needs Saves Money & Enables Decarbonization

**Non-traditional resources can provide all the grid services we need, as long as the needs are defined in technology-neutral ways**

**Technology Types**

| System Needs | Coal | CC | CT | Nuclear | RoR Hydro | Hydro w/ Storage | Wind | Solar | Battery Storage | DR | EE | Imports |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Day-Ahead Energy | ✓ | ✓ | ○ | ✓ | ✓ | ✓ | ✓ | ✓ | ○ | ○ | ○ | ✓ |
| Real-Time Energy (5 Min) | ✓ | ✓ | ○ | ○ | ✓ | ✓ | ✓ | ✓ | ○ | ○ | ○ | ○ |
| Regulation | ✓ | ✓ | ○ | X | ✓ | ✓ | ○ | ○ | ✓ | ○ | X | ○ |
| Spinning Reserves | ✓ | ✓ | ✓ | X | ○ | ✓ | X | X | ✓ | ○ | X | ○ |
| Non-Spinning Reserves | X | ✓ | ✓ | X | X | ✓ | X | X | ✓ | ○ | X | ○ |
| Load following / Flexibility | ○ | ✓ | ✓ | ○ | ○ | ✓ | ○ | ○ | ✓ | ○ | X | ○ |
| Capacity | ✓ | ✓ | ✓ | ✓ | ○ | ✓ | ○ | ○ | ○ | ✓ | ✓ | ✓ |
| Clean Attributes (RECs) | X | ○ | ○ | ✓ | ✓ | ✓ | ✓ | ✓ | ○ | ○ | ✓ | ✓ |
| Reactive / Voltage Support | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ○ | ○ | ✓ | X | X | ○ |
| Black Start | ○ | ✓ | ✓ | X | ✓ | ✓ | X | X | ○ | X | X | ○ |

**Technical Capability for Service**

- ✓ Well Suited
- ○ Somewhat Capable
- X Not / Poorly Suited

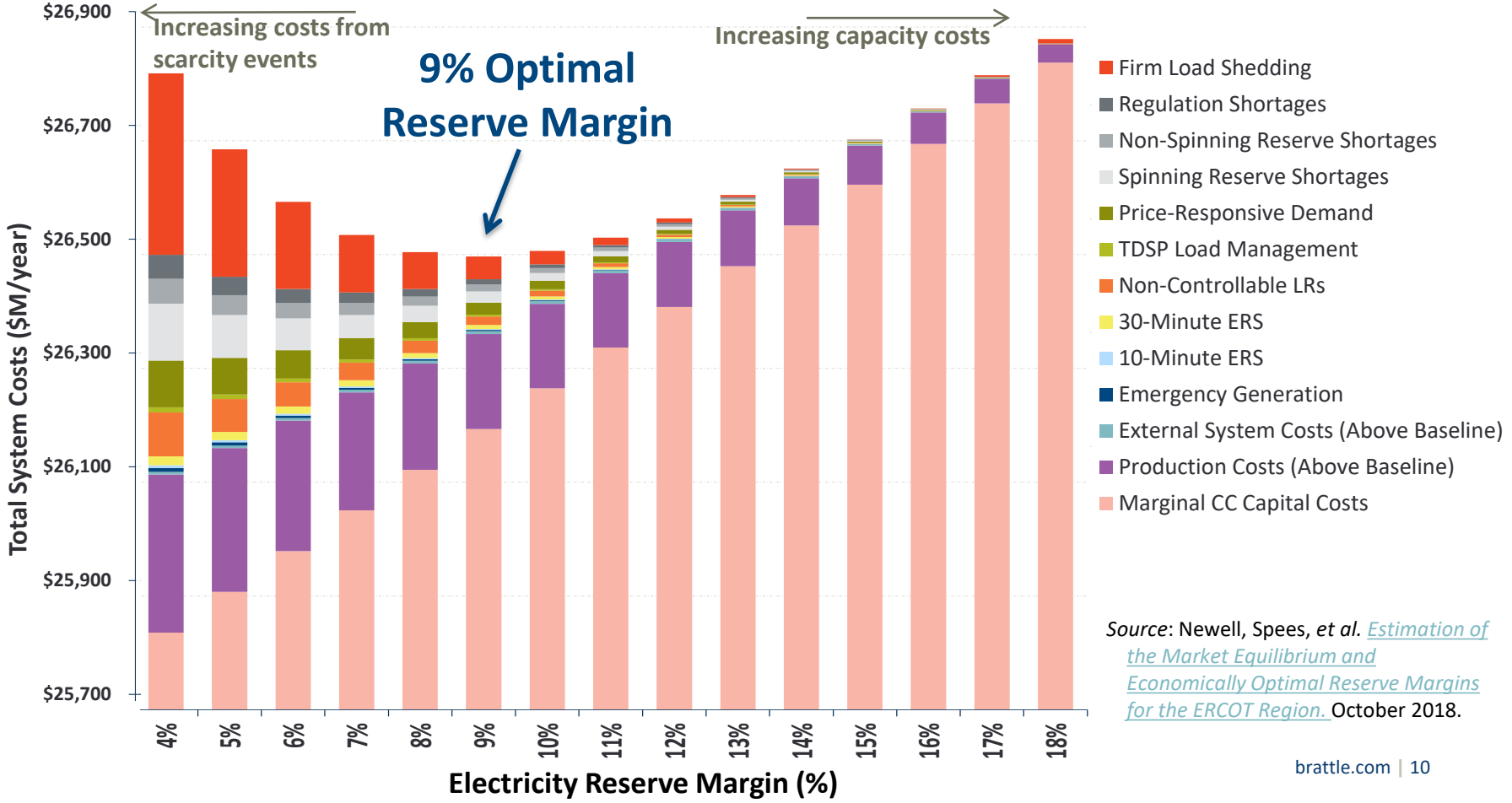
Even non-traditional, carbon-free supply can provide essential grid services (If enabled to compete)

Illustrative Experience:

# Texas: Reliability in the Energy-Only Market

# Texas: Estimating the "Optimal" Level of Bulk System Reliability

**Brattle's economic studies indicate that traditional 1-in-10 standards are higher that the economic optimum. Concept could be applied in many other reliability contexts (but rarely is….)**



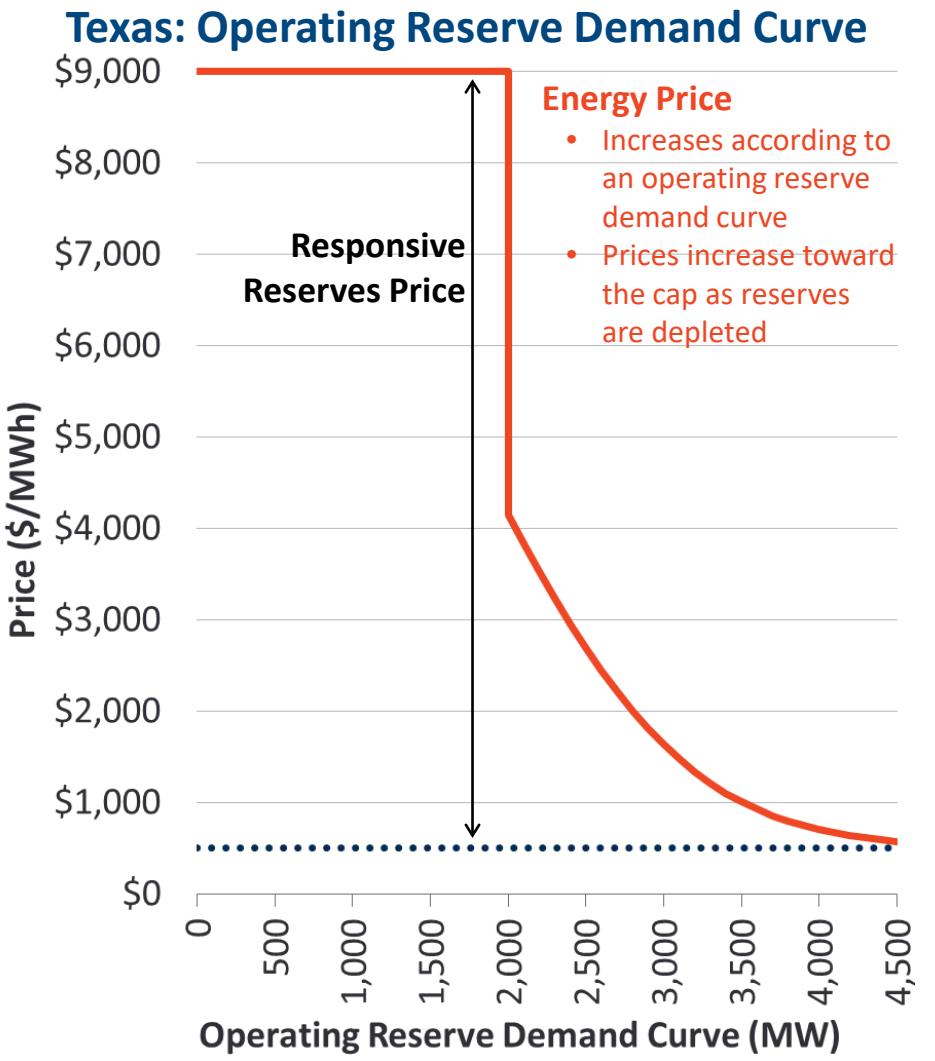

*Source*: Newell, Spees, *et al.* *Estimation of the Market Equilibrium and Economically Optimal Reserve Margins for the ERCOT Region.* October 2018.

# Texas: Energy-Only Market is Designed to Support the Cost-Effective Level of Reliability

- By design, the energy-only market supports (a bit more than) the cost-effective level of reliability
- Achieved by paying prices equal to marginal value of reliability:

**Price = Value of Lost Load × Probability of Lost Load**

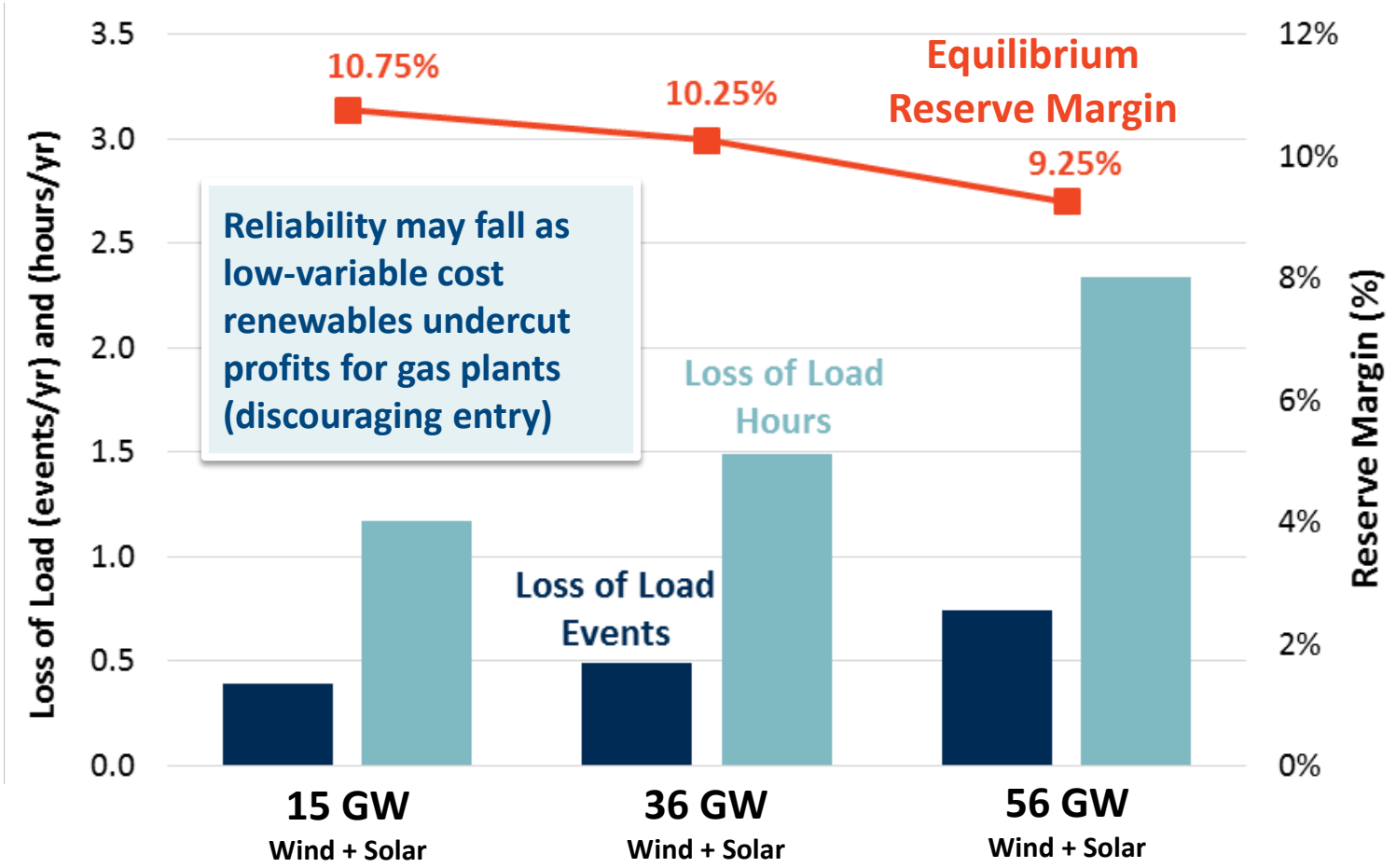
- Same concept can be applied for all types of grid services




*Source*: Newell, Spees, *et al.* Estimating the Economically Optimal Reserve Margin in ERCOT, January 31 2014

# Texas: Reliability May Drop Somewhat with Increasing Renewable Penetration

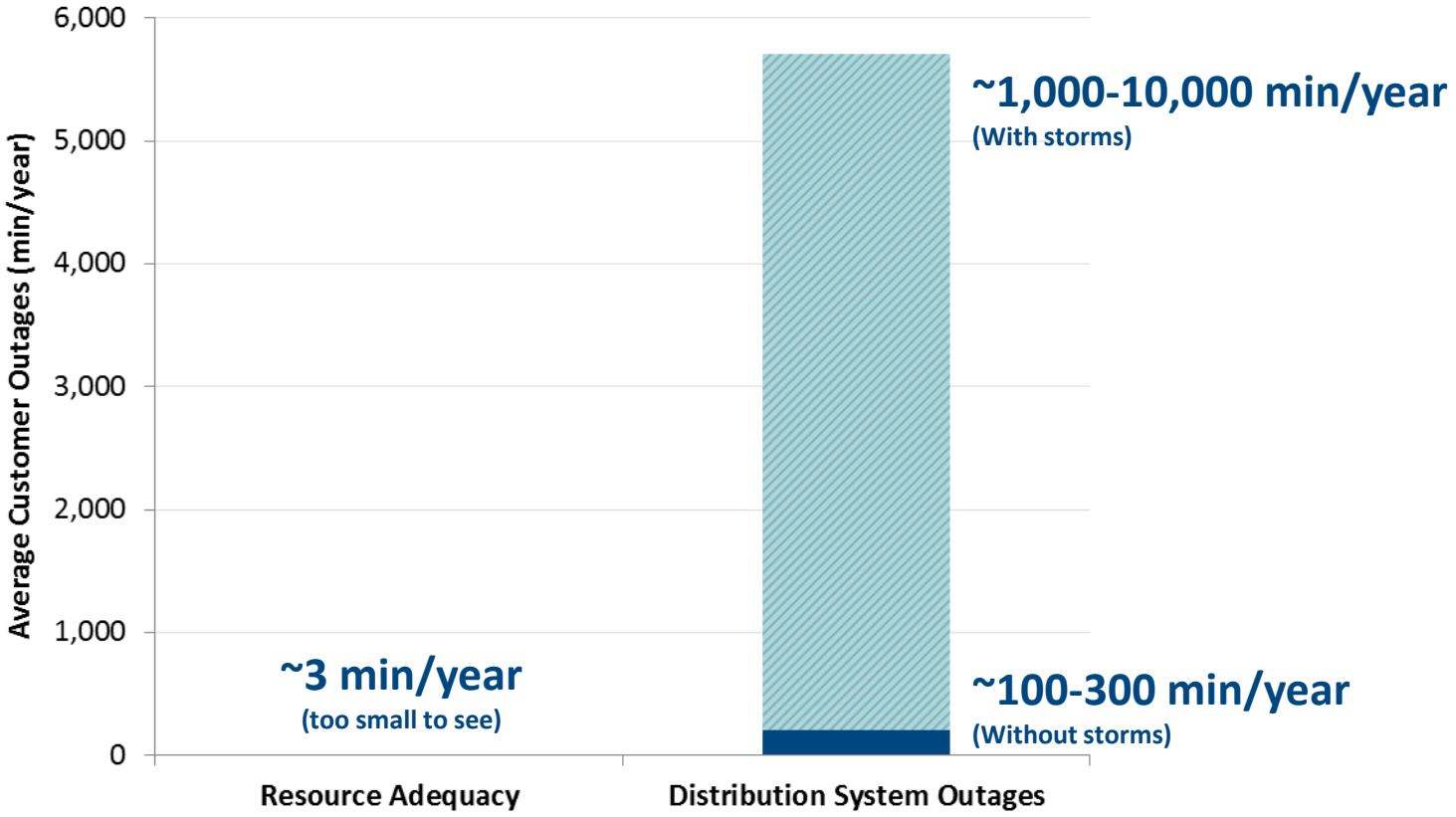
**Several regions (UK, Alberta) have abandoned their energy-only markets based on reliability concerns with increasing renewables**




*Source*: Newell, Spees, *et al.* *Estimation of the Market Equilibrium and Economically Optimal Reserve Margins for the ERCOT Region.* October 2018.

# But Then… Are A Few More Bulk System Outages Really a Big Concern?

**Bulk system outages account for a tiny fraction of all customer outages. Storms and distribution system failures cause many more outages**



Illustrative Experience:

# Reliability in the Capacity Markets

# Energy Transition is Outpacing Capacity Markets' Definition of Reliability

**Capacity markets were always a "blunt instrument" for expressing reliability needs**

- Often, the best place to start fixing the problem is in well-defined energy and ancillary service markets (shifts incentives toward true operating needs & more flexible supply)
- Capacity market incentives can also become much better (progress is happening, but slowly)

## Emerging Reliability Needs

- Winter reliability (mis-named as "fuel security")
- Reliability events outside of traditional annual peak hours (i.e. shift in the hours with net peak load; more events in shoulder months with many planned outages)
- Reliability events driven by flexibility needs and operational "surprises"
- Capacity value awarded to supply resources not aligned with true reliability value (may differ with resource penetration levels)

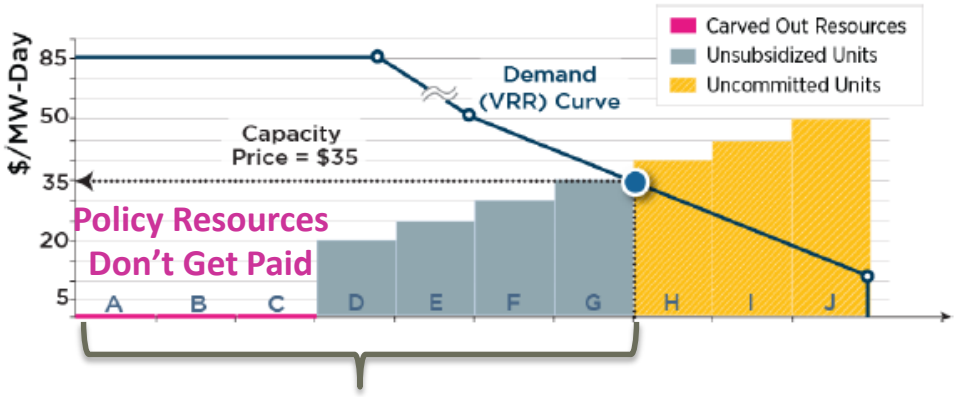
# PJM and New England "Capacity Repricing" Debates

**PJM and New England are concerned that increasing policy-supported resources are undercutting investment incentives. Their "solution" is:**

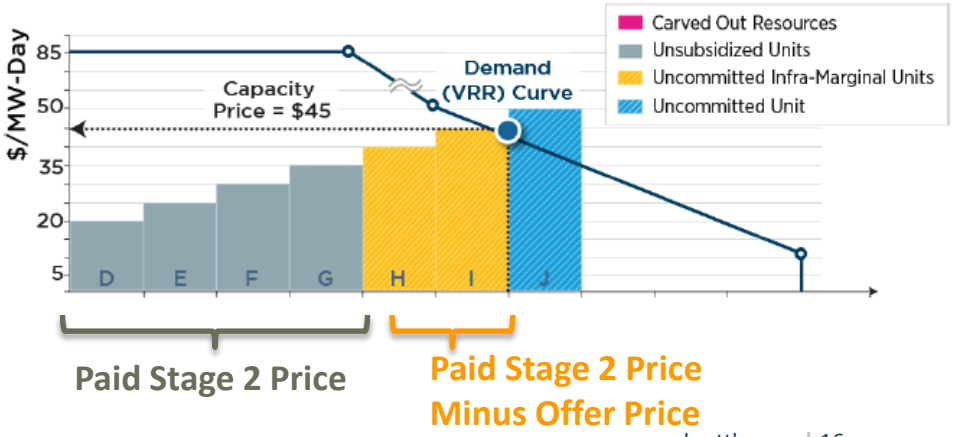
- Increase capacity prices to the higher level that would exist absent any state policies
- Introduce two-stage auctions with side payments to resources that don't clear even though they offered below the clearing price

**But these "solutions" do not address the real underlying problem**

## PJM Stage 1: Set Capacity Obligations




## PJM Stage 2: Set Higher Capacity Prices



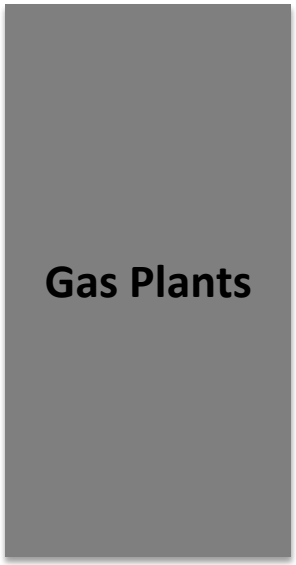

*Source*: PJM Filing before the FERC, Proposing the MOPR of Actionable Subsidies and Resource Carve Out Proposal. October 201, 2018.

# The Real Problem: Market Forces Working at Cross-Purposes with Carbon Goals

Current ISO Market Design Objective:

## Reliable & Low-Cost Electricity

*Markets designed for this purpose will attract and retain….*




*Market forces may drive carbon emissions up or down*

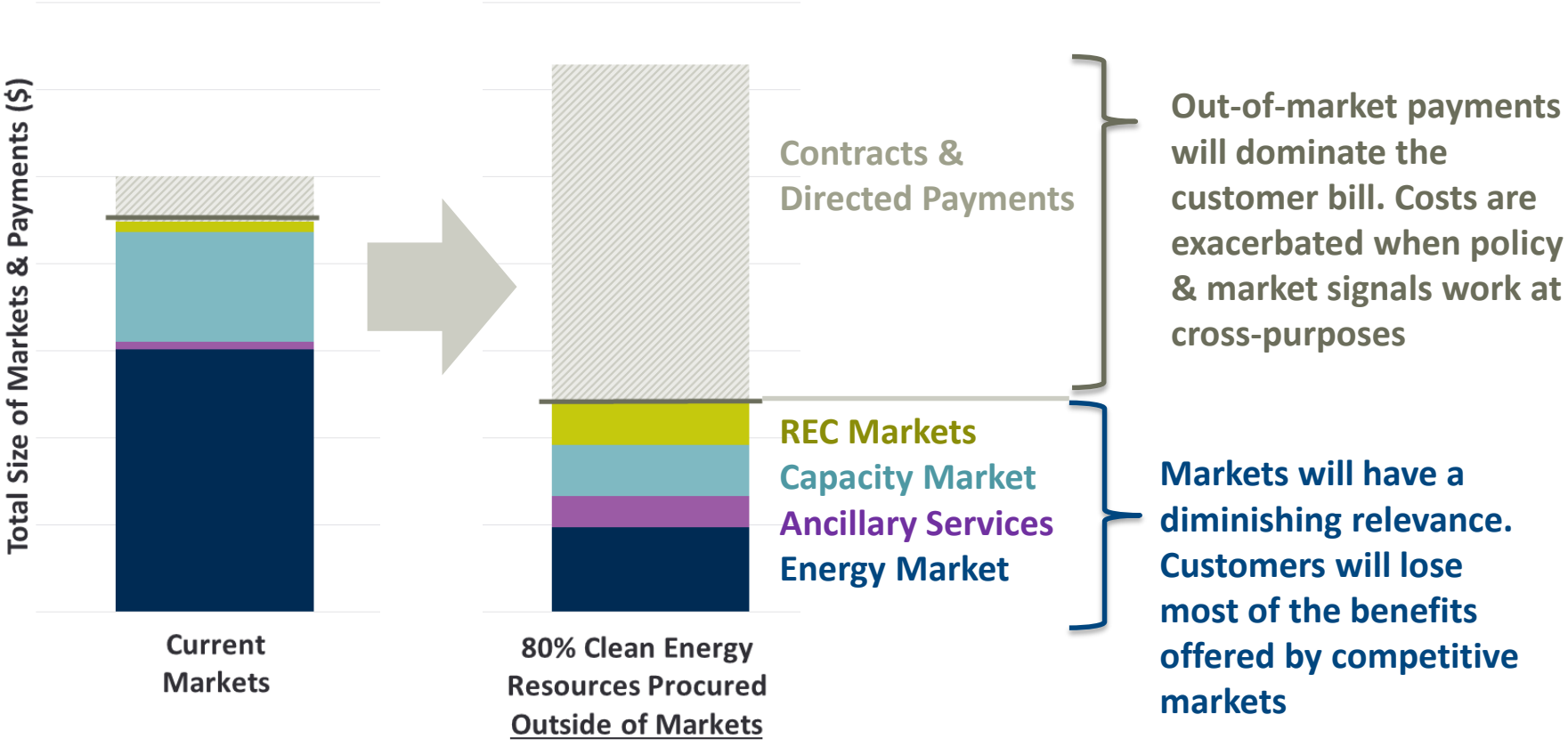
But Many States & Customers Want:

## Reliable, Low-Cost & Carbon-Free Electricity


*Market drives 80% carbon reductions at least cost*

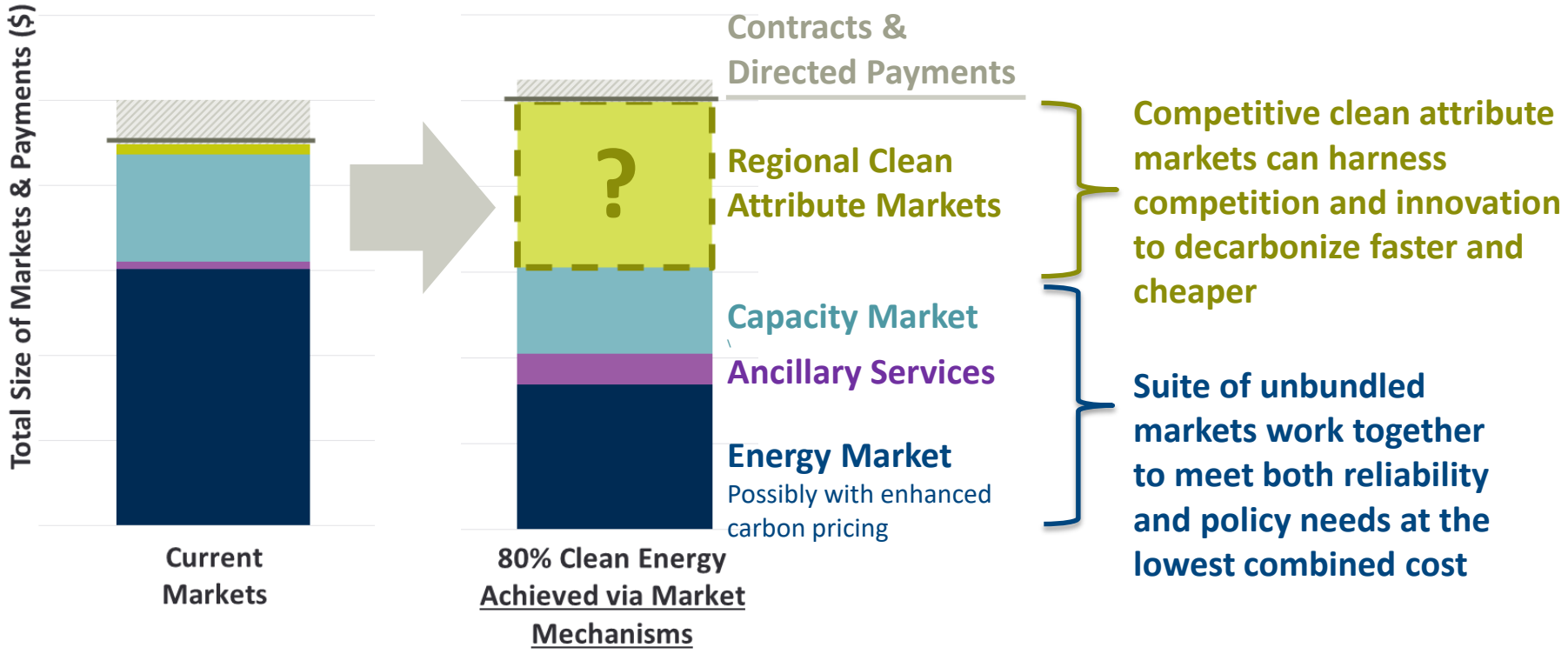
# Where is the Current Path Leading?

**The disconnect between what customers want and what the markets deliver will continue to grow…**



# But There's a Better Path to Align Wholesale Markets with Policy

**Clean energy attribute markets are the primary "missing link" needed to better align markets with customer and state demand for a cleaner grid**



# Takeaway: Cost-Effectively Meeting Both Reliability & Policy Goals is a Big Challenge…

**…But one that can be addressed through:**

- Rigorous analysis of **true reliability needs** & the **cost-effective level** of reliability we should aim for
- **Unbundling grid services** that were traditionally provided "free" as a byproduct of thermal generation
- Defining grid services in a **technology-neutral** fashion
- **Eliminating participation barriers** that currently prevent non-traditional resources from providing these grid services
- Transitioning to **market-based and market-compatible carbon and clean attribute mechanisms** to achieve state & customer carbon goals

Appendix:

# Clean Attribute Markets

# What Should the Clean Energy Markets Look Like?

**Best practices are the same, whether the leadership to develop clean energy markets comes from state policymakers, market operators, or others:**

- **Product Definition** that matches the underlying objective (carbon abatement)
- **Unbundled Attributes** that maximize competition across markets and technologies
- **States and Customers Choose** their own demand quantities and willingness to pay (no costs shifted to non-participants)
- **Technology-neutral** qualification and payments
- Broad **regional competition**
- Mechanisms to **mitigate regulatory risk** and ensure financeability at competitive costs
- Care to ensure **alignment with energy, ancillary, and capacity markets**

# Ensuring Financeability in Clean Energy Attribute Markets

**Three-year forward markets for clean attributes can be designed to ensure financeability, building on the lessons from capacity markets (which have attracted new resource investment). This may require offering multi-year commitments and other mechanisms for appropriately allocating & mitigating investment risks**

**Allocate Risks to Customers**

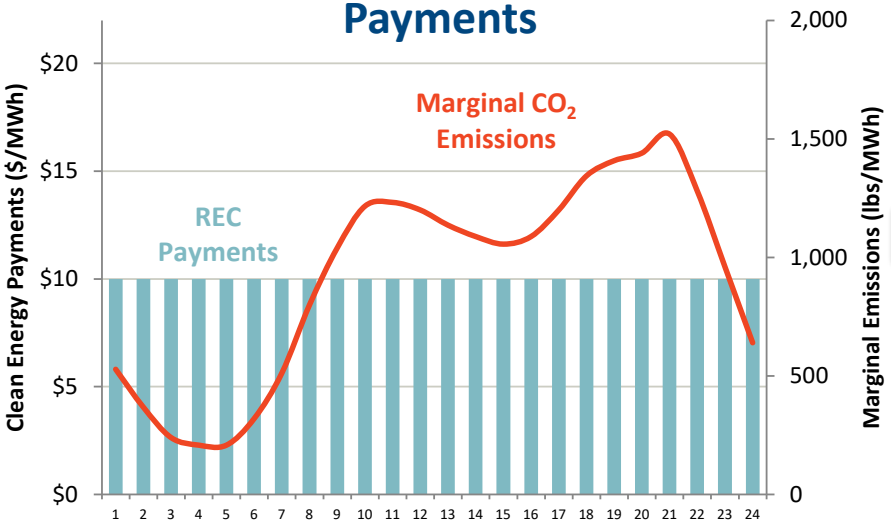
**Allocate Risks to Sellers**

| Regulatory Risks | Market Fundamentals | Asset-Specific Risks |
|---|---|---|
| • Unanticipated changes to state policy<br>• Unpredictable changes to state demand bids<br>• Rule changes | • Resource mix<br>• Load growth<br>• Fuel prices<br>• Transmission development<br>• Energy, capacity, and ancillary service prices | • Construction delays<br>• Unanticipated asset costs<br>• Asset performance |

# Better Product Definition: Achieves Faster Decarbonization at a Lower Cost

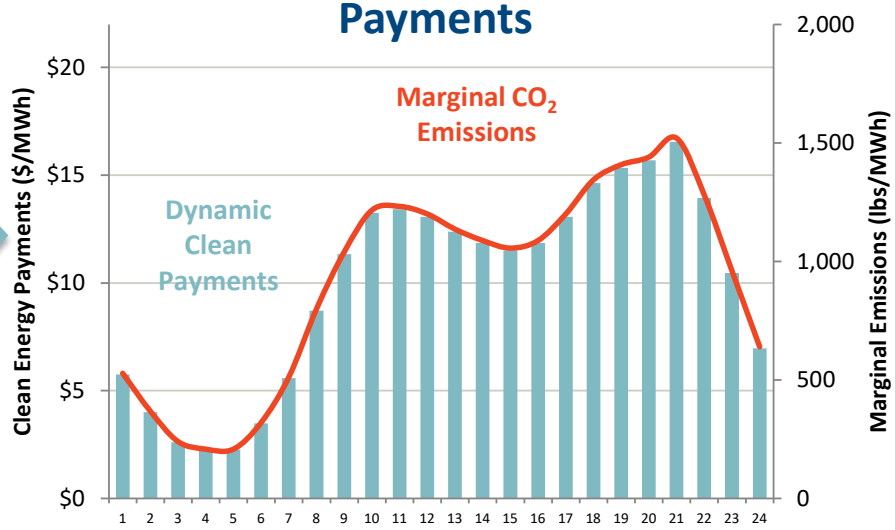
## Our proposal for a "Dynamic" Clean Energy Market in New England would align payments with marginal carbon abatement

### Illustrative Traditional REC Payments




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

### Illustrative "Dynamic" Clean Payments



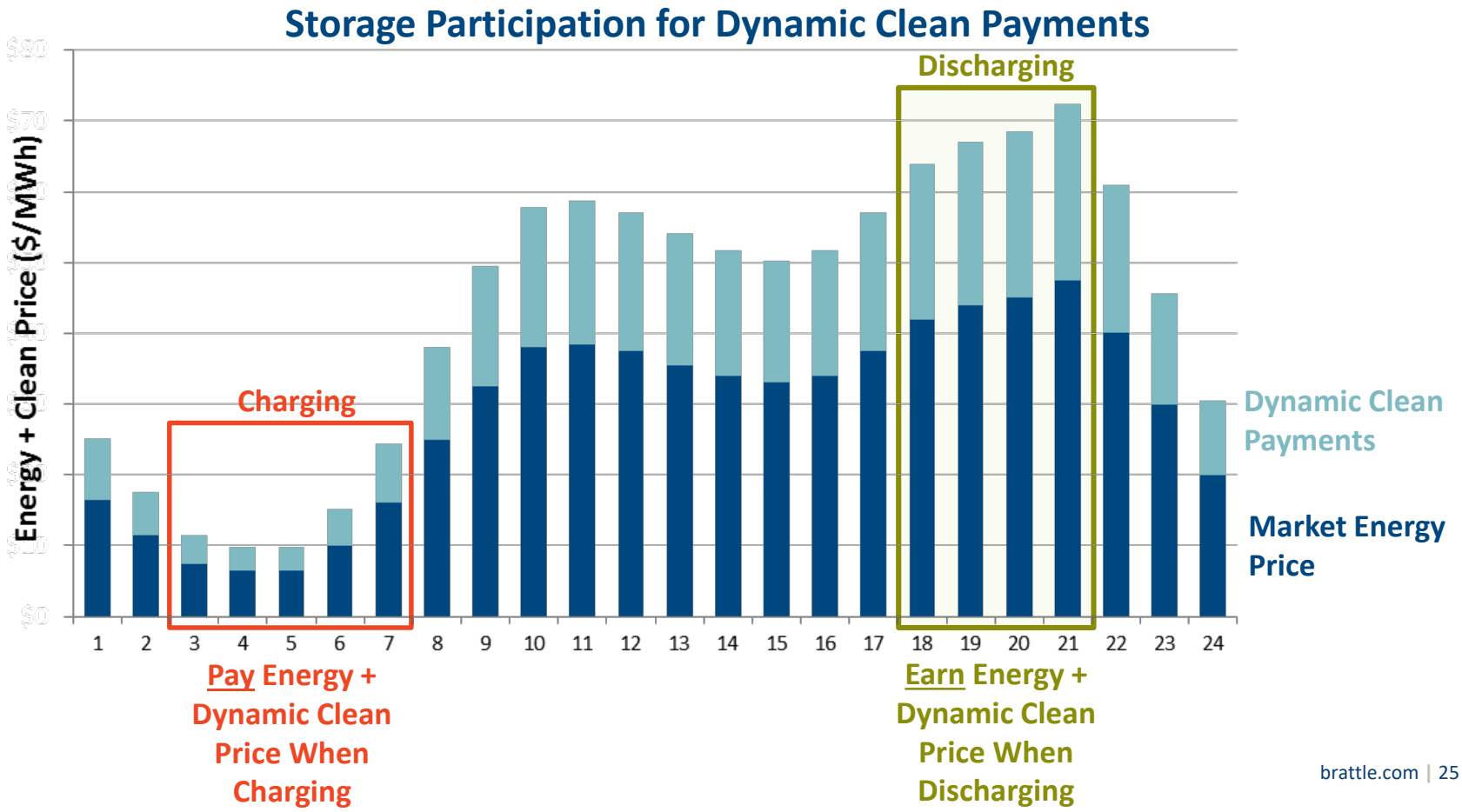

- Payments scale in proportion to marginal $CO_2$ emissions (by time and location)
- Incentive to produce clean energy when and where it avoids the most $CO_2$ emissions
- No incentive to offer at negative prices

*Sources and Notes:*

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

# Enabling Competition: Lets Innovative Players Identify Creative Solutions

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



PRESENTED BY

# KATHLEEN SPEES

PRINCIPAL, WASHINGTON DC

1.202.419.3390
KATHLEEN.SPEES@BRATTLE.COM

## Dr. Kathleen Spees is a principal at The Brattle Group with expertise in wholesale electricity markets design and environmental policy analysis.

Dr. Kathleen Spees is a Principal at The Brattle Group with expertise in designing and analyzing wholesale electric markets and carbon policies. Dr. Spees has worked with market operators, transmission system operators, and regulators in more than a dozen jurisdictions globally to improve their market designs for capacity investments, scarcity and surplus event pricing, ancillary services, wind integration, and market seams. She has worked with U.S. and international regulators to design and evaluate policy alternatives for achieving resource adequacy, storage integration, carbon reduction, and other policy goals. For private clients, Dr. Spees provides strategic guidance, expert testimony, and analytical support in the context of regulatory proceedings, business decisions, investment due diligence, and litigation. Her work spans matters of carbon policy, environmental regulations, demand response, virtual trading, transmission rights, ancillary services, plant retirements, merchant transmission, renewables integration, hedging, and storage.

Dr. Spees earned her PhD in Engineering and Public Policy within the Carnegie Mellon Electricity Industry Center and her MS in Electrical and Computer Engineering from Carnegie Mellon University. She earned her BS in Physics and Mechanical Engineering from Iowa State University.

# Our Practices and Industries

## ENERGY & UTILITIES

- Competition & Market Manipulation
- Distributed Energy Resources
- Electric Transmission
- Electricity Market Modeling & Resource Planning
- Electrification & Growth Opportunities
- Energy Litigation
- Energy Storage
- Environmental Policy, Planning and Compliance
- Finance and Ratemaking
- Gas/Electric Coordination
- Market Design
- Natural Gas & Petroleum
- Nuclear
- Renewable & Alternative Energy

## LITIGATION

- Accounting
- Analysis of Market Manipulation
- Antitrust/Competition
- Bankruptcy & Restructuring
- Big Data & Document Analytics
- Commercial Damages
- Environmental Litigation & Regulation
- Intellectual Property
- International Arbitration
- International Trade
- Labor & Employment
- Mergers & Acquisitions Litigation
- Product Liability
- Securities & Finance
- Tax Controversy & Transfer Pricing
- Valuation
- White Collar Investigations & Litigation

## INDUSTRIES

- Electric Power
- Financial Institutions
- Infrastructure
- Natural Gas & Petroleum
- Pharmaceuticals & Medical Devices
- Telecommunications, Internet, and Media
- Transportation
- Water

# Our Offices

BOSTON

NEW YORK

SAN FRANCISCO

WASHINGTON

TORONTO

LONDON

MADRID

ROME

SYDNEY