Investigation of Resource Adequacy Alternatives

February 19, 2021

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Integrated Clean Capacity Market

POWER MARKET EVOLUTION FOR THE CLEAN ELECTRICITY GRID

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Investigation of Resource Adequacy Alternatives

Second Work Session

FEBRUARY 19, 2021

Brattle

The Integrated Clean Capacity Market (ICCM) aims to:

Take the next step in the evolution of competitive power markets to drive a reliable, affordable and carbon-free power supply mix.

INTRODUCTION

What is the “Integrated Clean Capacity Market”?

The ICCM would be a scalable, technology-inclusive forward clean energy procurement mechanism to meet regional clean energy goals affordably

ICCM Would:

- Build on the successful elements of today’s power markets that are designed to achieve **reliability at least cost**
- For the first time, integrate **clean energy objectives** into the forward market to attract a reliable and carbon-free supply mix
- **Empower states and customers** to demand clean energy

INTRODUCTION

How would the ICCM work?

States

- Set clean energy goals and clean energy resource qualification standards
- Determine quantity of clean energy to buy through the ICCM

RTO

- Determines quantity of capacity needed for reliability (regionally and by location)

Buyers & Sellers

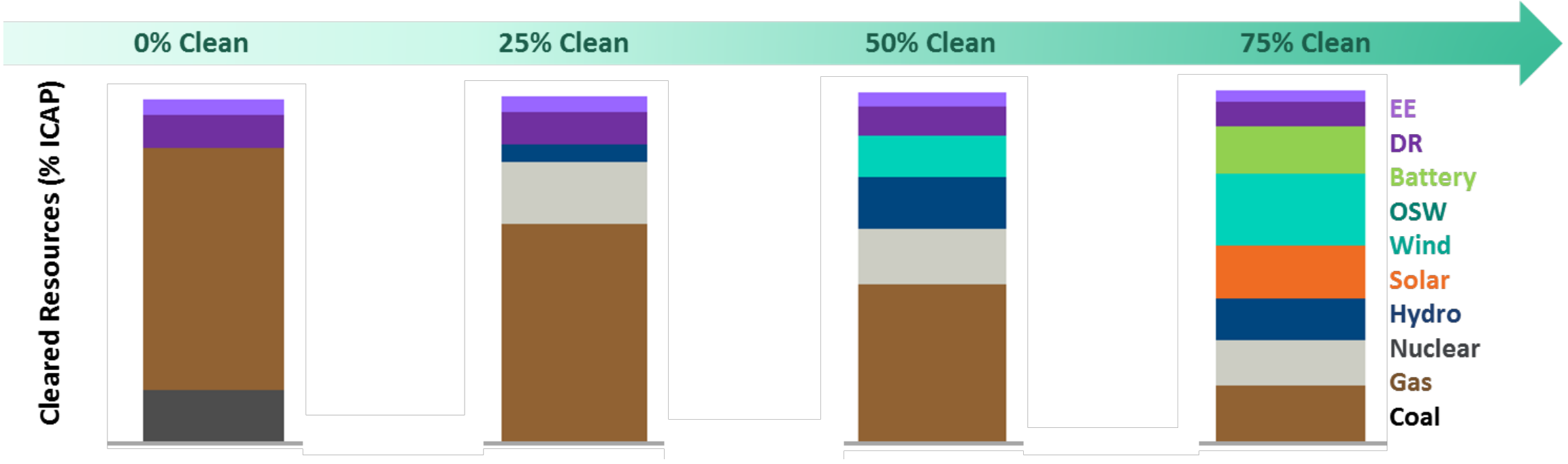
- Fossil generation: can sell capacity
- Clean resources: can sell both capacity and clean energy
- Voluntary buyers (cities, companies): can procure additional clean energy

Auction Administrator

- Three-year forward auction
- Least-cost procurement to meet both capacity and clean energy needs
- Separate prices for: (1) MW of capacity, and (2) MWh of clean energy attributes (RECs, ZECs, and CEACs)
- 7-12 year price lock-in for new resources

How could the ICCM guide the clean energy transition?

State mandates for clean energy would increase over time, driving a least-cost pathway to a cleaner grid

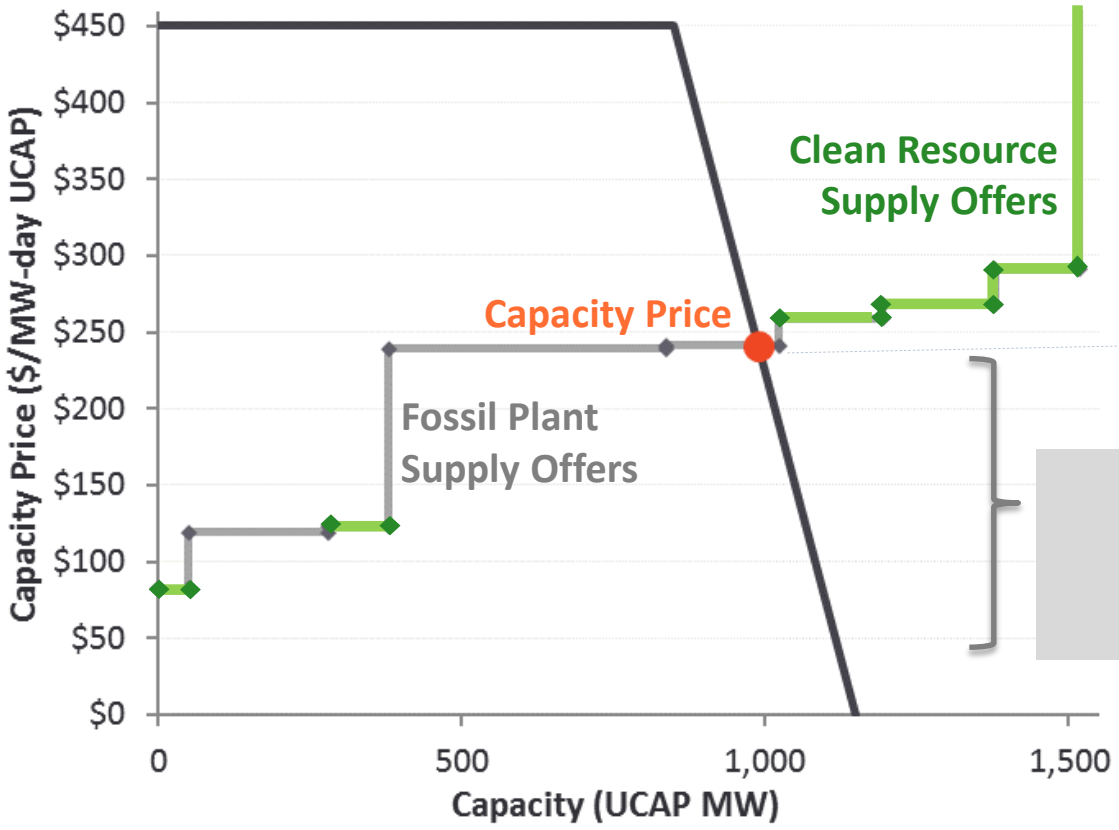


Note: Illustrative auction clearing and pricing model used to develop this example is available upon request. Simplified example is not intended to reflect PJM.

Today's Power Market:
Aims to Achieve Reliability at Least Cost

How does the current capacity auction clear?

Current Capacity Market Clearing



Capacity auction procures capacity at the lowest possible cost, setting prices at the intersection of supply and demand

Absent policy incentives for green power, most clean energy resources would fail to clear the capacity market (effect is exacerbated by MOPR)

Cleared supply is primarily fossil generation

Note: Simplified example. Not intended to reflect PJM.

How do clean energy resources get built?

Absent a wholesale market structure to express green energy preferences, customers and states must develop their own policies, programs or procurements to attract clean energy

Segmented approach poses challenges:

- Segmented sub-markets achieve less competition and cost advantage as compared to a broad regional marketplace
- Clean energy programs may not always align incentives with system reliability needs
- Sellers (or customers) face uncertainty in capacity clearing and associated revenues

Examples of Clean Resource Incentives

- Regional greenhouse gas initiative (RGGI) cap-and-trade market
- Renewable portfolio standard
- Clean energy standard
- Zero emission credits
- Technology-specific carve-out or contract solicitations
- Social cost of carbon consideration in ratemaking

Future Market with ICCM:

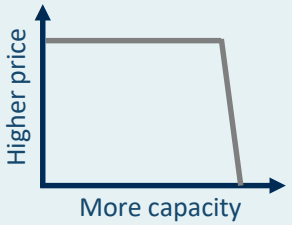
Will Procure Reliable & Carbon Free Supply

How would the ICCM meet capacity and clean energy needs at the lowest combined cost?

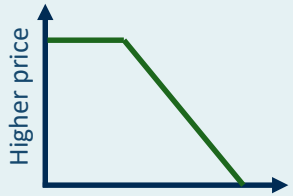
BIDS

Demand

Capacity (MW)



Clean Energy (CEACs)



Supply

- Total annual resource cost ($)
- Capacity quantity (UCAP MW)
- Clean attribute quantity (CEAC)

CO-OPTIMIZED AUCTION CLEARING

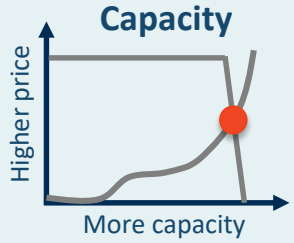
Similar to Current PJM Capacity Market Clearing

- **Objective function:** Maximize social surplus (area under demand curves minus cleared resource cost)
- **Cleared resources:** Least cost resources for meeting capacity & clean energy demand
- **Price setting:** Marginal cost of meeting incremental demand

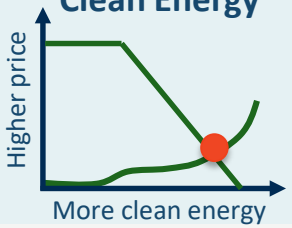
CLEARING RESULTS

Clearing Prices

Capacity



Clean Energy



Cleared Resources

Cleared Capacity Resources

Cleared Clean Energy Resources

How do sellers offer?

Sellers can offer up to three types of offers: capacity-only, attribute-only, or capacity+attribute. Examples of typical fossil and clean resource offers:

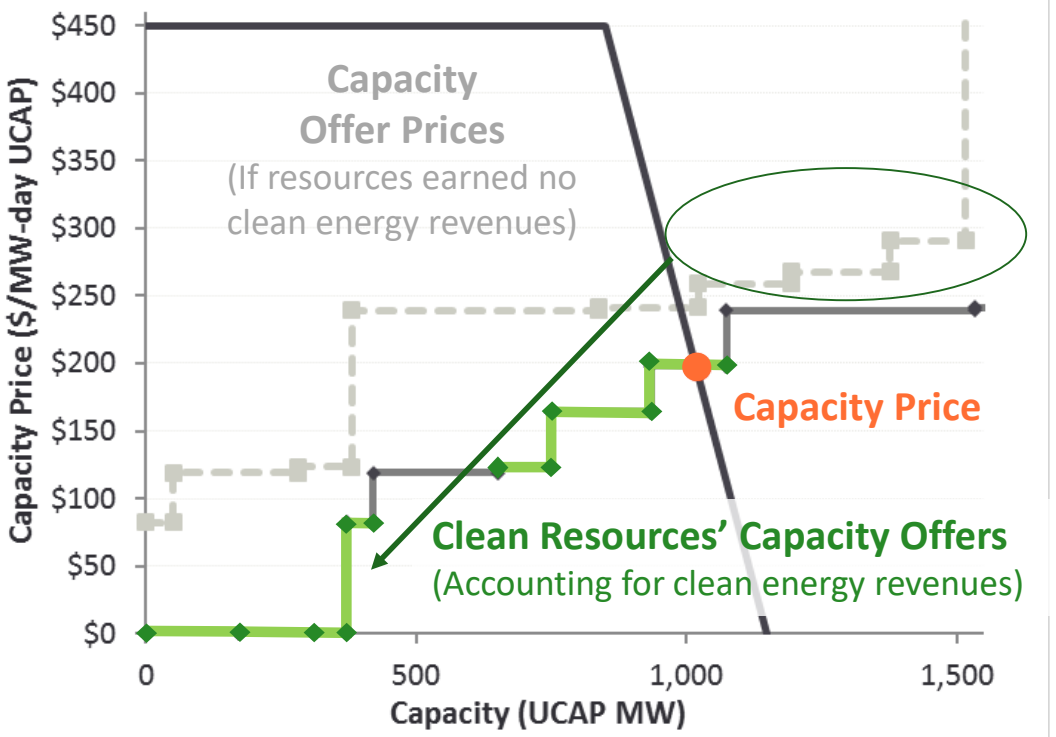
	Gas Plant	Solar Resource
Installed Capacity	100 MW ICAP	100 MW ICAP
Qualified Offer Quantity	**Capacity:** 95 MW UCAP **Attributes:** n/a (not eligible)	**Capacity:** 42 MW UCAP **Attributes:** 131 GWh RECs
Offer Price	$200/MW-day UCAP Same as current capacity market offer structure.	$80/kW-year ICAP One total revenue requirement to sell two products; resource will clear if total revenues from selling both products exceeds the offer price.

ICAP = Installed capacity, or maximum/nameplate rating
UCAP = Unforced capacity, or de-rated value contributing to capacity market reliability needs
Attributes = any REC, ZEC, or CEAC product that the resource is eligible to sell

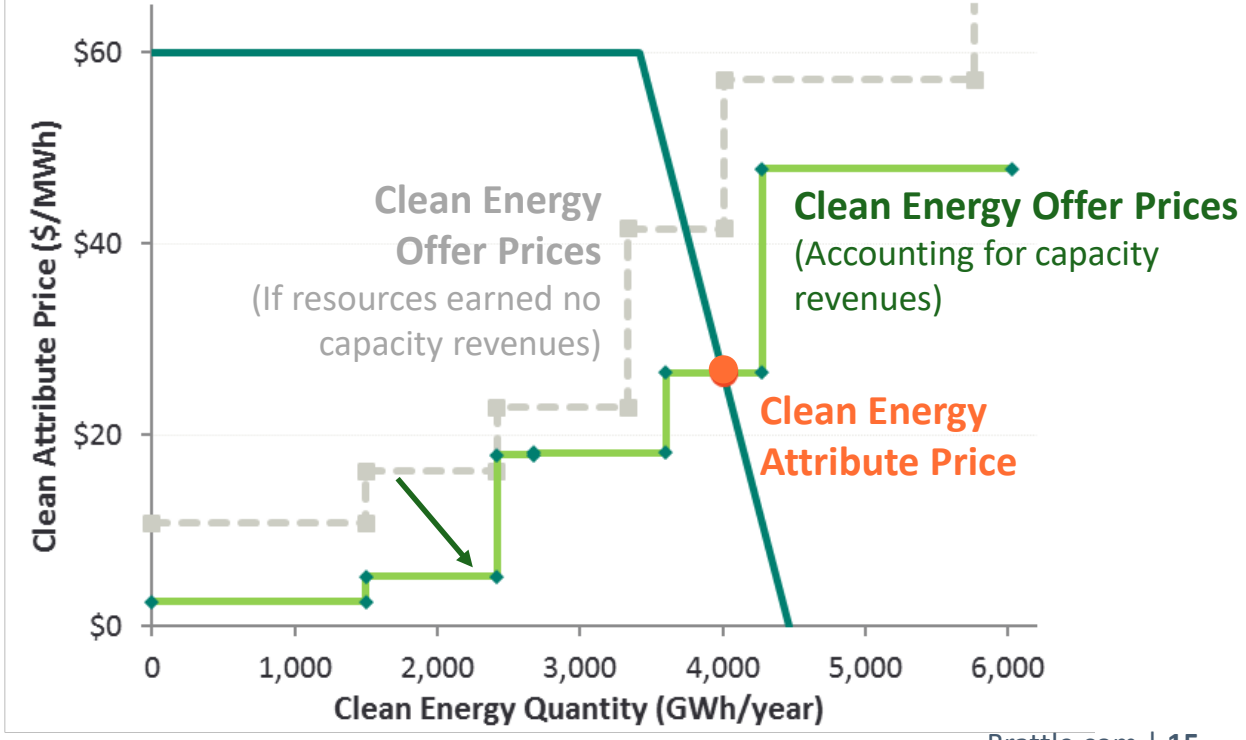
How are prices set?

Co-optimized price formation reflects marginal cost of each product.

Capacity Clearing



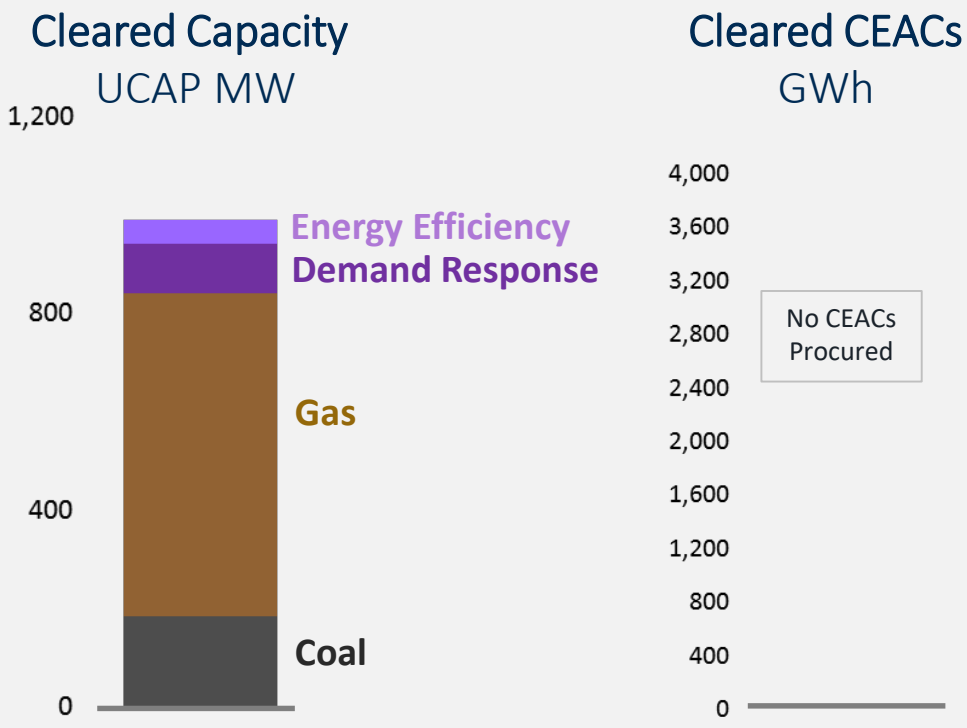
Clean Energy Clearing



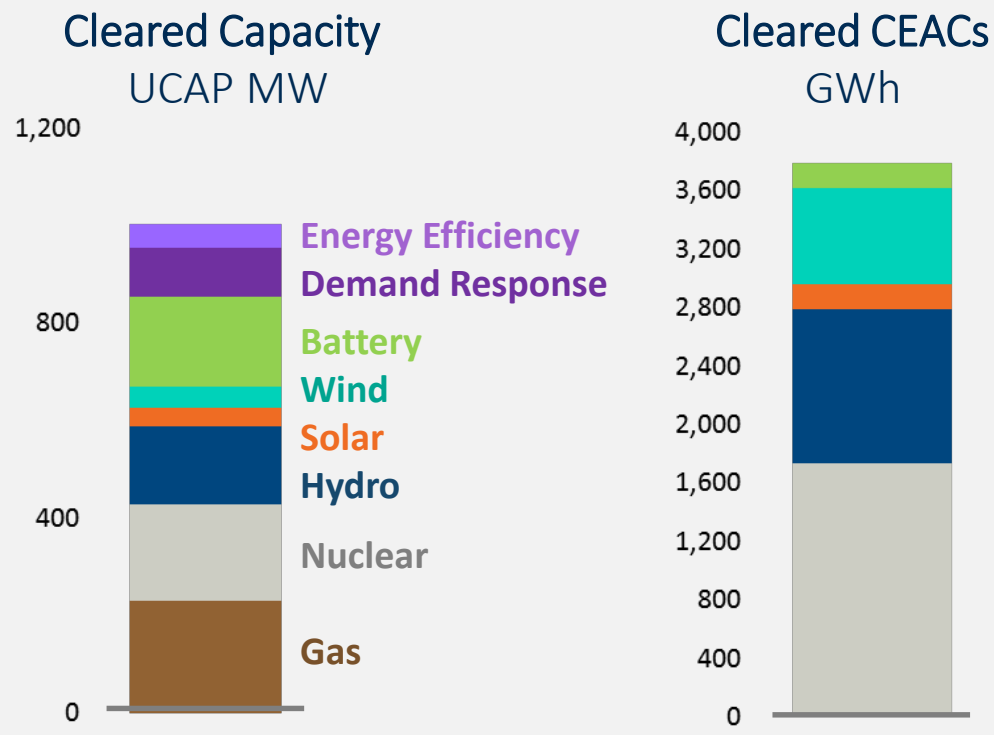
Note: Simplified example is not intended to reflect PJM. Clearing model available upon request.

What resources clear?

Traditional Capacity Market



Integrated Clean Capacity Market



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Future Market with ICCM:

Will Empower States and Customers to Demand Clean Energy

How would states and customers express demand for clean energy?

For the first time, the wholesale market would empower consumers to demand clean energy within their own budget constraints

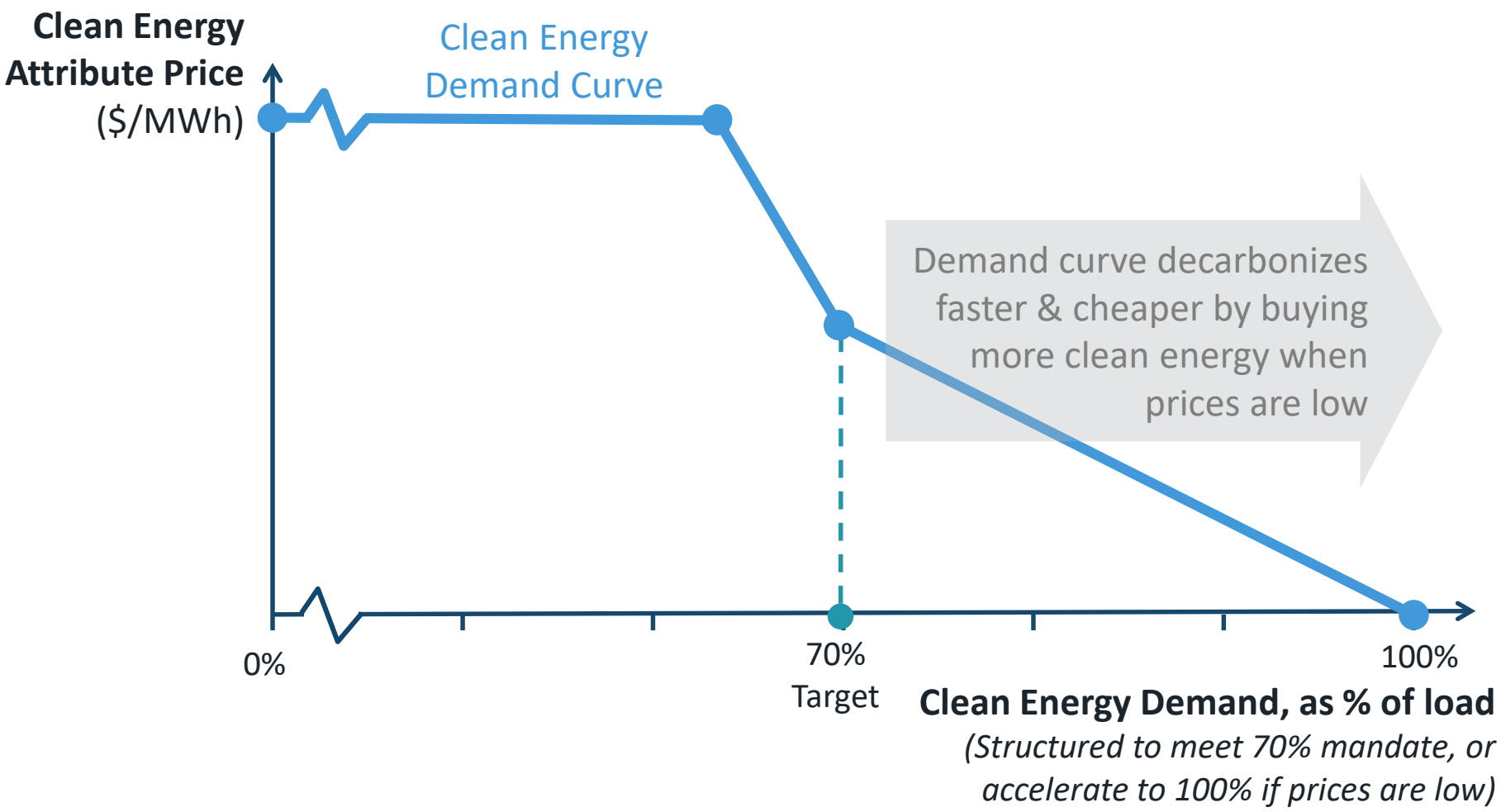
Each State would have options to:

- Define eligible resource types
- Set technology-specific carve-outs
- Procure attributes through state-defined renewable energy credit (RECs), state-defined zero emissions credit (ZECs), or a new resource-neutral regionally-defined clean energy attribute credits (CEACs)
- Buy as much (or as little) clean energy as they like
- Continue using other clean energy programs and procurements outside of ICCM

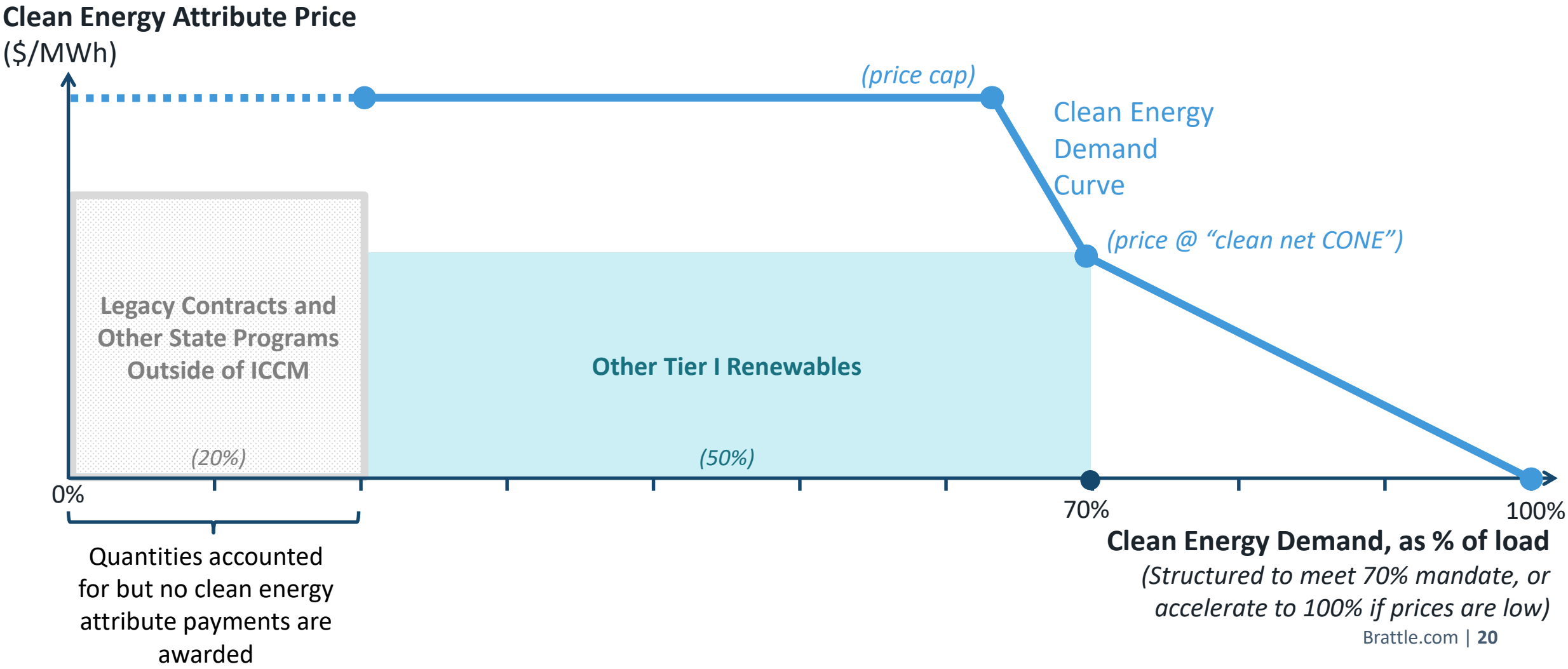
Voluntary buyers would have options to:

- Select the desired supply characteristics (types, locations, new/existing, maximum term)
- Set budget or price caps
- Express demand as price-quantity pairs
- Buy as much (or as little) clean energy as they like
- Self-supply within state mandates
- Express demand as price-quantity pairs
- *Design option*: select a “bespoke” or special product definition (e.g. attributes credited according to marginal carbon abatement value)

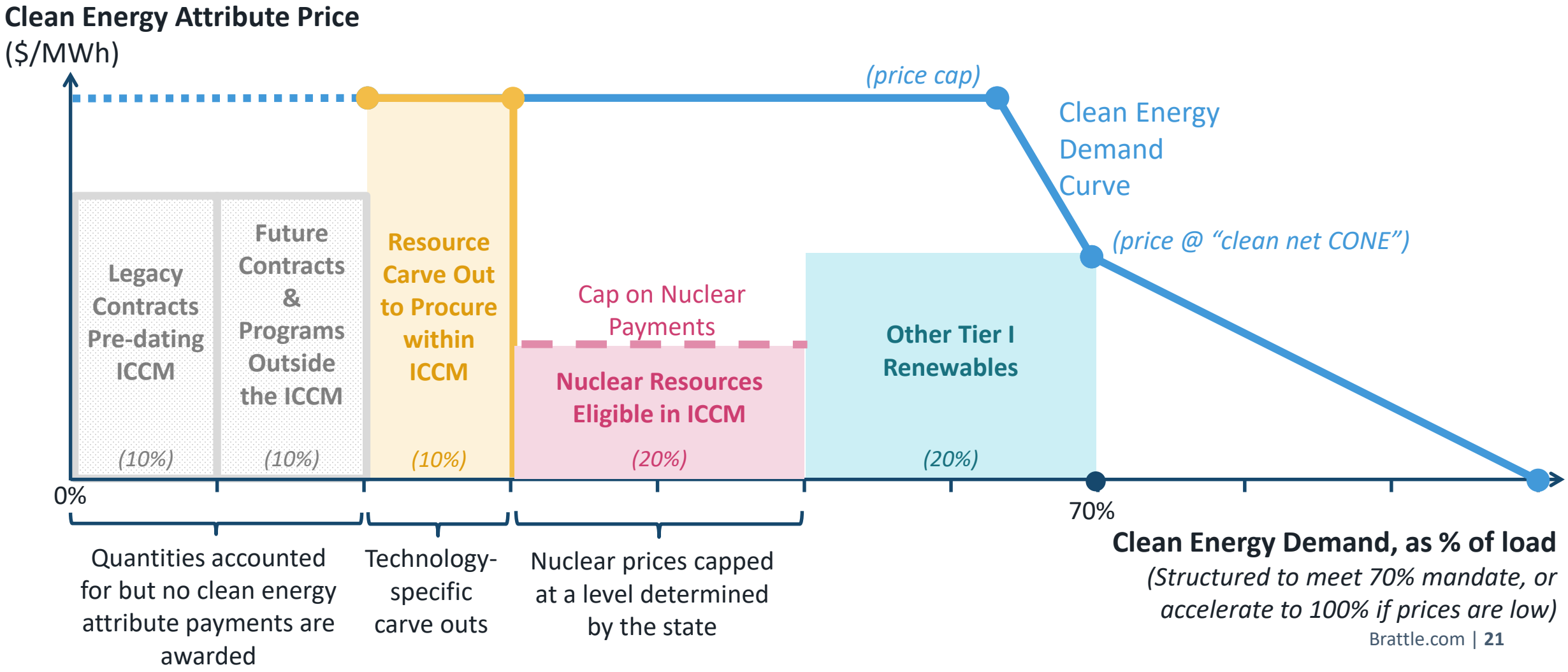
Indicative demand curve for a 70% clean energy target



Resources procured outside ICCM would reduce procured clean energy volumes



ICCM structure can be adapted to multiple policy structures that may exist in any one state



Next Steps

SUMMARY

How could ICCM be implemented?

- States, consumers, and stakeholders would refine the ICCM design that can attract a clean supply mix to serve reliability, carbon, and affordability goals
- PJM Interconnection could implement the design, drawing on their current staff expertise, capacity market structures, and state REC tracking systems
- As an alternative implementation path, a new organization could be created to act as the ICCM auction administrator. Participating states would utilize the Fixed Resource Requirement (FRR) alternative to opt out of the current PJM capacity market and opt in to procuring capacity and clean energy through the new ICCM

SUMMARY

ICCM Key Design Elements

Design Element	Resource Adequacy Objectives	Clean Electricity Objectives
Who Sets Demand?	• **RTO**	• **State policymakers** • **Voluntary buyers** (retailers, companies)
Product Definition	• Unforced capacity (UCAP MW) • Keep locational specificity (as today) • Accurate accounting of capacity needs and values of resource types	• Buyer selects which product to buy: state-defined RECs, state-defined ZECs, or regionally-defined clean energy attribute credits (CEACs) • *Consider*: CEAC accreditation tied to carbon abatement value
Supply Eligibility	• All clean and fossil resources are eligible • ELCC-based accounting for resource-neutral capacity values (by location, season, and flexibility)	• State REC/ZEC: utilize current eligibility rules from each state • Regional CEAC: PJM-wide product with uniform eligibility (likely renewable, nuclear, and storage charged from clean energy)
Quantity to Procure	• Quantity needed to support 1-in-10 • Based on advanced reliability modeling that considers emerging flexibility needs in the clean grid • *Consider*: State option to impose a maximum on the share of capacity procured from fossil plants	• States and customers decide the quantity needed • Pre-existing contracts enabled as self-supply • In vertically integrated or other Fixed Resource Requirement states, the resource mix is approved by the state and not subject to ICCM
Willingness to Pay for Each Product	• Sloping demand curves for each system-wide and locational capacity requirement • Consider: Separate demand curves for summer/winter needs and “flexible” capacity needs	• States submit sloping demand curves for state-mandated clean energy demand • Voluntary buyers can submit price-quantity pairs to exceed state mandates

Contact Information

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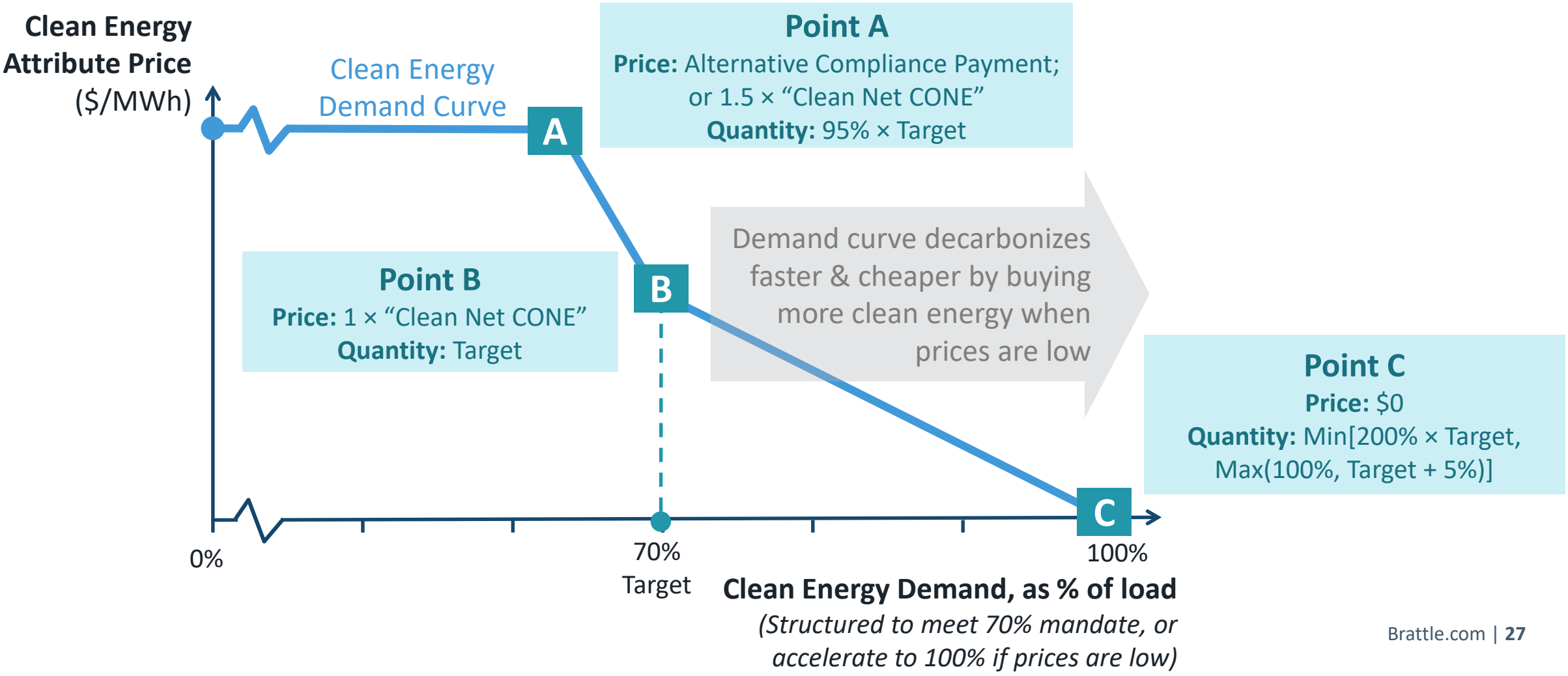
Dr. Kathleen Spees is a principal at The Brattle Group with expertise in wholesale electricity markets design and environmental policy analysis.

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.

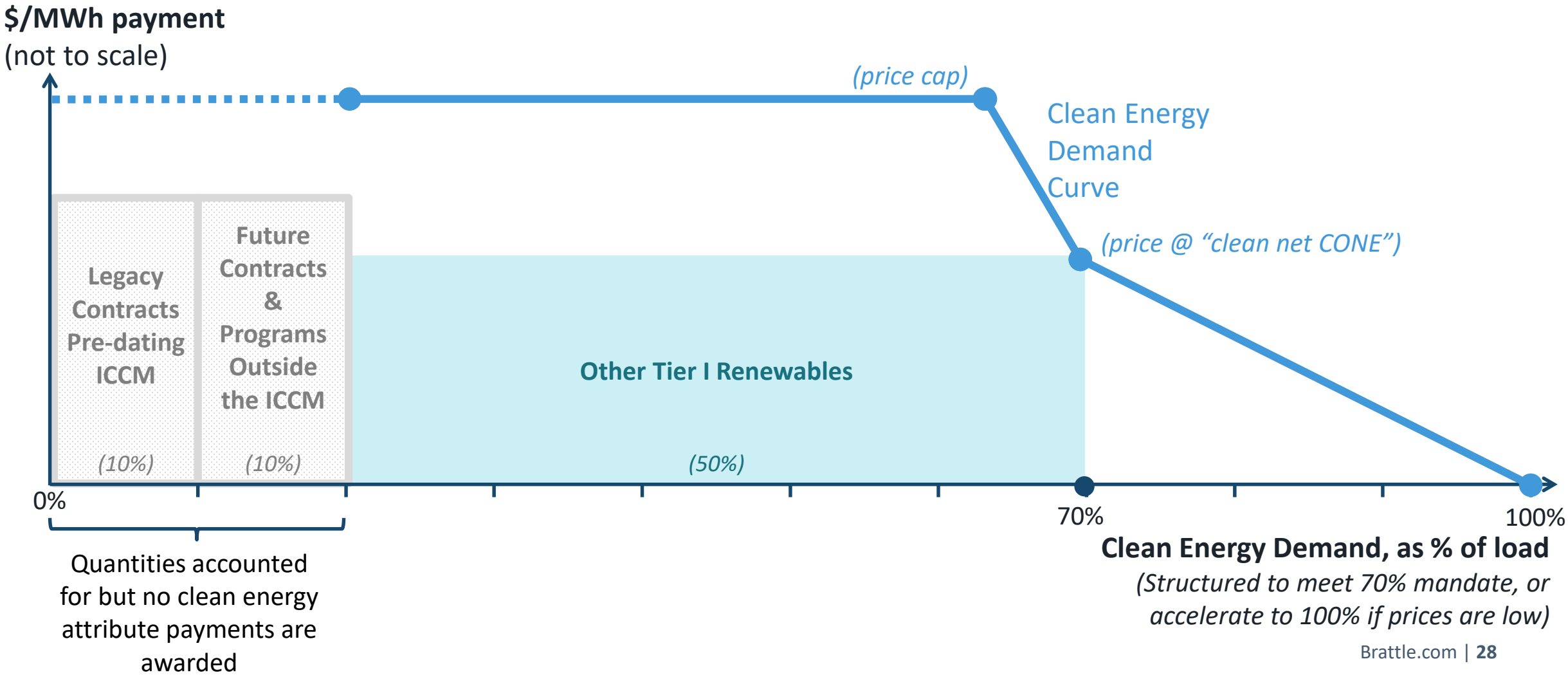
Dr. Spees earned her PhD in Engineering and Public Policy within the Carnegie Mellon Electricity Industry Center and her MS in Electrical and Computer Engineering from Carnegie Mellon University. She earned her BS in Physics and Mechanical Engineering from Iowa State University.

Appendices

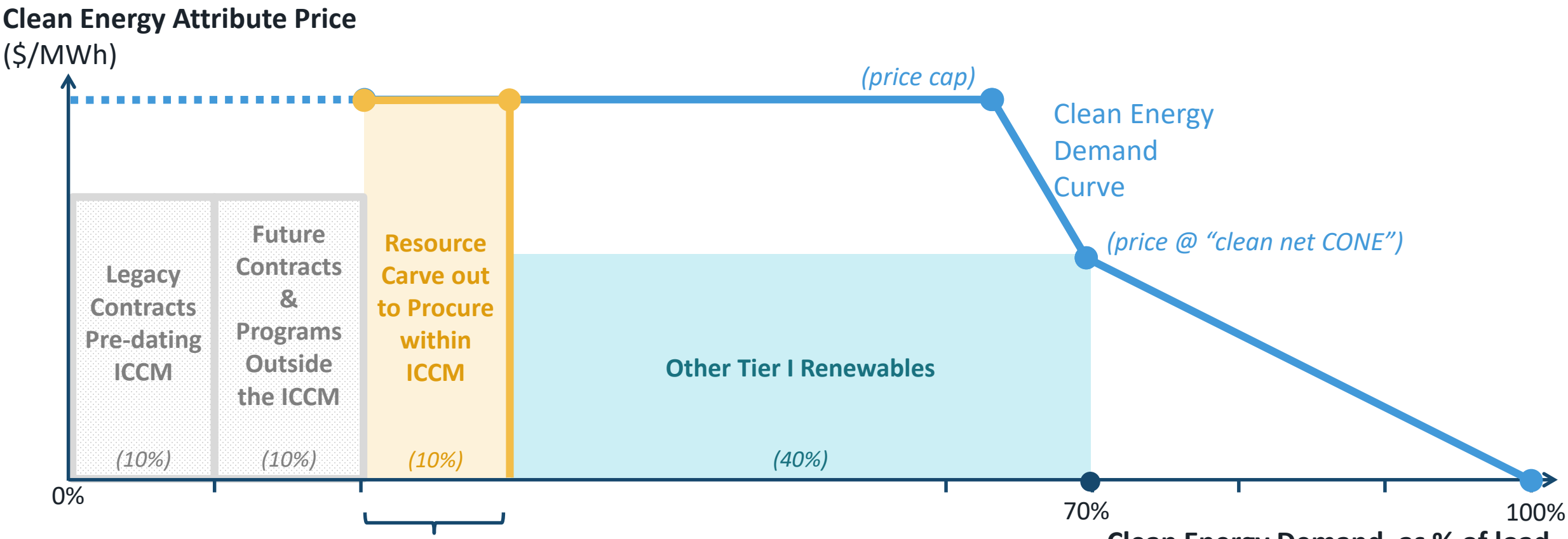
Example 1: Indicative demand curve parameters



Example 2: Accommodating out-of-market clean energy programs through ICCM

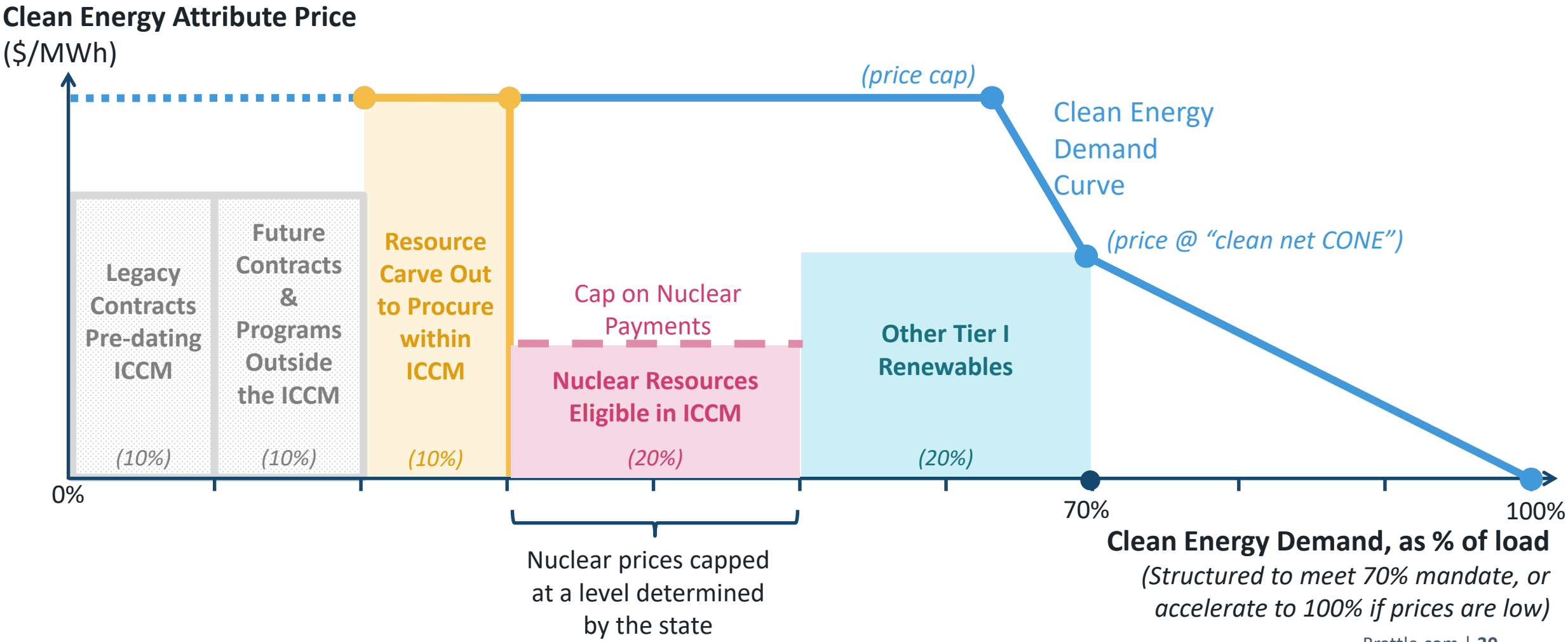


Example 3: Achieving a technology-specific carve out



ICCM can procure a minimum share of clean energy from technology-specific carve outs defined within an RPS. Carve-out supply an clear at a higher (but not a lower) price

Example 4: Imposing a nuclear program budget cap



Written Comments:

- The Board will be accepting written comments on this matter until 5pm E.S.T. on March 5, 2021.
- Please submit your electronic comments in PDF or Word format to board.secretary@bpu.nj.gov or see meeting notice for instructions on e-filing and submitting written comments.
- Please reference Docket No. EO20030203 in the subject line of your comments.

Thank you!