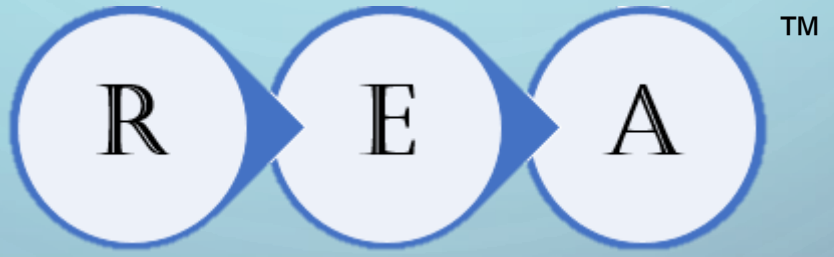
ALWAYS ON CAPACITY EXCHANGE (AOCE)

STRAWMAN CONCEPTUAL INTRODUCTION

JUNE 1, 2023



RELIABLE ENERGY ANALYTICS LLC (REA)™

ABOUT ME

- 14 Years ISO New England
  - Smart Grid White Paper Co-Author
  - **Forward Capacity Market Clearing Engine Software Architect**
  - Enterprise Architect
  - Technical Lead BI and Data Analytics Platform
  - Retired November 2018
- Co-Founder and CTO Reliable Energy Analytics (REA) 2018
  - Lead Software Engineer Software Assurance Guardian Point Man™ (SAG-PM™)
  - Author "Always on Capacity Exchange" (AOCE)
- NAESB Standards Developer 1995 – present (Former WEQ Executive Committee Vice Chair)
- Software Engineer with 40+ years experience providing software products to the Energy Industry since 1995

AOCE DISCLAIMER

- AOCE is a **strawman conceptual capacity market design** for the energy transition that was created in early 2019 designed by a software engineer with lots of help from friends who reviewed and commented on AOCE
- NO economic studies have been performed on the AOCE concept
- **AOCE is NOT a fully functional capacity market proposal**
- **AOCE is presented today for awareness that these concepts exists,** it is not a proposal for a PJM Capacity Market Design

AOCE DESIGN GOAL – THE OBJECTIVE FUNCTION

ENSURE a reliable and resilient electric grid, by acquiring the proper amount of grid services capacity needed for reliability

WHILE also supporting Green Buyer and State energy goals

AS the energy transition dynamics evolve,

WHILE also providing consumers with reliable electric service at just and reasonable costs

AND generators with adequate and reasonable revenues to ensure their ability to meet capacity obligations under all weather conditions.

WHAT IS AN AOCE (PRONOUNCED *ACE*)

- An online, 24x7, Marketplace for Sellers and Buyers to transact in both Capacity and Energy contracts (i.e. a PPA), operated by Independent System Operators (ISO), modeled on the CEBA and Level Ten Marketplace
- A platform for ISO's to secure grid service capacity for reliability that honors individual State based energy targets and eliminates the cost of acquiring excess capacity, that is occurring today
- A more flexible platform for acquiring the right amount of capacity, closer to when it's needed, as opposed to the 3-year planning horizon used by some ISO's today, while also supporting long term **new capacity** projects (ISORB)
- An approach that anticipates, and accommodates, daily increases in new supply coming from behind the meter resources and other distributed energy resources
- A new, dynamic marketplace that properly values Green Capacity/Energy and other characteristics/services that may be valuable for reliability, i.e. rapid ramping
- A place where anyone: Generators, Energy Suppliers, Traders, Investors, Utility Companies, State's, Companies with their own Green agenda, and of course, ISO's, can buy and sell capacity, on their own terms i.e. duration, type, location, price
- A market mechanism that aims to achieve just and reasonable price points for all stakeholders

AOCE OBJECTIVES

- **Ensure that we have a reliable electrical system for all,** at a just and reasonable price point for all stakeholders
- **Achieve State Energy Goals as a top priority,** that properly charges the beneficiaries of that State, without burdening other States consumers with costs of the program
- Be market based so that **each resource is properly valued for the grid services it provides** to grid reliability, resiliency, grid operations, consumers, the environment and society at large
- Efficiently **secures future grid services capacity using a just-in-time approach** that eliminates the excessive over-buying of capacity that occurs today by ISO's WHILE supporting new, long term capacity construction projects (ISORB)
- **Incentivizes investment** in the most beneficial technologies used to generate electricity and manage grid operations reliably (including DR) that achieves Societal and Environmental goals determined by each individual State, such as clean air and water
- Provide a vibrant, **24x7 marketplace for Investors and Green Energy Buyers to secure PPA's** and Investors to trade WHILE focusing on requirements for grid reliability and resilience

AOCE TECHNICAL DESIGN – 3 PROVEN TECHNOLOGIES

- Bilateral Capacity Exchange used by Green Buyers today
  - **KEY Finding: Generators will make long-term capacity commitments IF they are properly compensated**
- Acquisition of Grid Services, following Irish Model
- CSO Issuance Process Based on ISO-NE Model, with some tweaks (ISORB), but no descending clock auction – all prices/payments for grid service capacity are determined using the capacity exchange and a Uniform Clearing Price, similar to DA Energy Market
- ONE Overarching Goal driving the objective function: Grid Reliability

POWERFUL SHIFTING DYNAMIC FACTORS

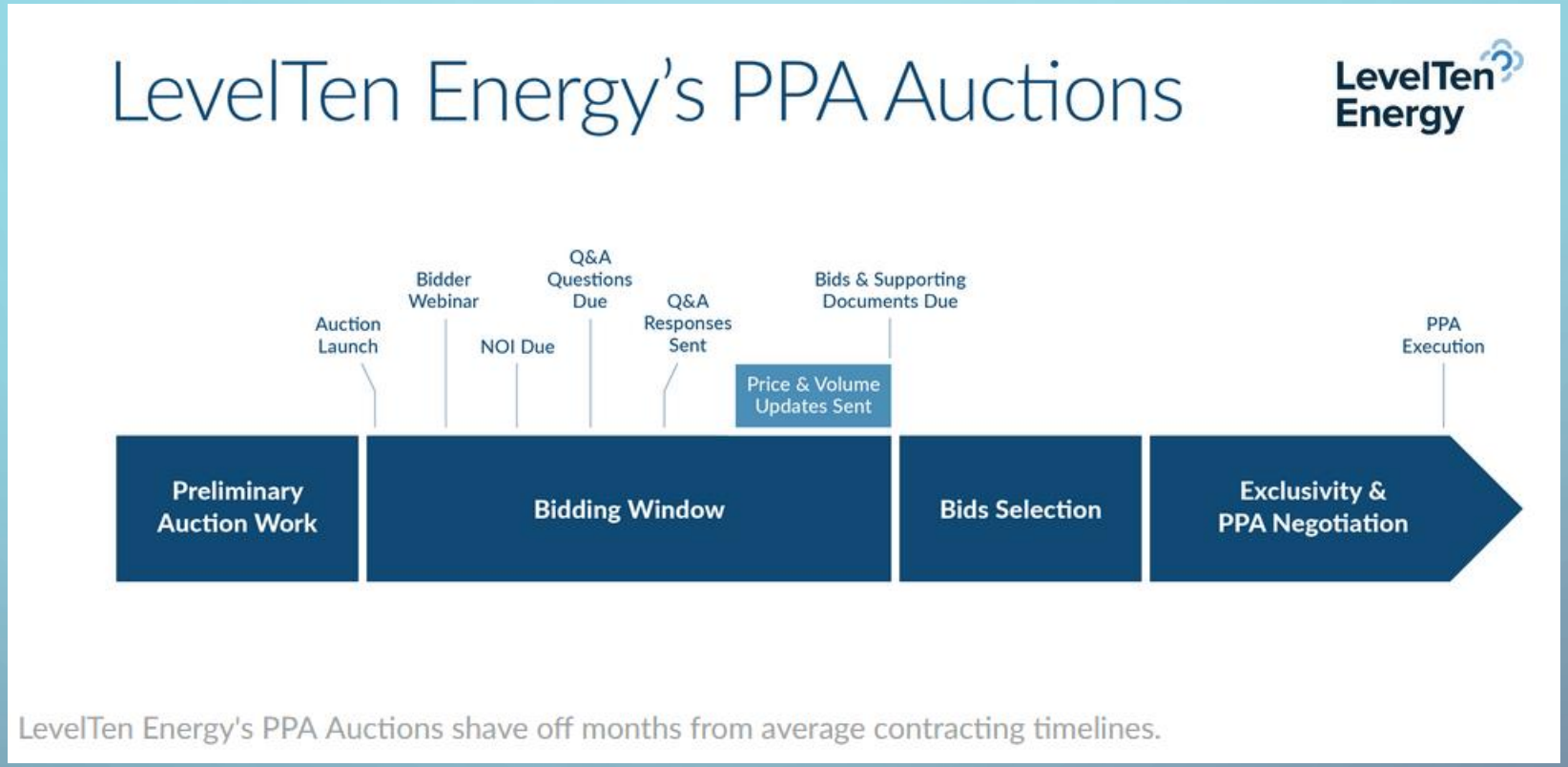
- Changing Supply Mix
- State Energy Goals
- Green Buyer Goals
- Inverter Based Resources/DER/FERC Order 2222 impact on reliability
- Hourly Grid Service Requirements (Duck Curve Shoulder Periods)
- Highly stochastic supply and demand influenced by changing atmospheric and seasonal factors
- Retirements of spinning mass resources and loss of critical services, i.e. inertia for system ride-through
- Grid stability with higher penetration of VER and IBR
- Short Duration Energy Supplies (BESS) with charging requirements and Max runtimes
- Behind the meter supply and its yin-yang effect
- Challenges in Forecasting BOTH Supply and Demand
- The effects of climate change and extreme weather events
- Constrained Fuel Supplies and Gas-Electric system interdependencies
- Government investments rapidly advancing new supply resources
- Software influencing changes to expected operational efficiency (EOE) of supply resources

ONLY ONE PARTY IS RESPONSIBLE FOR GRID RELIABILITY

ISO's

AOCE was designed from an ISO perspective

LEVEL TEN CAPACITY EXCHANGE OVERVIEW



AOCE CONCEPTUAL DESIGN; CAPACITY COMMITMENTS

Capacity Sellers receive qualification approval from their local ISO to place offers in AOCE

Capacity Sellers place offers in AOCE, backed by a qualified Resource

Aligned Bids/Offers Result in a Capacity Commitment (CC)

Buyers place bids in AOCE to secure capacity and/or Energy

ISO controlling the Locations in the Bid/Offer must Approve a CC for feasibility

ISO approved CC results in an Approved Capacity Commitment (ACC)

CC Buyers become the Owners of ACC's

CAPACITY SUPPLY OBLIGATIONS FROM ACC'S

ACC

Owners (Buyers) of ACC's receive capacity payments equal to the uniform clearing price multiplied by the Amount of MW's in the CSO Issued to generators in an ACC

Capacity Resource Owner

CSO

The ISO performs the CSO Issuance Process (CSOIP) for resources located within ACC's resulting in CSO's to Capacity Resource Owners of an ACC, establishing a Uniform Clearing Price per grid service (CSOIP Step 2) or as part of each States clearing Process (CSOIP Step 1)

Some Resource Owners in an ACC may not receive a CSO due to reliability concerns. ACC owners receive no capacity payment in this case

CSO ISSUANCE PROCESS (CSOIP)

- **Market Rules determine when this process is executed**
- The ISO will prioritize the issuance of CSO's for ACC's as follows:
  1. Satisfy State based energy targets using a cost curve and uniform clearing price, like DA Energy Market, based on State provided parameters.
  2. Satisfy Reliability Requirements by issuing a CSO to ACC resources based on a **priority services hierarchy** (see **Note** below) specified by Market Rules, using a cost curve and uniform clearing price, like the DA Energy Market, to properly compensate Generators and Investors for their grid services capacity commitment
  3. The ISO may refuse to issue a CSO to an ACC resource, based on reliability concerns
  4. In the event that an ISO is unable to secure enough capacity to meet reliability requirements, via this process, one or more ISO Reliability Bid's (ISORB) may be placed into the AOCE to secure required capacity

NOTE: A priority services hierarchy instructs an ISO on the type and quantity of grid services to be acquired in precedence order, using a fuel and technology neutral approach, to meet reliability requirements.

FUTURE CAPACITY FOR RELIABILITY (ISORB)

- Need is determined by ISO for specific grid services at specific locations for specific hours based on planning studies for reliability
- An ISO can issue an ISORB at any time, specifying start and end time (duration), along with other characteristics, when a grid service will be needed for reliability
- Can be near term need, i.e. next week or long term need, i.e. 500 MW of fast up ramping starting 2025 through 2030 for hours 1500 – 2000 during December and January
- ISORB is based on ISO identified requirements to ensure reliability, influenced by shifting factors

ISO RELIABILITY TARGETS AND BIDS

At some point the ISO calculates the Reliability Target MW's (ISORT) for a specific Commitment Period and Location

Total Amount of Reliability MW needed for a location and timeframe (commitment period), determined by ISO

MINUS

CSO's already issued for the same location and Commitment Period time frame, determined by ISO

ISO submits one or more Reliability Bids (ISORB) into AOCE, specifying ISORT MW, Capacity type, location and other characteristics

ISO Reliability Target (ISORT) indicating additional MW's that are needed by an ISO to satisfy Reliability Requirements

CSO ISSUANCE PROCESS FOR OFFERS TO ISORB'S

Capacity Resource Owner
OR
ACC Owner
of submitted/cleared
offers

CSO

Capacity payments are made by the ISO
To ACC/Capacity Owners of cleared
Offers that are issued a CSO. No
profit/uplift payment is made. Payment
Is based on MW * Price

Submitted Offers to ISORB

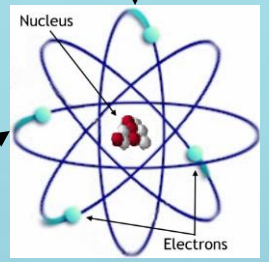
ACC Owners with no CSO and
Capacity Resource Owners with
Available capacity may
submit Offers to
satisfy an ISORB

The ISO for a Control Area
performs a CSO Issuance
Process (CSOIP)
resulting in CSO's to Capacity
Resource/ACC Owners **based on
their submitted offers** to the ISORB's
in AOCE

The ISO only awards enough CSO's to
satisfy the calculated ISORT
No excess MW above ISORT
may be acquired

ENERGY MARKETS, PPA'S AND ENERGY PAYMENTS

Capacity Resource Owners with Capacity Supply Obligations MUST submit Energy offers into the Energy Markets.
ISO performs SCUC/SCED the same as today's DA/RT Energy Markets



Generators produce Energy throughout the Operating day, some may be self-scheduled

ISO processes Settlements to determine payments for Energy and compensates the appropriate party

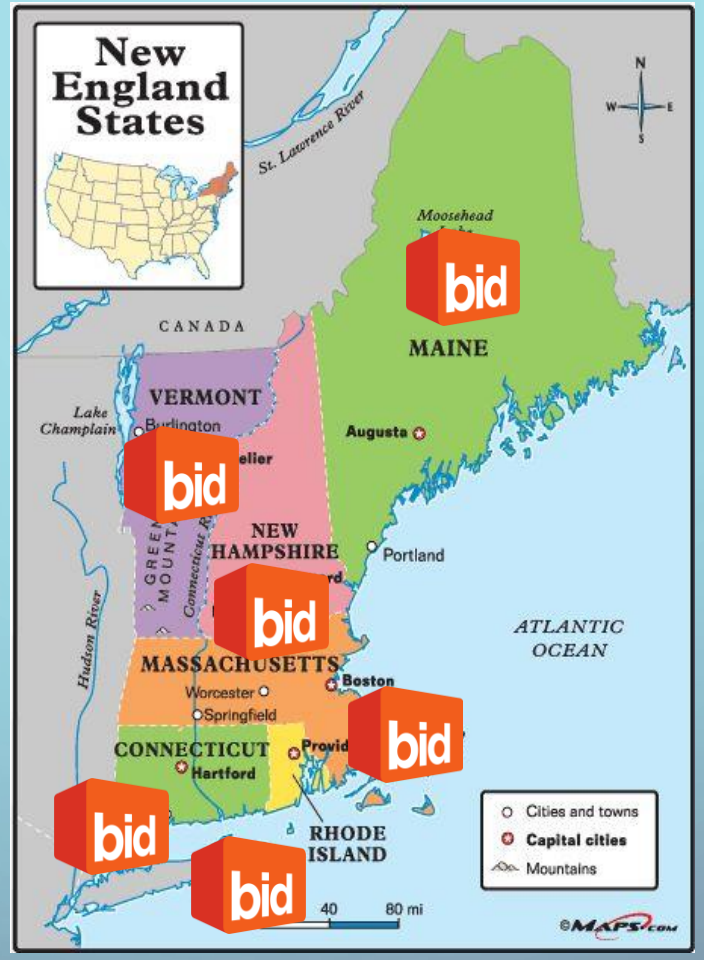
An ACC that specifies an Energy Revenue Percentage > 0 Is a Power Purchase Agreement

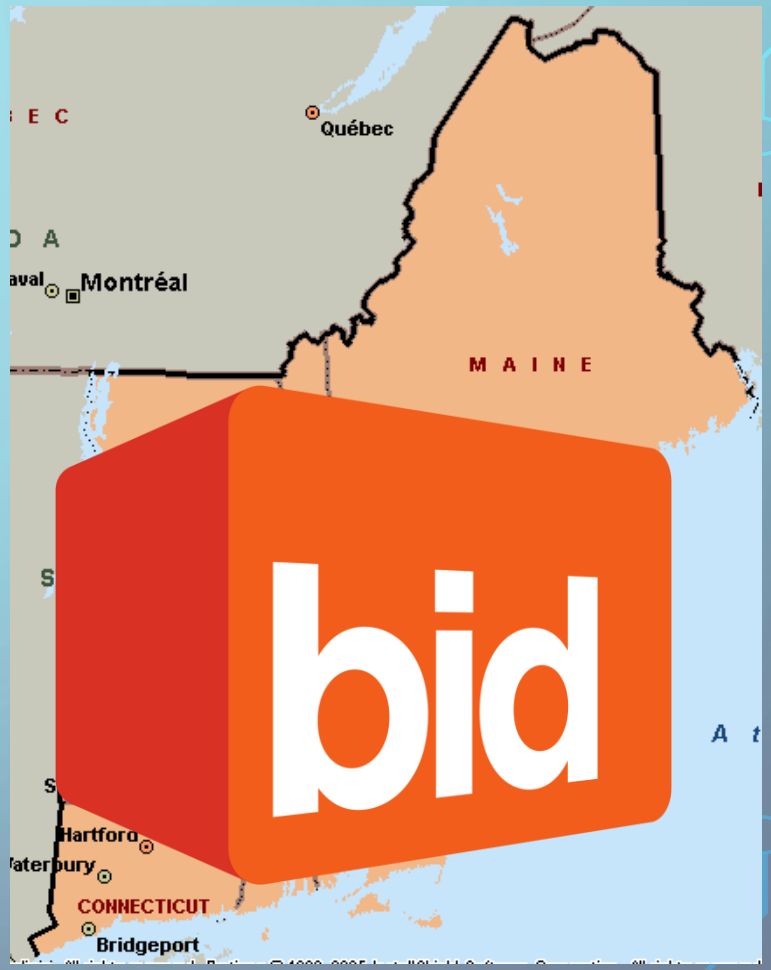
CAPACITY CHARGES TO COVER CAPACITY PAYMENTS

Capacity Charges are issued to Load Serving Entities throughout a control area for all capacity payments made by an ISO servicing that area.

<u>Capacity Charges are allocated to LSE's, based on the location specified in the (ACC/ISORB) Bids</u>

Bids that apply to the entire control area location will have their Capacity Charges allocated to LSE's based on a fair and appropriate allocation scheme,
i.e. proportion or nominal load in the region





CONCLUSION

- AOCE is over 4 years old and may need to be updated
- More areas need attention, i.e. pay for performance penalties, support for REC's and integration of existing capacity supply obligations, and more…
- AOCE is not a fully functioning capacity market design; it's a strawman concept for consideration as a possible capacity market design for the energy transition that leverages existing capabilities (Level10 Capacity Exchange, Grid Services in Ireland, CSO process – with some tweaks), from the perspective of an ISO
- Based on past experience at ISO New England working on FCM Market Clearing Engine and work at EirGrid in Ireland
- I hope you find this information useful as you pursue market reforms in PJM

THANK YOU FOR YOUR TIME AND CONSIDERATION

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