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The Energy Storage Technology Advancement Partnership (ESTAP) is a US DOE-OE funded federal/state partnership project conducted under contract with Sandia National Laboratories.

ESTAP Key Activities:

1. Facilitate public/private partnerships to support joint federal/state energy storage demonstration project deployment

2. Disseminate information to stakeholders
   - ESTAP listserv >5,000 members
   - Webinars, conferences, information updates, surveys.

3. Support state energy storage efforts with technical, policy and program assistance

ESTAP Project Locations
Thank You!

Dr. Imre Gyuk
Director, Energy Storage Research, U.S. Department of Energy

Dan Borneo
Engineering Project/Program Lead, Sandia National Laboratory

And thank you to all of today’s speakers!
Today’s Webinar Speakers

Mike Berlinski
Director – Emerging Technology, Customized Energy Solutions

Nehal Divekar
Manager – Future Grids, Customized Energy Solutions

Jim Kennerly
Senior Consultant, Sustainable Energy Advantage

Todd Olinsky-Paul
Senior Project Director, Clean Energy States Alliance (moderator)
The Massachusetts Clean Peak Energy Standard
How it will affect renewable and storage value streams, projects, and markets

September 2, 2020
Introduction to Customized Energy Solutions and Sustainable Energy Advantage

Background on the MA Clean Peak Energy Standard

Analysis
- Energy Storage
- Renewables

Best Practices for a Clean Peak Standard

Questions & Answers
Introduction to Customized Energy Solutions and Sustainable Energy Advantage
Established in 1998, Customized Energy Solutions (CES) is a consulting and services company that assists clients in managing and staying ahead of the changes in the wholesale and retail electricity and natural gas markets. Serving hundreds of clients, Customized Energy Solutions offers best-in-class hosted energy market operations platforms and a wide spectrum of consulting services. CES is committed to promoting economic development through the advancement of transparent, efficient, and non-discriminatory wholesale and retail electricity and natural gas markets.

<table>
<thead>
<tr>
<th>Resources</th>
<th>Awards and Recognitions</th>
<th>Clients</th>
</tr>
</thead>
</table>
| >11,000 MW assets under Active Management | Inc. 5000 – Eleven Time Honoree, Philadelphia 100 - 2001, 2004 – 2012,2019  
2016 Energy Storage Association Brad Roberts Award Winner | 500+ Clients Worldwide |
| >300 MW Energy Storage under Management | | |

Our consulting services enable competitive suppliers, technology providers, marketers, utilities, and their customers to prosper through change, by turning knowledge into value.
**CES Business Lines**

### Wholesale Services
- Dispatch
- Scheduling
- Monitoring
- Bidding
- Telemetry

### Retail Services
- Market Entry
- EDI/Billing
- Forecasting
- Scheduling
- Settlements

### Future Grid
- **Distributed Resource Integration**
  - Market Rules and Entry
  - Market Integration Consulting
  - Revenue Modeling

- **Emerging Technologies**
  - Telemetry & Resource Registrations
  - Market Operations
  - Scheduling, Dispatch and Control

### Market Intelligence
- Comprehensive Markets Coverage
- ISO Rules & Reporting
- Market Rule Changes
- Regulatory Proceedings

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**CES** was the lead consultant for the MA State of Charge report, we supported MassCEC on Solar + Storage for Manufacturers, and supported MA DOER on the CPS. We advise the Energy Storage Association on its wholesale electricity market policy efforts.
Sustainable Energy Advantage, LLC
Consulting & advisory firm helping clients build renewable energy business, markets, policies and projects through analysis, strategy & implementation since 1998.

Objective Analysis
- Tracking & Analysis
- Financial Models & Analysis

Modeling
- Development
- Due Diligence & Feasibility

Forecasting
- Implementation

Transaction Facilitation
- Multi-Stakeholder Support

Insight
- Strategy
- Projects

Intelligence
- Markets
- Policies

Negotiation Support
- Strategy
- Projects

Action
- Markets
- Policies

Our Subscription Service Suite

New England Renewable Energy Market Outlook (REMO)
- Detailed REC market fundamentals analysis, briefings, providing actionable information on New England's complex REC markets to support informed business decisions.
- Delivered 3x per year
- Since 2005

Northeast Eyes & Ears
- We track it...now you can too.
- Renewable Energy Regulatory Policy & Legislative Tracking & Analysis Service
- Extending & enhancing subscribers' busy users' government affairs / market intelligence functions

New York Renewable Energy Market Outlook (REMO)
- Bulletins, Topical Webinars, and detailed REC Market Fundamentals Analysis, providing subscribers with comprehensive & timely insight into New York's rapidly expanding / evolving renewables market.

Massachusetts Solar Market Study
- In-depth analyses of the Massachusetts solar markets since 2014, focusing on solar renewable energy credit market and Solar Massachusetts Renewable Target (SMART) program

PJM... coming soon!
Background on the MA Clean Peak Energy Standard (CPS)
• Goals: reduce peak electricity demand, cut emissions, and lower ratepayer costs
• Design: like an RPS, but different
• History: March 2018 - August 2020
• Some details still TBD

Source: DOER

CPS shifted wind energy generated overnight when prices and demand are lower to evening peak when demand is high.

2030 Winter Week With CPS

MA Electric Demand (MW)

Opportunity to shift clean energy to peak periods through storage

Monday  Tuesday  Wednesday  Thursday  Friday

Hydro  Solar PV  Offshore Wind  Clean Peak Storage  Clean Peak Change  Electric Demand

PRESS RELEASE

8/04/2020

Massachusetts Clean Peak Standard: Market Model
Final Report August 27, 2019

Baker-Polito Administration Launches First-in-the-Nation Clean Peak Energy Standard

Program Will Promote Use of Clean Energy When Costly

Electricity Demand is Highest
MA CPS Program Details

- Seasonal, daily 4-hour windows (see table)
- Demand – LSEs must meet % of elec with clean peak energy (see graph)
  - For 2020, 1.5% of eligible retail sales (contracts executed or extended on or after January 1, 2020, MLPs exempt)
  - Annual obligation will increase by 1.5% per year
  - Through 2050
- Banking – LSEs can bank up to 30% a year for up to three years
- Procurement – EDCs to procure at least 30% of obligation

<table>
<thead>
<tr>
<th>Season</th>
<th>Peak Season</th>
<th>Peak Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winter</td>
<td>12/1 to 2/28</td>
<td>4pm - 8pm</td>
</tr>
<tr>
<td>Spring</td>
<td>3/1 to 5/14</td>
<td>5pm - 9pm</td>
</tr>
<tr>
<td>Summer</td>
<td>5/15 to 9/14</td>
<td>3pm - 7pm</td>
</tr>
<tr>
<td>Fall</td>
<td>9/15 to 11/30</td>
<td>4pm - 8pm</td>
</tr>
</tbody>
</table>

**Graph:** CPS Demand (% of retail electric sales)
• Supply – MA-based or -focused renewables, storage, and DR are eligible
  1. New Renewables – RPS Class I, COD >1/1/19
  2. Existing Renewables – RPS Class I/II, COD <1/1/19 – co-located with QESS, >=25% MW, >=4-hour duration
  3. Qualified Energy Storage Systems (QESS) – COD >1/1/19, that primarily charge from renewable energy:
     1. Co-Location with a qualified renewable resource, >=75% of the storage MW
     2. Contractual pairing with a qualified renewable resource
     3. Charging during high renewable energy periods (see table)
     4. Operational schedule in the ISA showing resolves power issues
  4. Demand Response – Generators ineligible; storage & EV OK, active DR programs OK

<table>
<thead>
<tr>
<th>Clean Peak Season</th>
<th>Energy Storage Charging Windows</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Wind-Based Charging Hours</td>
</tr>
<tr>
<td>Spring</td>
<td>12am - 6am</td>
</tr>
<tr>
<td>Summer</td>
<td>12am - 6am</td>
</tr>
<tr>
<td>Fall</td>
<td>12am - 6am</td>
</tr>
<tr>
<td>Winter</td>
<td>12am - 6am</td>
</tr>
</tbody>
</table>
Multipliers
- Multipliers adjust the number of CPECs for each MWh of energy generated during the peak period to align generation with time periods and resource attributes of highest impact
  - Seasonal – Summer/Winter – 4x, Spring/Fall – 1x
  - Monthly System Peak – 25x (for hour)
  - Resilience – 1.5x
  - Existing – 0.1x
  - Contracted – 0.01x
  - SMART ES Resource – 0.3x
- Certificate price based on market
- Alternative Compliance Payment (ACP) (see graph)
- Annual compliance reporting
- Metering requirements
- Levers to adjust program
- Periodic program review
Analysis
Energy Storage System for CPS

- Energy Storage System (ESS) is a versatile technology that is uniquely suited to drive the goals of the Clean Peak Standard.
- ESS is a dispatchable resource and can therefore play an effective role in shifting clean energy to times of high demand on the grid.
- To Qualify for CPS, ESS can be both in a standalone, physically paired or contractually paired configuration with certain restrictions on charging.
- ESS can continue to participate in a variety of wholesale energy market value streams and yet continue to earn incremental revenues from the CPS.
- ESS resources can use a variety of dispatch strategies to benefit from the CPS, depending on the level of financial incentives provided by Clean Peak Energy Certificates (CPEC).
Dispatch Strategy Options for QESS

Dispatch Strategy I *

The most profitable combination of market services to maximize revenues

Dispatch Strategy II *

Daily Clean Peak Period between HE16-HE19

Dispatch Prioritized for Market Revenues (assuming total opportunity cost > $45)

Dispatch Prioritized for CPS & Market Revenues (assuming $45/Certificate, also the ACP)

* Sample dispatch day for a prototypical 1MW/4MWh ESS operating in Massachusetts
Prices of Clean Peak Energy Certificates (CPES) can have a significant impact to potential realizable revenues for a Qualified Energy Storage System.

* Sample single year revenue components for a prototypical 1MW/4MWh ESS operating in Massachusetts
<table>
<thead>
<tr>
<th>RE Resource Type</th>
<th>Program Eligibility (Contracted or Merchant?)</th>
<th>Assumed Nameplate Capacity (MW&lt;sub&gt;AC&lt;/sub&gt;)</th>
<th>Illustrative Value from CPEC @ 50% of ACP (assumed COD of 1/1/2021)</th>
<th>Scale of Near-Term Contribution to CPEC Market (qualitative)</th>
<th>Importance of CPS to Project Viability? (qualitative)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land Based Wind (LBW)</td>
<td>Merchant, no reductive “multiplier” assumed</td>
<td>2 MW</td>
<td>Total Levelized CPEC Revenue: $8.27/MWh</td>
<td>Limited (most in-state development has moved toward DG solar)</td>
<td>Material source of value, but unlikely to influence operation</td>
</tr>
<tr>
<td>Offshore Wind (OSW)</td>
<td>Contracted, will receive 0.01x contracted “multiplier”</td>
<td>800 MW</td>
<td>Total Levelized CPEC Revenue: $0.10/MWh</td>
<td>Substantial, but contribution to supply volume mitigated significantly by 0.01x contracted multiplier</td>
<td>De minimis (EDCs may not even attempt qualification)</td>
</tr>
<tr>
<td>DG Solar Not Paired w/QESS</td>
<td>SMART program tariff compensation, will receive 0.01x contracted “multiplier”</td>
<td>3 MW</td>
<td>Total Levelized CPEC Revenue: $0.04/MWh</td>
<td>See above cell</td>
<td>See above cell</td>
</tr>
</tbody>
</table>
### Illustrative Revenue Cases: Existing RE As of 1/1/2019 Required to Physically Pair w/ESS (“Category 2”)

<table>
<thead>
<tr>
<th>RE Resource Type</th>
<th>Program Eligibility (Contracted or Merchant?)</th>
<th>Assumed Nameplate Capacity ((\text{MW}_{\text{AC}}))</th>
<th>Illustrative Value from CPEC @ 50% of ACP (start date of 1/1/2021)</th>
<th>Scale of Contribution to CPEC Market (Qualitative)</th>
<th>Importance of CPS to project viability? (Qualitative)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DG Solar Paired w/QESS</td>
<td>Solar Carve-Out (SREC I) and Solar Carve-Out II (SREC II), will receive Existing (0.1x) “multiplier”</td>
<td>• 3 MW Solar • 1.5 MW 4-hour duration storage</td>
<td>Total Levelized CPEC Rev $/\text{MWh produced:}\ $17.03/\text{MWh}</td>
<td>Material (especially for demand charge management use cases), but not likely a major driver across the board</td>
<td>Relatively modest additional compensation relative to typical SREC compensation, but could have material influence on operations</td>
</tr>
<tr>
<td>LBW Paired w/QESS</td>
<td>Merchant, will receive Existing (0.1x) “multiplier”</td>
<td>• 2 MW LBW • 0.5 MW 4-hour duration storage</td>
<td>Total Levelized CPEC Rev $/\text{MWh produced:}\ $19.00</td>
<td>Unlikely to be as large as DG solar or OSW (is scaled to existing LBW fleet, which is more limited regionally than DG solar)</td>
<td>Could be highly valuable as additional revenue stream, and have significant influence over operations</td>
</tr>
</tbody>
</table>
## Illustrative Revenue Cases: New Renewables Physically (or “Virtually”) Paired with Energy Storage (“Category 1/3”)

<table>
<thead>
<tr>
<th>RE Resource Type</th>
<th>Program Eligibility (Contracted or Merchant?)</th>
<th>Assumed Nameplate Capacity (MW&lt;sub&gt;AC&lt;/sub&gt;)</th>
<th>Illustrative Value from CPEC @ 50% of ACP (start date of 1/1/2021)</th>
<th>Scale of contribution to CPEC market (qualitative)</th>
<th>Importance of CPS to project viability? (qualitative)</th>
</tr>
</thead>
</table>
| DG Solar Physically (or “Virtually”) Paired w/QESS | • SMART solar capacity receives 0.01x contracted “multiplier”  
• Paired ESS receives 0.3x SMART ES “multiplier” | • 3 MW solar  
• 1.5 MW storage w/4-hour duration | Total Levelized CPEC Revenue: $4.68/MWh | Likely to be major contributor in near term (given substantial paired solar and ESS projects in IC queues) | Likely to influence operations to a moderate degree, but not central to value proposition |
| OSW “Virtually Paired” w/QESS | • OSW receives contracted multiplier (0.01x)  
• “Virtually paired” Storage does not receive reductive “multiplier” | • 800 MW OSW,  
• 200 MW w/4-hour duration | Total Levelized CPEC Revenue: $17.32/MWh (but revenue assumed shared with storage resource due to “virtual pairing” arrangement) | Potentially major additional contributor (esp. as MA increases OSW procurements beyond 1,600 MW) | Could provide significant cost advantage if considered a part of combined resource/ESS bid in OSW procurements; operational impacts would depend on compensation under procurement |
Best Practices for Other States Considering a Clean Peak Standard
Best Practices for Other States Considering a CPS

• Best to first identify program goals, and then balance supplier value and cost to load, and benefits
• Best to be clear on resource eligibility
• Important to identify revenue gap for suppliers to better estimate project development and participation
• Having levers to adjust program parameters will be helpful
• Good to be clear on who owns program attributes
• Good to be clear on ability to participate in multiple programs, from all programs’ administrators
Thank you!

Coming soon:
Customized Energy Solutions & Sustainable Energy Advantage, Continuing Their Collaboration on MA Clean Peak Standard Analysis to Support the New CPS Market, Are Offering a Two-Part MA Clean Peak Standard Webinar Series:

Webinar 1: CPS Market Introduction & Early Insights
October 1, 2020, 12:30 pm ET

Webinar 2: Preliminary CPS Market Analysis
November (date TBD)

Email info@seadvantage.com for more information
This webinar was presented by the DOE-OE Energy Storage Technology Advancement Partnership (ESTAP)

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The Role of Hydropower in State Clean Energy Policy
*September 8, 2-3 pm ET*

Power After Carbon: Findings and Insights for State Policymakers
*September 9, 3-4 pm ET*

Innovative Pathways to Developing Solar+Storage in Low-Income Communities: Norfolk Solar’s Qualified Opportunity Zone Fund
*September 10, 1-2 pm ET*

Developing non-Lithium Ion Energy Storage Technologies to Support California's Clean Energy Goals
*September 24, 2020, 2-3 pm ET*

An Introduction to Virtual Power Plants
*September 28, 1-2pm ET*

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