

MA Clean Peak Standard: *Market Issues and Implications for Hydroelectric*

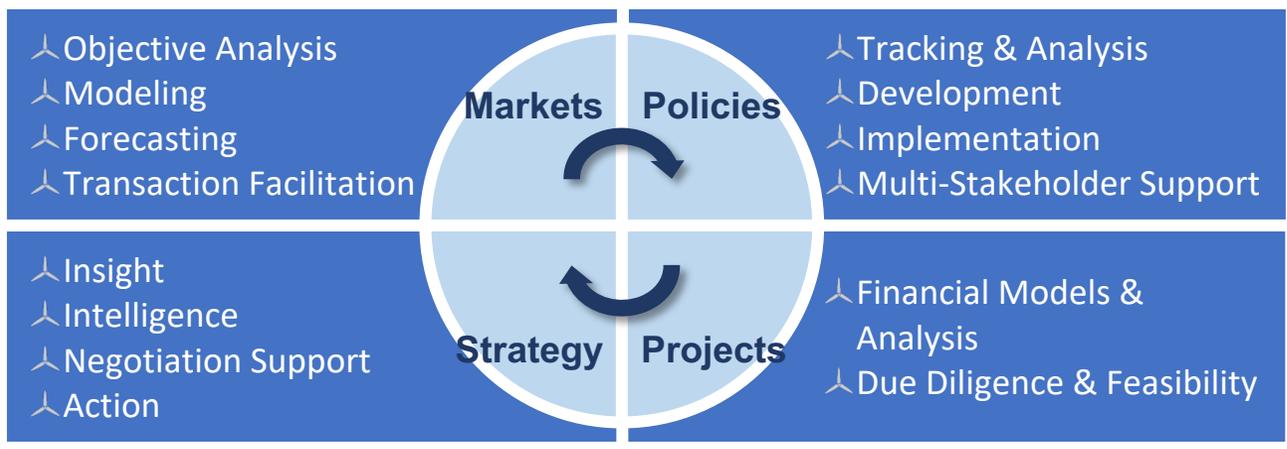
Webinar hosted by UMass-Lowell & the Low Impact Hydropower Institute
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Sustainable Energy Advantage, LLC

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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
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Northeast Eyes & Ears

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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!

Eligible Technologies

- “Cat1”: All RPS Class I w/ COD on/after Jan 1, 2019
- **“Cat2”:** *RPS Class I and RPS Class II w/ COD before Jan 1, 2019 paired with a Qualified Energy Storage System that has COD on/after Jan 1, 2019*
- “Cat3”: Standalone Qualified Energy Storage System that charges/discharges primarily from renewable energy
- “Cat 4”: Demand Response Resources (that are measurable and verifiable + do NOT generate electricity)

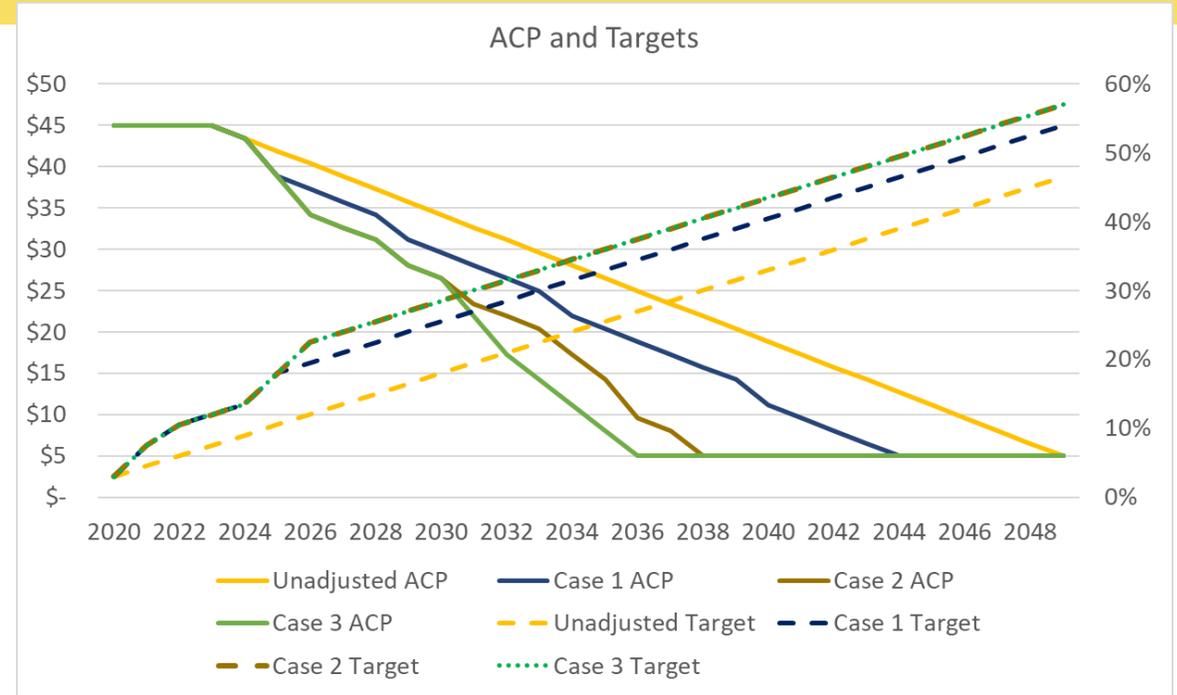
Access (Interconnection & Geography)

- **In MA:**
 - **Eligible:**
 - Interconnected to Distribution system in MA
 - Interconnected to Transmission system in MA (unless...)
 - **Not:** have an obligation to deliver outside
- **Out of MA**
 - **Eligible:** CP Resources that are “interconnected to the Transmission System” and “have an obligation to deliver to MA” sufficiently demonstrate that they will discharge to the Distribution System of MA
 - **Not:** no obligation to deliver to MA
- Key question: What constitutes an “obligation to deliver to MA”?



CPS Revenue = CPEC price * CPEC quantity

- Will CPS price be financeable?
- Hedged CPECs
 - 30% (15%-35%) of demand to be sought by EDCs under *periodic* long-term contract competitive procurements
 - Details *TBD*
- Market CPECs
 - Price = f(supply-demand, ACP, start date)
 - Market supply-demand difficult to discern this early
 - No firm price floor, but → self-correcting targets, ACP designed to support price
 - Spot price will often be below ACP
- Take-aways:
 - Unless hedged, confidence gained only through experience & market analysis
 - For revenue, earlier better than later



After 2024, ACP declines by \$1.54/CPEC, unless:

- If "Market Supply" between 100%-120% of target, the following year
 - Before 2030, the minimum standard would increase 4.5% in the following Compliance Year (3x the normal rate of increase)
 - ACP would decrease \$3.08/CPEC (2x the normal rate of decline).
- If "Market Supply" >120%:
 - Before 2030, the minimum standard would increase 4.5% in the following Compliance Year (3x the normal rate of increase)
 - ACP would also decline \$4.62/CPEC during that time period (3x the normal rate of decline).

Once the ACP reaches four dollars and ninety-six cents (\$4.96), it will hold fixed at that price for the remainder of the program

CPS Revenue = CPEC price * CPEC quantity

- # CPECs earned = function of:
 - eligibility category
 - project configuration
 - multipliers
 - performance during peak periods
- CPEC earnings →
 - see illustrative use cases
- Multipliers
 - Seasonal (x1/4)
 - Monthly peak hour (x25)
 - Existing (Cat 2) (x0.1)
 - Contracted (any category)(x0.01)
 - Resilience (backup power to onsite load)
 - Distribution circuit



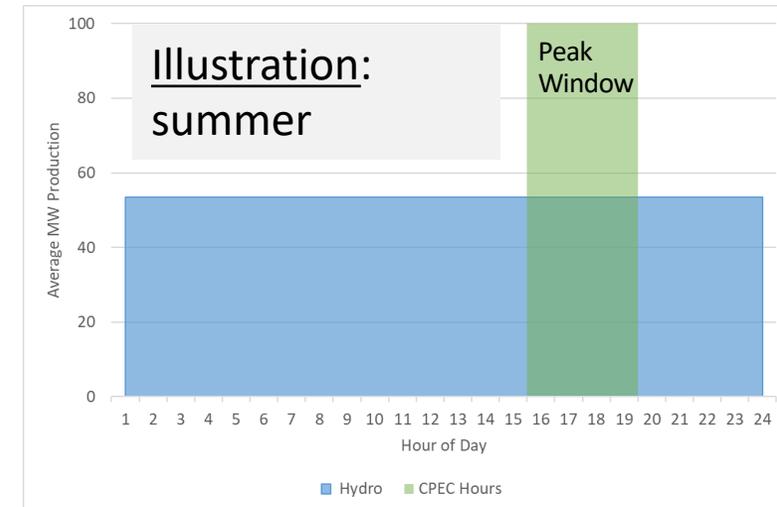
Lowell Hydroelectric Project. Source: LIHI

Cat 1: New or Upgraded MA RPS Class 1 hydro

- **CPS Opportunity:** Additional revenue stream for new/upgraded renewable resources. *Not required but can also be paired with Cat 3 QESS.*
- **Resource Potential:** Incremental opportunities -
 - Upgrade or new powerhouses not requiring new impoundment: Resource already heavily exploited: 2003 INEEL study: of 2155 sites identified → 2 in MA (2 MW)
 - Many costly, hard to site, require long lead time
 - Limited additional small upgrade or conduit sites?
- **Incentive for investment:** Levelized CPEC Revenue \$/MWh produced
 - Ex: 1 MW ROR, COD 2023
 - \$3.60/MWh (25% of ACP) to \$10.81 (75% of ACP)
 - (or, NPV of \$123 to \$370/kW over 20 years @ 10% discount rate)
- **Project design & operations:** Design project and manage operations to maximize performance in CP windows (e.g., can impoundment be utilized?); design for storage, operate in CP windows
- **O&M:** enhanced incentive re: scheduling / strategy in non-CP windows
- **Considerations & issues, open questions:**
 - For non-MA, eligibility via contracting for delivery into MA via EDC procurements or other contractual structures. What will be sufficient to constitute delivery? Would financial structures of most EDC long-term contracts (which typically deliver to the generator pricing node and do not require physical delivery) be sufficient? What if “delivered” to a MA pricing node, e.g., MA HUB?

Resource Potential		
	MA (#/ MW)	Northeast (#/MW)
Certified since 1/2019 ¹	0/0	10/14
Incremental ROR ²	2/2	109/471
Incremental, total ²	2/2	132/709

Sources: (1) DOER; (2) 2003 Idaho National Engineering and Environmental Laboratory Hydropower Resource Economics Database (IHRED) study



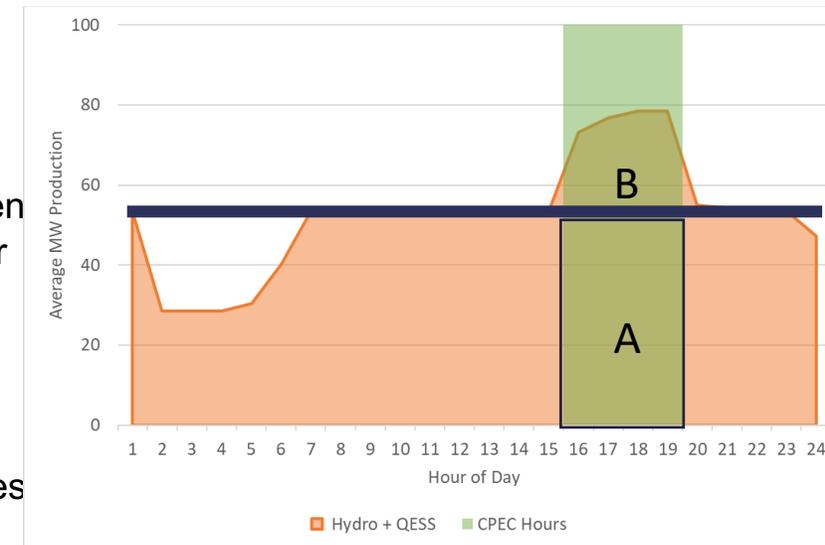
Use Case:

Cat 2: Existing MA RPS Class 1 or Class 2 hydro

- **CPS Opportunity:** Add co-located QESS to existing sites (if sufficient physical/interconnection space)
 - Additional revenue stream for to be shared by existing (pre- Jan. 2019 COD) RE resources when paired w/ new (post-Jan. 2019) QESS (either co-located or virtually) with capacity of *at least 25% of the RE capacity and at least 4-hr duration or equivalent*
- **Resource Potential:**
 - Certified existing Class I or Class II supply
 - Additional Class II 2 supply that may become certified
- **Incentive for investment:** Ex: 2 MW “MA typical” ROR hydro; 0.5 MW 4-hour duration ‘perfect’ storage, → NPV of CPEC revenue over 20 years @ 10% discount rate for 25% - 75% of ACP:
 - [B] Storage Alone: \$68 - \$204/kWh of storage
 - [A]Hydro Resource (0.1x existing multiplier): \$12 - \$37/kWh of storage
 - [A+B] Total: \$80 - \$241/kWh of storage
- **Project design & operations**
 - Operate both RE & QESS to maximize performance in CP windows (e.g., can impoundment be utilized?); or design for QESS to maximize CP windows and RE is essentially free-rider
- **O&M:** Enhanced incentive re: scheduling / strategy
- **Considerations & issues, open questions**
 - For non-MA, eligibility via contracting for delivery into MA via EDC procurements or other contractual structures?
 - Interconnected to T system: ‘excess capacity’ / incremental capacity interconnection request
 - Interconnected to D system: Can existing interconnection accommodate w/o material modification (guidance from DPU Docket 19-55)

Resource Potential		
	MA (#/ MW)	Northeast (#/MW)
Certified Class 1 hydro	20/14.7	53/67
Certified Class 2 hydro	36/67.6	139/325

Source: DOER



Cat 3 Stand Alone Qualified Energy Storage System

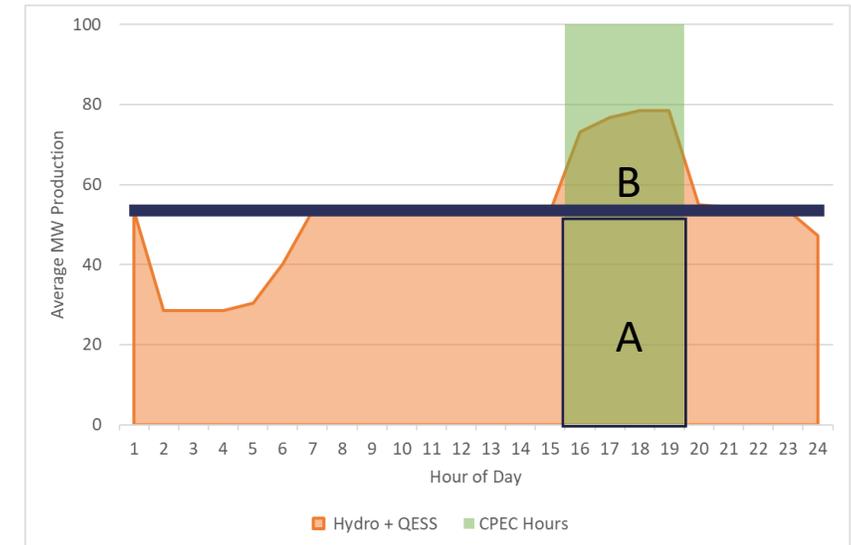
- **CPS Opportunity:** Additional revenue stream for new QESS *if primarily charged from renewable energy*
- **Resource Potential:** limited only by quantity of renewables with which to pair
- **Incentive for investment:** Ex: 50 MW, 4 hr duration ‘perfect’ storage NPV of CPEC revenue over 20 years @ 10% discount rate, for 25% - 75% of ACP → \$68 - \$204/kWh
- **Project design & operations** – maximize operations of both RE & QESS to maximize performance in CP windows (e.g., can impoundment be utilized?); or design for QESS to maximize CP windows and RE is essentially free-rider

	<i>Energy Storage Charging Windows</i>	
<i>Clean Peak Season</i>	<i>Wind-Based Charging Hours</i>	<i>Solar-Based Charging Hours</i>
<i>Spring</i>	<i>12am - 6am</i>	<i>8am - 4pm</i>
<i>Summer</i>	<i>12am - 6am</i>	<i>7am - 2pm</i>
<i>Fall</i>	<i>12am - 6am</i>	<i>9am - 3pm</i>
<i>Winter</i>	<i>12am - 6am</i>	<i>10am - 3pm</i>

- **O&M: Must charged primarily from RE by**
 - 1) Co-location with a Qualified RPS Resource (Cat 1 or Cat 2)
 - 2) Contractual pairing with a Qualified RPS Resource (Cat 1 or Cat 2)
 - 3) Charging coincident with periods of typically high renewable energy production
 - 4) Inclusion of an operational schedule in the QESS’s ISA demonstrating that the QESS serves to resolve load flow or power quality concerns otherwise associated with intermittent renewable energy resources.
- **Considerations & issues, open questions**
 - Will there be opportunity to earn anything through virtual pairing?
 - Without the timing option for Cat 3, maybe... but timing option may undercut, unless physical or interconnection synergies or a more flexible charging profile is worth an ESS giving up a share of rev to virtual RE partner - could this be the case?

Cat 1 + Cat 3

- **Opportunity:** Additional revenue stream for new paired (collocated or virtually) RE & QESS (compared to pre-CPS) if primarily charged from renewable energy.
- **Incentive for investment?** For a 2 MW “MA typical” ROR hydro; 0.5 MW 4-hour duration ‘perfect’ storage → NPV of CPEC revenue over 20 years @ 10% discount rate for 25% - 75% of ACP:
 - [B] Storage Alone: \$68 - \$204/kWh NPV
 - [A] Hydro Resource: \$124-\$371/kWh NPV
 - [A + B] Total: \$192-575/kWh NPV



• Considerations & issues, open questions

- Will there be opportunity to earn anything through virtual pairing?
- Benefits on the cost side (Interconnection, permitting) on the revenue side (more capacity value?)
- Without the timing option for Cat 3, maybe... but timing option may undercut, unless a more flexible charging profile is worth an ESS giving up a share of rev to virtual RE partner - could this be the case?

Opportunities to Learn More:

Coming soon:

Two-Part Mass 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)

*A collaboration between Customized Energy Solutions &
Sustainable Energy Advantage*

*Continuing Their Collaboration on MA Clean Peak Standard Analysis
to Support the New CPS Market*

Email info@seadvantage.com for more information



**Clean Peak Standard
Market Fundamentals
Analysis Service**
Coming in December 2020



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