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COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF ENERGY RESOURCES
Elizabeth Mahony, Commissioner

Energy Storage Policies and Programs in Massachusetts

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December 7, 2023

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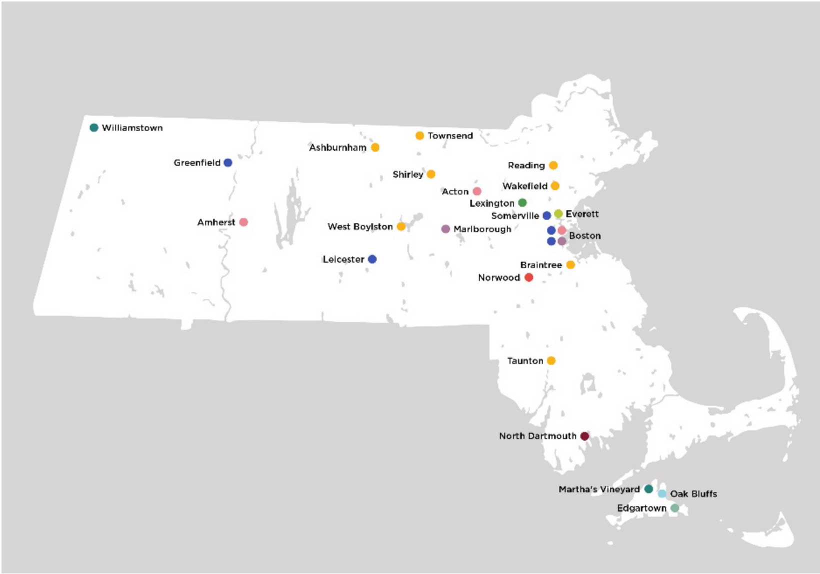
Overview of ESI and Energy Storage Programs

- **Energy Storage Initiative (ESI)**
  - **2016**: Published *State of Charge* report, which firmly established the many value propositions of energy storage
  - **2017**: Created the $20M Advancing Commonwealth Energy Storage (ACES) program to fund pilot and demonstration projects for a range of energy storage use cases across the Commonwealth
  - **2018**: established a target of 1,000 MWh of energy storage by December 31, 2025
- **Clean Peak Energy Standard (CPS)** **(2020)**: Incentivizes renewable generation dispatch during peak hours each season; storage that charges primarily from renewable energy qualifies
- **SMART Storage Adder** **(2018)**: Primarily a solar incentive program, includes an adder for energy storage paired with solar
- **ConnectedSolutions** **(2019)**: Demand response program offering incentives based on performance during calls. Managed by Energy Efficiency Advisory Council (EEAC)

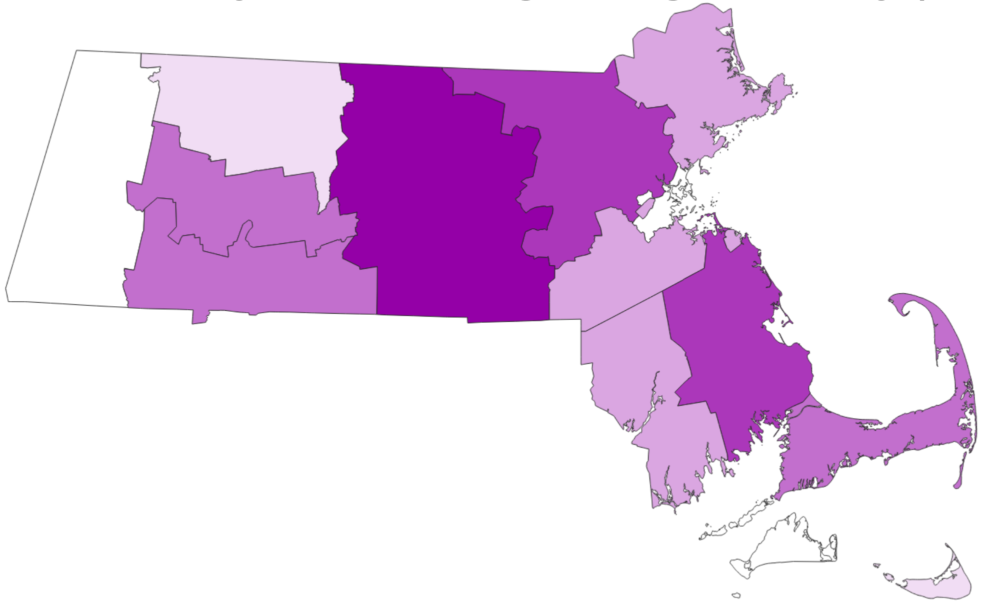
ACES Installations



Energy Storage Deployments and 2025 Target Progress

- The majority of existing storage in the state comes from two pumped hydro facilities built in the 1970s, which have a combined capacity of nearly 1,800 MW, and average duration of 7 hrs.
- The remaining ~300 MW of existing storage are mostly small (<5 MW), front-of-meter Li-Ion installations, clustered in Worcester, Middlesex, and Plymouth counties
  - Many of these are co-located with solar, and have been developed since the launch of the SMART incentive program
- Interconnection queue (not shown) indicates a similar geographic development focus, with many larger storage projects proposed
- As of February 2023, EDCs have reported 550 MWh of deployed storage toward the 1,000 MWh by 2025 target

Total Non-Hydro Operating Storage Capacity (MW)

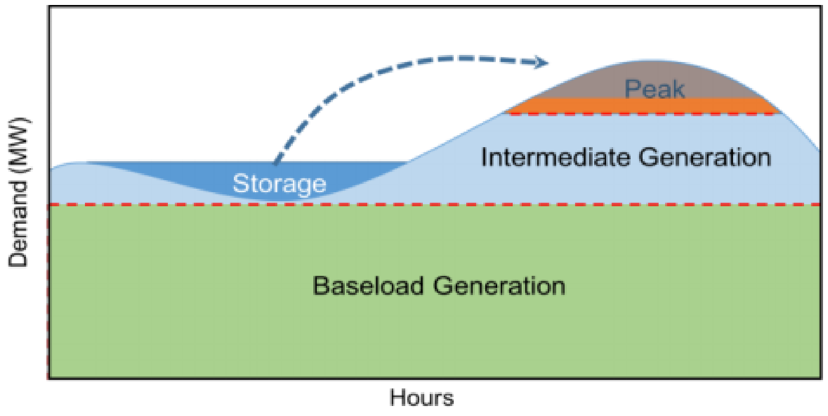


Resource Connection Type	Capacity (MW)	Energy (MWh)	Avg. Duration (Hrs.)
Front of Meter	2,028	13,488	7
Behind the Meter	50	45	1
Total	**2,078**	**13,533**	**n/a**
Additional Resources (<0.5 MW)	37	24	1

Technology	Capacity (MW)	Energy (MWh)	Avg. Duration (Hrs.)
Hydroelectric Pumped Storage	1,768	12,944	7
Lithium-Ion Battery	282	565	2
Sodium-Ion Battery	18	15	1
Thermal Storage	3	1	0
Vanadium Redox Flow Battery	1	3	6
Zinc Iron Flow Battery	-	-	-
Latent Heat Storage	-	-	-
Flywheel	-	-	-
Battery (Unspecified)	2	5	2
Total (Pumped Hydro Excluded)	**307**	**588**	**n/a**
Additional Resources (<0.5 MW)	37	24	n/a

Clean Peak Energy Standard (CPS)

- **Objective**: Reduce cost and emissions impacts of peak demand through renewables, energy storage, and demand response
- **Mechanism – Market-based**
  1. Eligible resources that generate, dispatch or discharge energy during **Seasonal Peak Periods** will generate **Clean Peak Energy Certificates (CPECs)**
  2. All electricity suppliers must annually purchase a certain number of Clean Peak Energy Certificates (CPECs) relative to their load served
- **Seasonal Peak Periods** – Late afternoon to evening
  - **Winter** (Dec. 1 – Feb. 28): 4pm – 8pm
  - **Spring** (Mar. 1 – May 14): 5pm – 9pm
  - **Summer** (May 15 – Sept. 14): 3pm – 7pm
  - **Fall** (Sept. 15 – Nov. 30): 4pm – 8pm



Existing CPEC Multipliers

Mainly meant to further incentivize certain behaviors and deployments

- **Seasonal Multiplier:** Seasonal multipliers are established for each Clean Peak Season to reflect the level of emissions and magnitude of peak demands in a season
  - **4x** Summer/Winter
  - **1x** Spring/Fall
- **Actual Monthly System Peak Multiplier:**
  - **25x** for performance coincident with highest single hour of demand in the month
- **Resilience Multiplier:**
  - **1.5x** provided to resources that increase resilience to outages
- **Existing Resource Multiplier**
  - **0.1x** applied to existing renewable resources
- **Contracted Resource Multiplier**
  - **0.01x** applied to state contracted renewable resources
- **SMART ES Resource Multiplier**
  - **0.3x** applied to SMART energy storage resources
- **Distribution Circuit Multiplier**
  - Guideline to be released imminently, applied to specific constrained circuits on distribution system

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CPS Participating Resources – October 2023

Technology	Qualified Systems	Capacity (MW)
Energy Storage	49	147
Demand Response	282	59
RPS Resources	12	31
Total	**343**	**237**

- **Demand Response**: Has mainly been building load curtailment, but this year have begun to see EVs qualify and participate
- **Energy Storage**: Largely < 5 MW batteries paired with solar through SMART, though 1 pumped hydro expansion of 33 MW
- **RPS Resources**: Comprise PV, onshore wind, and anaerobic digesters. Largest capacity is a 5.6 MW PV system.

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Solar Massachusetts Renewable Target Program (SMART)

- Declining block program that pays owners fixed $/kWh for solar energy produced
- Storage adder increases $/kWh paid for solar energy produced if storage meets following criteria
  - At least 2 hours duration
  - At least 65% RTE
  - At least 25% of the capacity of the solar its paired with
  - At least 52 cycles per year
- May 2023: Estimated 446 MWh energy storage participating
- Incentive focuses on deploying storage with solar, not on operations

ConnectedSolutions

- Demand response program where customers respond to peak event signals from utilities during summer
- Residential
  - 30-60 events may be called per season during 3-8pm lasting no more than 3 hours
  - Receive $275/kW of dispatch performed, averaged over all calls in a season.
- Commercial – Have 2 enrollment options
  - Daily Dispatch: Max 60 events, $200/kW incentive
  - Targeted: Max 8 events, $35/kW incentive
- Start of 2023: 2,900 energy storage customers enrolled, totaling 30.7 MW

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Charging Forward: New Energy Storage Study

New study, required by legislature with analyses led by consulting firm E3, addresses three broad questions:

1. **What is the current state of energy storage in the Commonwealth?**

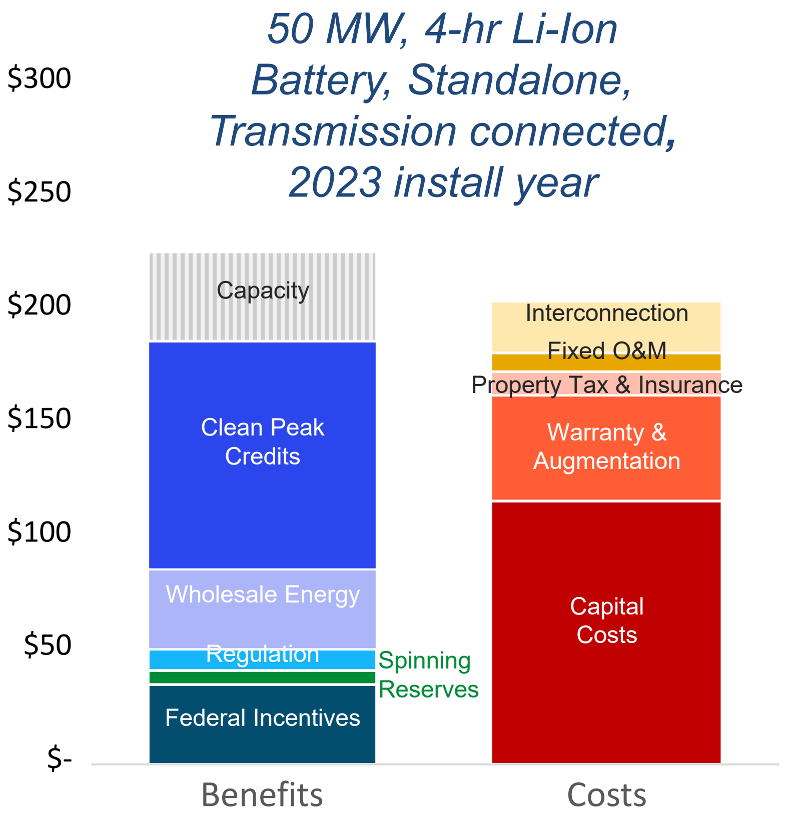
   Example Sub-Questions Investigated
   - *What are the costs and benefits of current use cases for energy storage?*
   - *What barriers exist to further deployment and use, and what are the recommended mitigation actions by the state?*

2. **What are potential applications of mid- and long-duration energy storage?**
   - *How can mid- and long-duration energy storage (M/LDES) contribute to reliability in a decarbonized system?*
   - *What are the emission benefits of M/LDES technologies?*

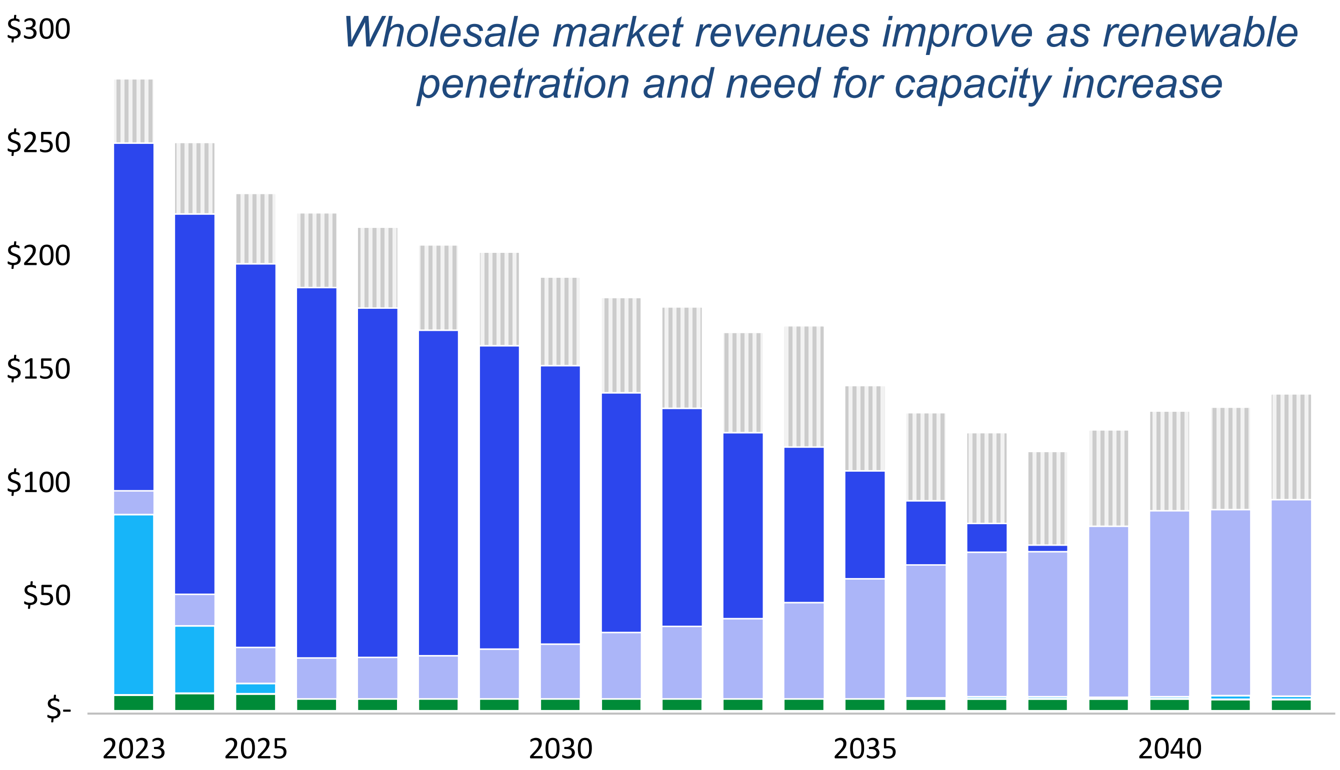
3. **What is the market outlook for emerging mid- and long-duration energy storage (M/LDES) technologies?**
   - *What is the level of maturity for various emerging M/LDES technologies?*

Cost-Benefit Analysis (CBA): Tx-connected standalone

Levelized revenues & costs - developer view
($2022/kW-yr.)

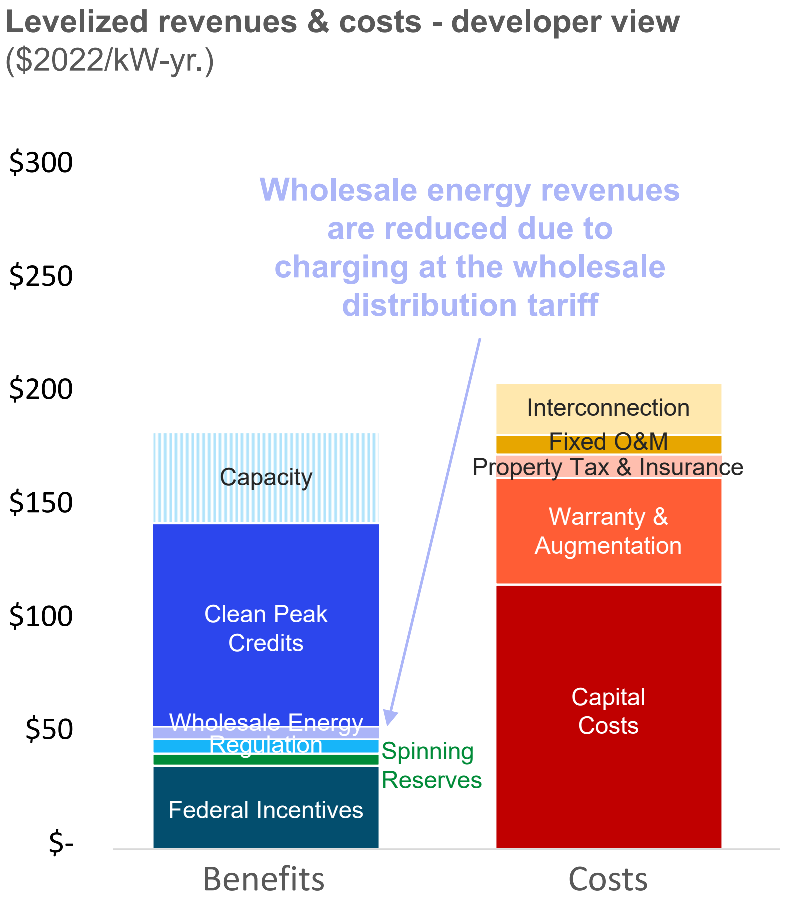


Annual revenues - developer view
($2022/kW-yr.)

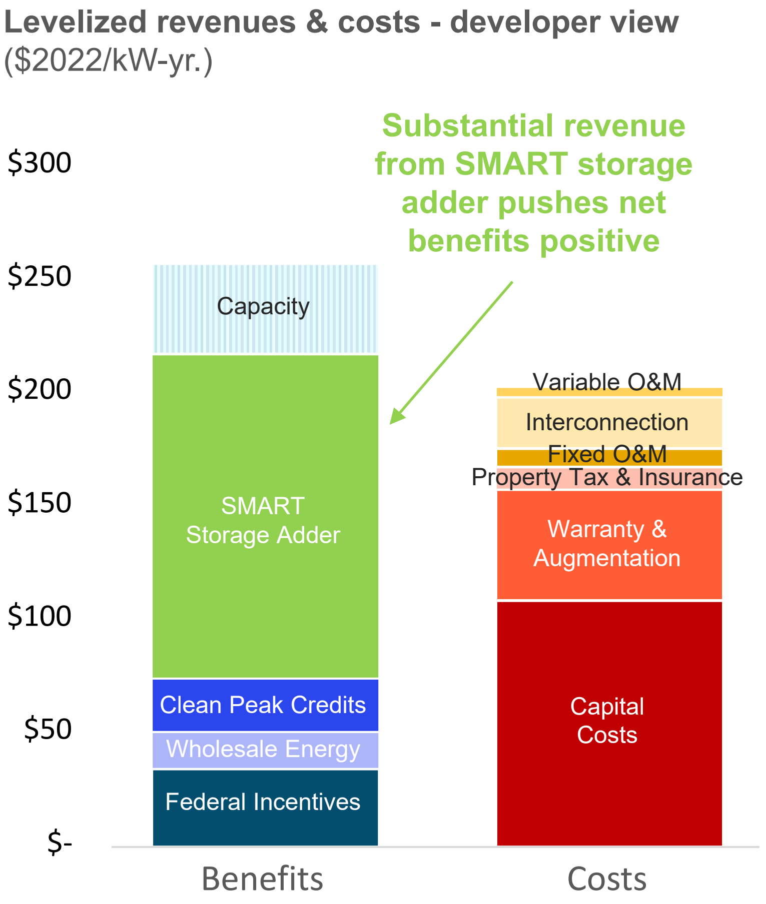


- **Challenge**: Lack of long-term certainty in CPS challenges benefit realization

CBA: Dx-standalone and Dx-solar+storage



*5 MW, 4-hr Li-Ion Battery, **Standalone**, Distribution connected, 2024 install year*



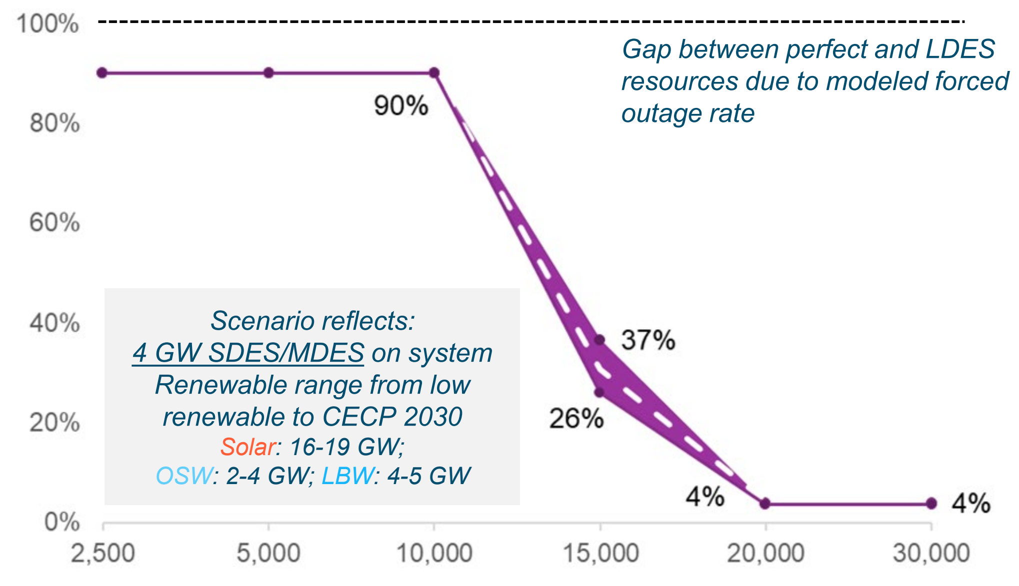
*1 MW, 4-hr Li-Ion Battery, **Paired with 4 MW solar***, *Distribution connected, 2024 install year*

*Costs/benefits shown are incremental costs/benefits of storage component of solar+storage installation

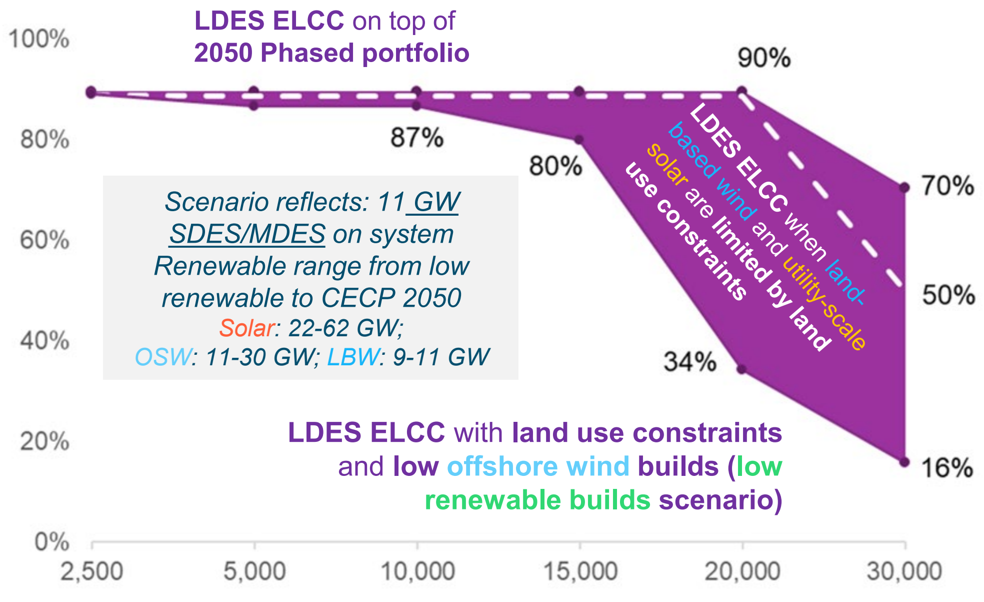
Long Duration Energy Storage (LDES) ELCC in 2030 and 2050 for New England

- Long duration (e.g., 100-hour) energy storage ELCC (i.e., capacity value) remains high in low penetrations but then declines sharply at in 2030 as total additions shave peak and flatten the net load profile
- In 2050, the difference between LDES ELCC under CECP phased portfolio and low renewable builds scenario is substantial at higher penetrations when LDES recharging capability is limited, and system requires storage to dispatch even longer for effective peak-shaving

Long Duration Energy Storage Incremental ELCC, 2030 *(%)*

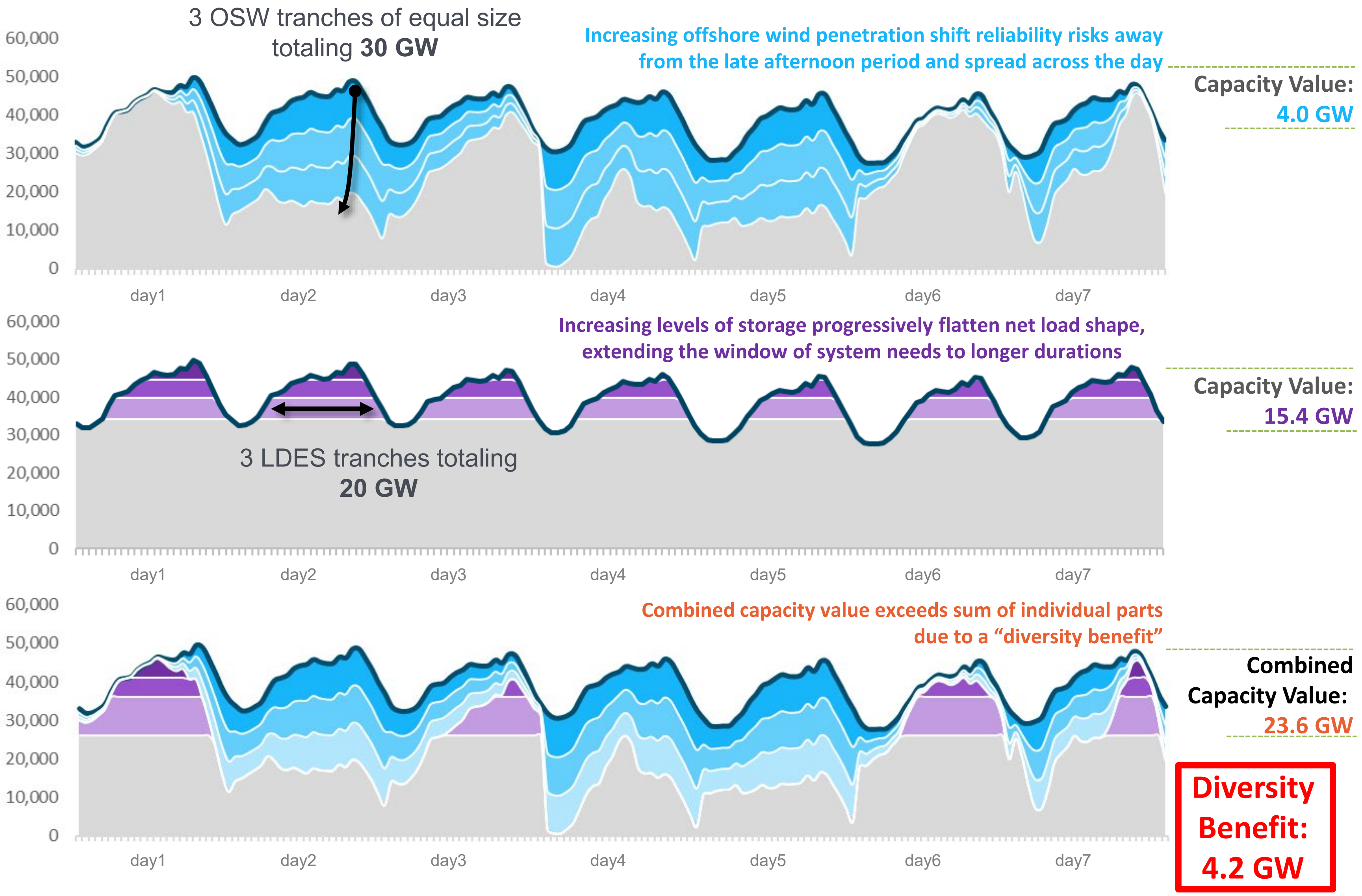


Long Duration Energy Storage Incremental ELCC, 2050 *(%)*



Diversity Benefit: Offshore Wind (OSW) and LDES

- The complementary interaction between renewable and energy storage resources can create diversity benefits where total ELCC is greater than the sum of its parts
- Diversity benefit between OSW and LDES is a main driver of LDES ELCC, especially at high penetration



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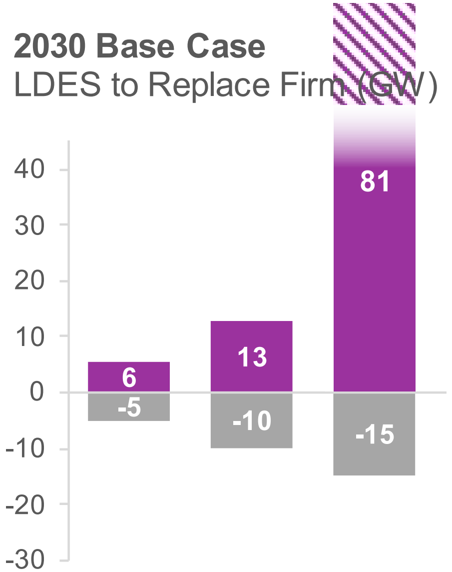
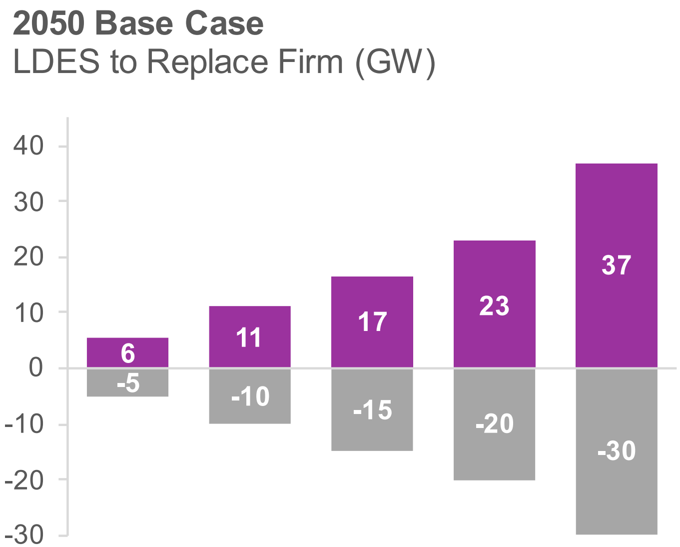
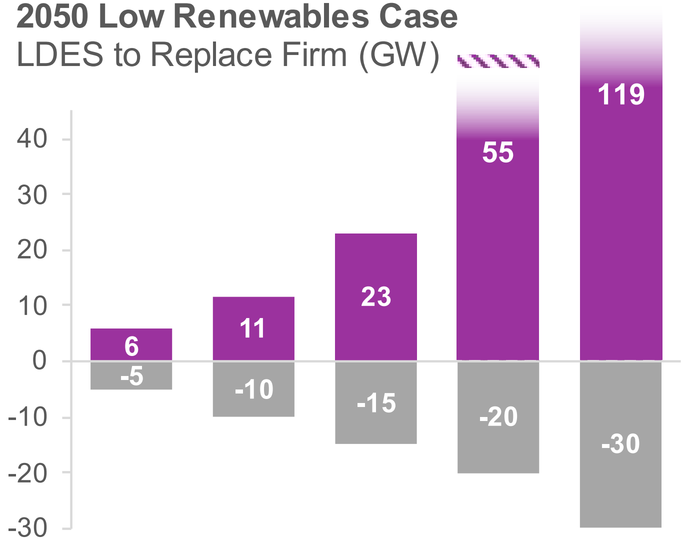
LDES Supplanting Firm Capacity

- If New England hits renewable build-outs in line with the CECP 2050, 10-20 GW of 100-hour storage have the ability to substitute for theoretical “perfect” firm capacity on a nearly 1:1 basis
  - ➢ Large jump in LDES capacity needed to firm in 2050 Base vs. Low Renewables cases due to not having enough renewables, yielding rapidly declining capacity values







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Study Next Steps + Thanks

- Delivering study and recommendations by December 31, 2023
- Policy implementation with continued stakeholder process in 2024

Thank you!