BREAKTHROUGH LOW-COST, MULTI-DAY ENERGY STORAGE

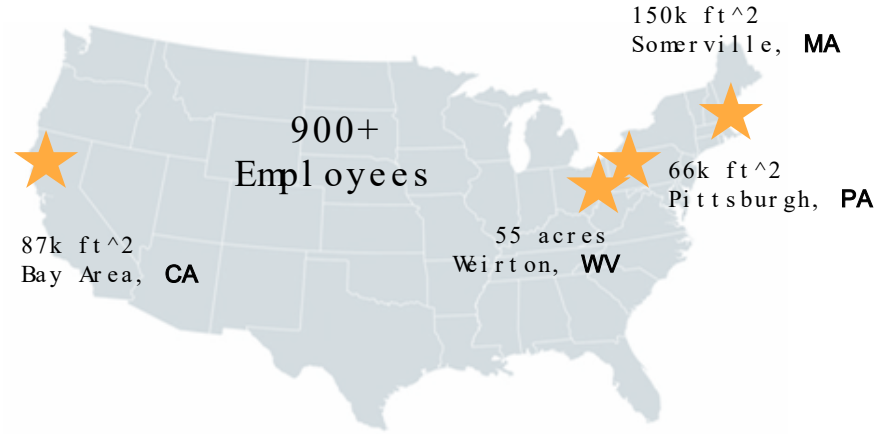
Sarah Jackson, Senior Policy Manager

June 24, 2025

Form energy

Energy Storage
For A Better World

Form Energy Overview



OUR INVESTORS: LONG-TERM AND IMPACT-FOCUSED

$1.2B+ in venture capital from top investors including: T. Rowe Price, GE Vernova, Breakthrough Energy Ventures (BEV), TPG's Climate Rise Fund, Coatue Management, GIC, NGP Energy Technology Partners III, ArcelorMittal, Temasek, Energy Impact Partners, Prelude Ventures, MIT's The Engine, Capricorn Investment Group, Eni Next, Macquarie Capital, Canada Pension Plan Investment Board, and other long-term, impact oriented investors

LED BY ENERGY STORAGE VETERANS

Decades of cumulative experience in energy storage with 100's of MW of storage deployed

TESLA ENERGY

A123 SYSTEMS

SUNPOWER FROM MAXEON SOLAR TECHNOLOGIES

24M

NEXTera ENERGY

amsc

Massachusetts Institute of Technology

AQUION ENERGY

The Challenge

New England needs clean, firm sources of energy

Extreme weather events have become more frequent and disruptive

Power supply is becoming tighter

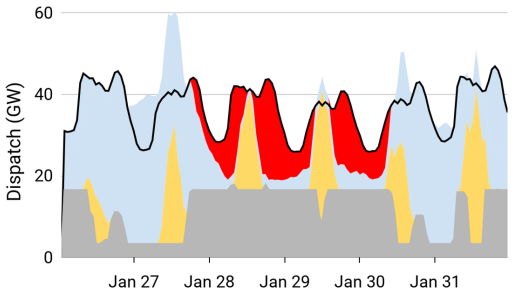
Intermittent resources need firming up

Transmission congestion and interconnection queues are increasing

The grid is increasingly vulnerable to multi-day reliability risks driven by weather

Prolonged energy scarcity for 24+ hour periods

Example: ISO-NE winter wind lull[1]

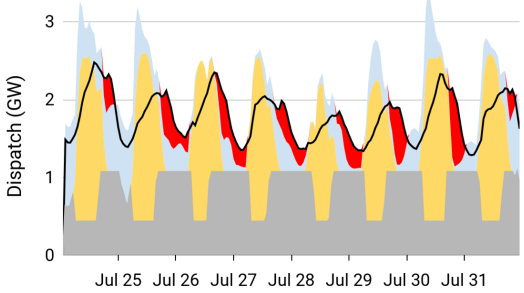


The challenge: Continuous periods of high net load or fuel shortages/price spikes can put the grid at risk of outage for 24+ hour periods.

Causes: multi-day wind generation lulls, winter storms (resulting in demand surges and fuel scarcity)

Back-to-back days with 8+ hours of tight conditions

Example: WECC utility during summer week[2]

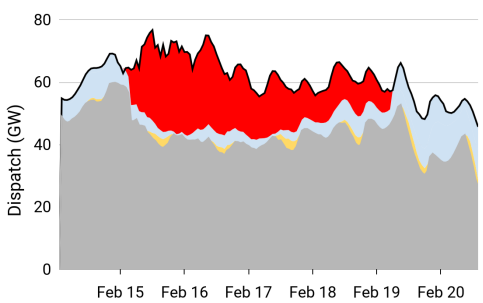


The challenge: Back-to-back days of high peak demand results in reliability risks during afternoon & evening hours. The system has insufficient energy to fully recharge short-duration batteries each day.

Causes: multi-day heat waves, multi-day stretch of low solar output

Extreme weather events lasting several days

Example: ERCOT Winter Storm Uri[3]



The challenge: Extreme weather events can result in prolonged grid failure, creating a need for firm energy reserves that can be dispatched for several days.

Causes: extreme storm conditions (e.g. Uri, Elliot, etc.) resulting in multi-day thermal outages, renewable outages, and/or limited regional import availability

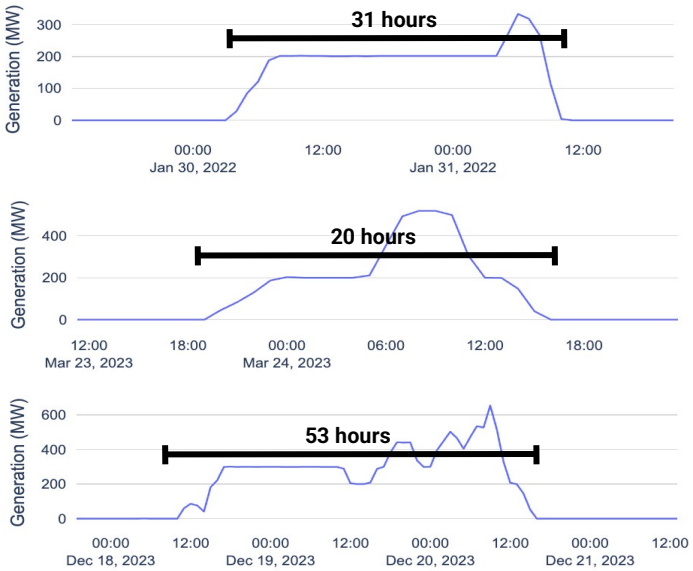
Load
Thermals
Solar
Wind
Energy shortfall

[1] Full study available at Wilson *et al.*, "Clean, Reliable, Affordable: The Value of Multi-Day Storage in New England," September 2023.
[2] Operational simulation in Formware™ of 2035 WECC utility portfolio
[3] Historical ERCOT operational data during Winter Storm Uri from EIA-930

Now more than ever, the grid needs resources than can deliver multi-day reliability

Historically, coal and gas generators have been dispatched over multi-day periods to keep the grid reliable

2022-23 dispatch of Southeastern Utility “reliability-only” gas peaker



Rapid changes to the grid are creating an acute need for new multi-day reliability assets

Rapid load growth driven by electrification and large C&I loads, with a 38 GW increase in US peak demand forecasted by 2028(2)

Increasing supply from intermittent renewables, with renewable share of total US electricity supply expected to increase to 49% by 2030(3)

Retirement of aging thermal generators, with 96 GW (~12%) of US fossil and nuclear capacity expected to retire by 2028(1)

Increasing exposure to extreme weather events, with the number of billion-dollar climate events in the US increasing by 68% over the last decade(4)

Sources: (1) North American Electric Reliability Corporation, “2023 Long-Term Reliability Assessment,” December 2023 & U.S. Energy Information Administration, “Electricity explained: Electricity generation, capacity, and sales in the United States”. (2) Wilson & Zimmerman, “The Era of Flat Power Demand is Over,” December 2023. (3) U.S. Energy Information Administration, “Annual Energy Outlook 2023”. (4) NOAA National Centers for Environmental Information, “US Billion-Dollar Weather and Climate Disasters,” as of June 2024.

Multi-day Storage is a low-cost energy reservoir for the electricity grid

	Multi-day Storage *Example: 100 hr Iron-air Battery*	Intra-day LDES *Example: 12 hr Flow Battery*	Short-duration storage *Example: 4 hr Li-ion Battery*	Comparison
Energy capacity / duration How much energy can the reservoir hold?	1 MW = 100 MWh stored energy = 100 hours of continuous energy supply 	1 MW = 12 MWh stored energy = 12 hours of continuous energy supply 	1 MW = 4 MWh stored energy = 4 hours of continuous energy supply 	Multi-day storage holds **25x more energy** than short-duration storage with the same MW capacity
Cost How much does the reservoir cost, in terms of energy (duration) and capacity (max output)?	~$20 per kWh of energy (reservoir size) ~$2,000 per kW of power (reservoir max output)	~$150 per kWh of energy (reservoir size) ~$2,000 per kW of power (reservoir max output)	~$250 per kWh of energy (reservoir size) ~$1,000 per kW of power (reservoir max output)	Multi-day Storage stores energy at **~1/10th the cost** of a short-duration battery

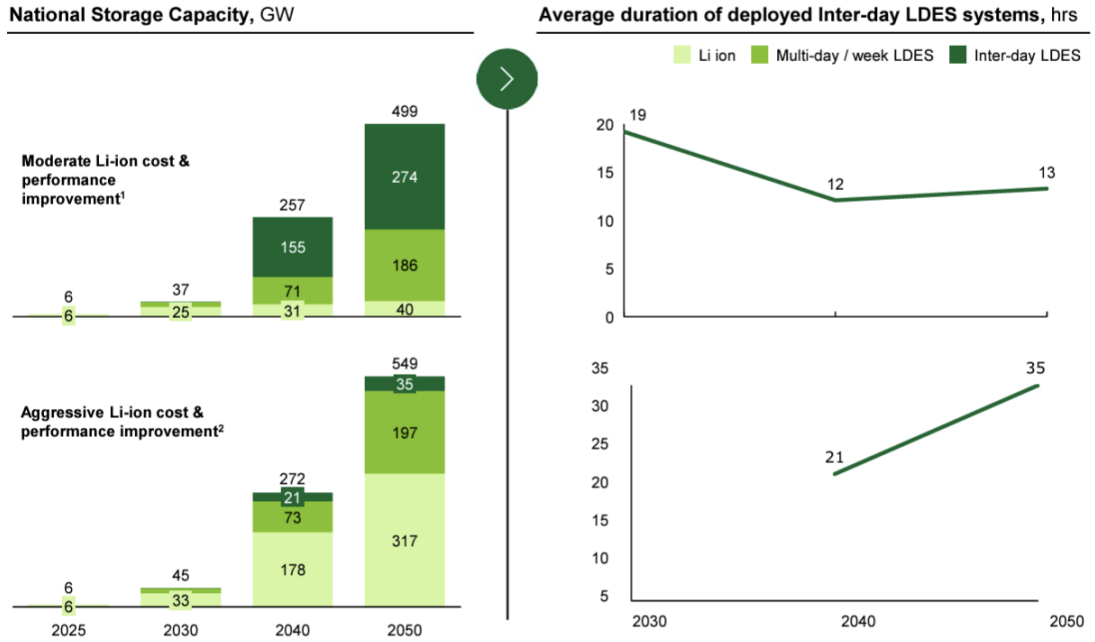
Needs for Multi-Day Storage & Long-Duration Storage Nationally

From 2040 to 2050, 28-35% of national storage needs will be from multi-day storage (DOE)

- Defines
  - *inter-day LDES: 10-36 hrs*
  - *multi-day LDES; >36-hrs*
- 2040-2050 US storage needs
  - *88-92% is LDES in base case (both inter-day and multi-day)*
  - *34-42% is LDES in low li-ion cost case (both inter-day and multi-day)*
  - *Needs for multi-day storage remain constant regardless of li-ion price scenario: 28% to 37% of storage needs from 2040-2050*

US DOE Storage Scenarios to Achieve 2050 Net Zero GHGs

Li - ion price sensitivities*



*DOE Pathways to Commercial Liftoff LDES report, p. 17

LONG DURATION ENERGY STORAGE TECHNOLOGIES

Long duration energy storage (LDES) technologies store electricity for 10+ hours. They can complement intermittent renewables, boost grid resilience, and reduce fossil fuel dependency.

Here, we show the characteristics of those that have commercial or pre-commercial readiness.

LDES technologies are often categorized into **four primary types** of energy storage

MECHANICAL
Stores potential energy

	Storage Capacity Megawatts (MW)	Nominal Duration	Average Round-Trip Efficiency Ratio of energy output to energy input	Market readiness
UNDERGROUND PUMPED HYDRO	10–100	0–15 hours	50–80%	Mature
LIQUID AIR	50–100	10–25 hours	40–70%	Pre-commercial
ABOVEGROUND PUMPED HYDRO	200–400	0–15 hours	70–80%	Mature
LIQUID CO_2	10–500	4–24 hours	70–80%	Pre-commercial
COMPRESSED AIR	200–500	6–24 hours	40–70%	Commercial
GRAVITY-BASED	20–1,000	0–15 hours	70–90%	Pre-commercial

THERMAL
Stores heat energy

	Storage Capacity	Nominal Duration	Average Round-Trip Efficiency	Market readiness
SENSIBLE HEAT	10–500	200 hours	55-90%	Commercial

CHEMICAL
Stores energy within chemical bonds

	Storage Capacity	Nominal Duration	Average Round-Trip Efficiency	Market readiness
POWER-TO-GAS-TO-POWER	10–100	500–1,000 hours	40–70%	Commercial

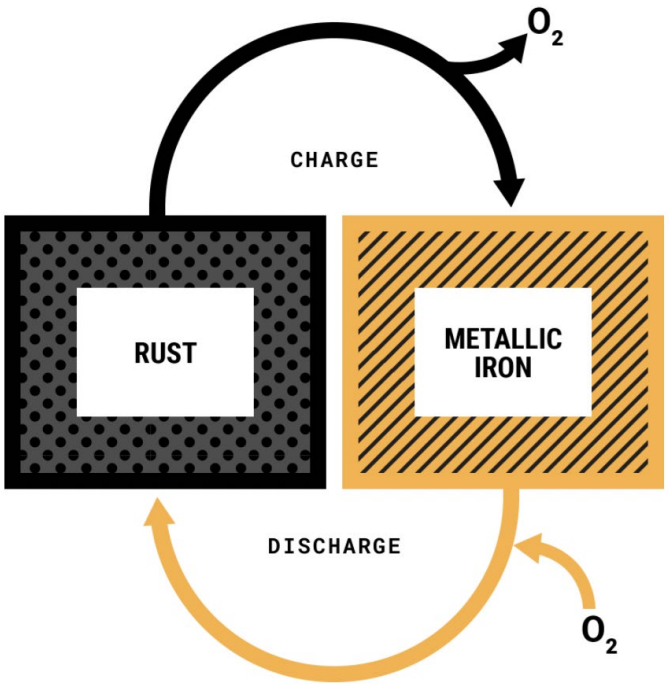
ELECTROCHEMICAL
Stores energy of chemical reactions (batteries)

	Storage Capacity	Nominal Duration	Average Round-Trip Efficiency	Market readiness
AQUEOUS ELECTROLYTE FLOW BATTERY	10–100	25–100 hours	50–80%	Commercial
METAL ANODE BATTERY	10–100	50–200 hours	40–70%	Commercial
HYBRID FLOW BATTERY	>100	8–50 hours	55–75%	Commercial

Source: https://decarbonization.visualcapitalist.com/all-commercially-available-long-duration-energy-storage-technologies-in-one-chart/

Rechargeable iron-air is the best technology for multi-day storage

Reversible Rust Battery



COST

Lowest cost rechargeable battery chemistry.
Less than 1/10th the cost of lithium-ion batteries

SAFETY

Non-flammable aqueous electrolyte. No risk of thermal runaway.

SCALE

Uses materials available at the global scale needed for a zero carbon economy. High recyclability.

RELIABLE

100+ hr duration required to make wind, water and solar reliable year round, anywhere in the world.

What makes up a Form Energy system

Modular design enables easy scaling to GWh systems

Cell

~0.15 kW / 15 kWh

~1.37m x 0.94m x 70mm

Electrodes + electrolyte

Smallest electrochemical functional unit

Battery Module

~4.5 kW / 450 kWh

~1.8m x 1m x 2.5m

30 cells

Smallest building block of DC power

Enclosure

~45 kW / 4,500 kWh

~9.5’ x 8’ x 40’

10 modules

Product building block with integrated auxiliary systems

Power Block

~2.9 MW / 290 MWh

<2 acres

64 enclosures

Smallest independent system and AC power building block

System

10+ MW / 1000+ MWh

5+ acres

Many power blocks

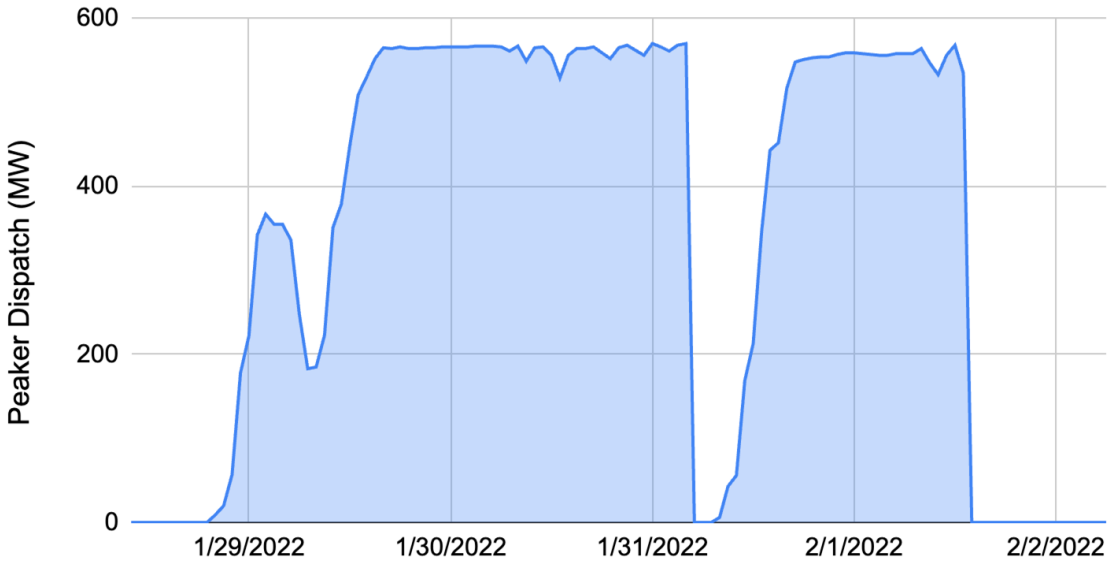
Commercial intent system

Multi-day storage is a non-emitting alternative to gas peakers

Peaker plants tend to run continuously for days during periods of grid stress. Alternatives must also be able to match this profile to deliver firm capacity over the same period of time

- Peakers dispatch continuously during extreme weather or renewable energy lulls
- Short-duration lithium-ion batteries can't match this output cost-effectively; they need to recharge each day
- A portfolio of multi-day storage + short-duration lithium ion is often the most economic alternative

Example: Canal Generating Station Unit 2, MA (Winter 2022)



Source: US EPA Clean Air Markets Program Data (CAMPD)

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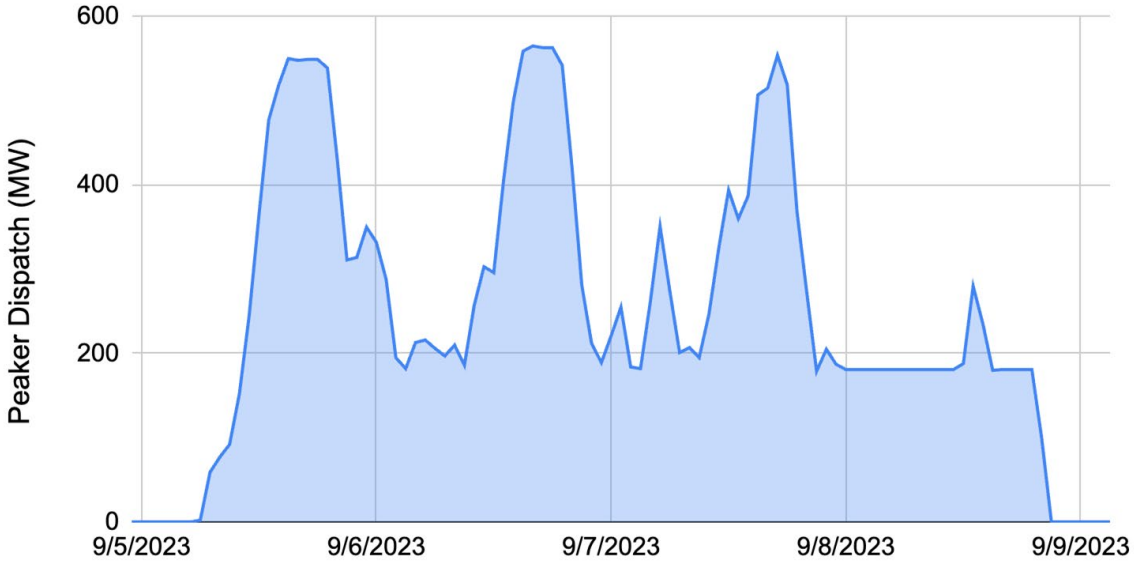

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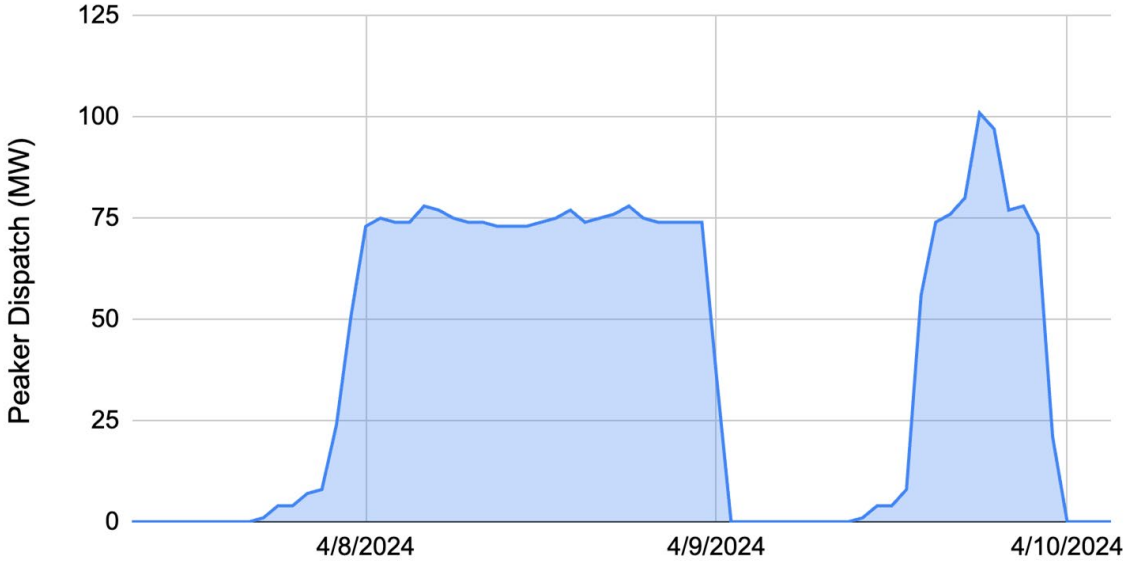
Example: Cleary Flood Unit 9, MA (Spring 2024)



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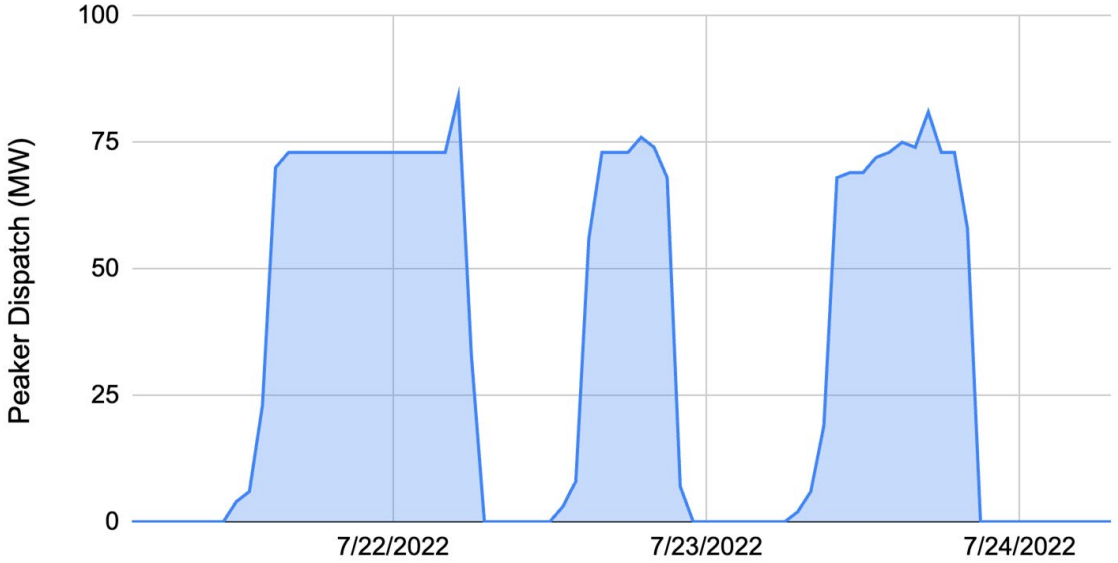
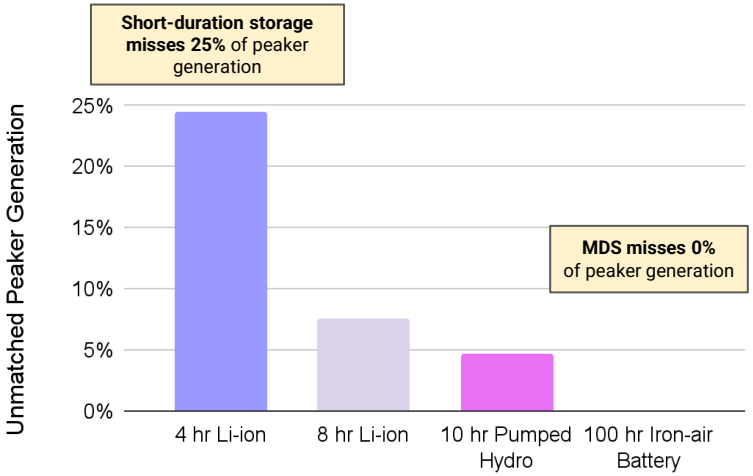


Source: US EPA Clean Air Markets Program Data (CAMPD)

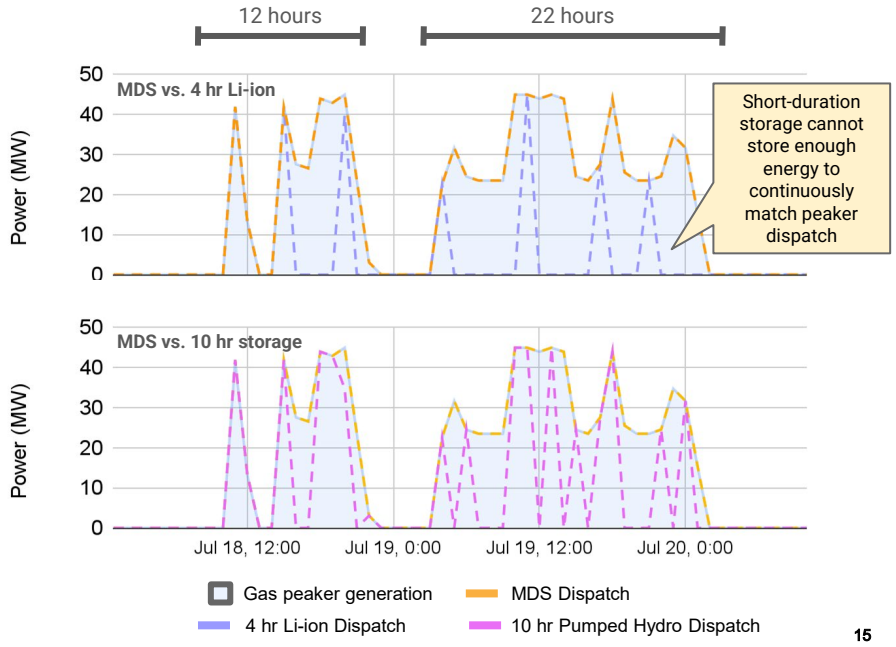
Multi-Day Storage can deliver the same dispatchability as thermal peaker plants during reliability events

50 MW storage projects dispatched to match the
2023 operations of a 50 MW gas peaker (Southwestern utility)

Ability to match annual peaker operations



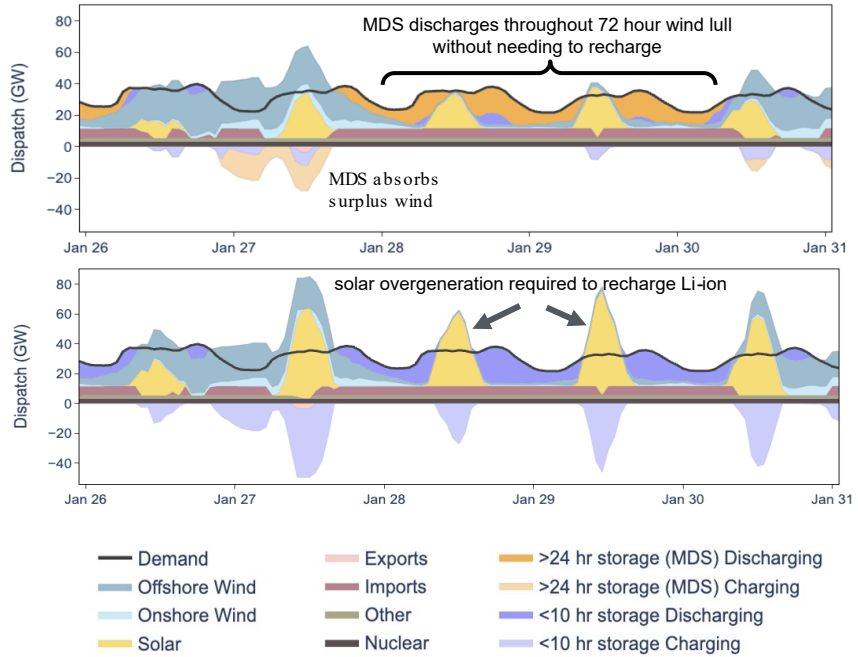
Example operations during July 2023 heat wave



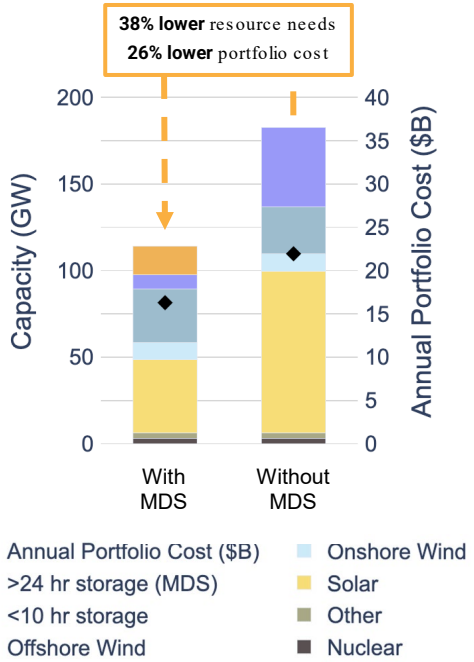
Multi-day storage avoids resource overbuild and reduces system costs

ISO- NE Study, 2040 Zero - Carbon Scenario

MDS utilizes renewables more effectively to fill multi-day reliability gaps



This reduces total resource build and costs



Note: Full study available at Wilson *et al.*, "Clean, Reliable, Affordable: The Value of Multi-Day Storage in New England," September 2023.

Thank you!

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