Sandia National Laboratories

State Level Policy: Building Markets for Long Duration Energy Storage

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Energy Storage Workshop 2023

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What I will be discussing today:

- Sandia's Policy & Outreach work.
- The energy storage policy landscape—current status (state level).
- How LDES fits into this broader policy landscape.
- Policy challenges for LDES.
- The LDES National Consortium.
- Q&A

Sandia's Policy & Outreach includes six core focus areas:

1. Educational outreach services to state regulatory utility commissions
2. Policy analysis and thought leadership via industry publishing
3. Support of state-level decarbonization modeling
4. Representation and engagement with federal policy groups
5. Collaboration with other federal labs
6. Support of the ESGC and DOE—OE as needed

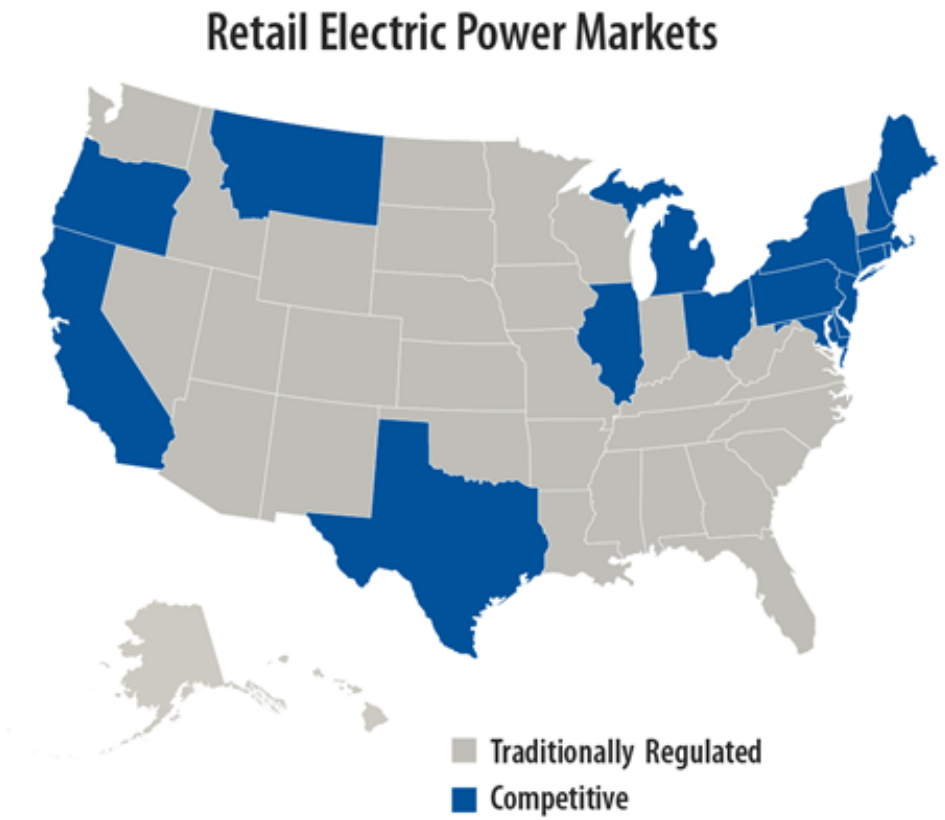
This work is funded by the Department of Energy, Office of Electricity, Energy Storage Program, Dr. Imre Gyuk, Program Director

The U.S. market is not homogenous.

Regulated Markets

- ✓ "Vertically integrated" utility **owns or controls** generation, transmission, and distribution
- ✓ **Regulated by states** (public utility commissions)
- ✓ Cost recovery via rates charged to customers

ES/LDES needs to solve grid problem and be reliable, low-risk



https://www.epa.gov/repowertoolbox/understanding-electricity-market-frameworks-policies

Restructured Markets

- ✓ Market is **competitive**
- ✓ Utilities usually prohibited from owning G&T assets.
- ✓ **RTOS/ISOs** responsible for inter-/intra-state T, D and O&M with oversight from FERC

ES/LDES needs to make money

Energy Storage Policy—Current Status

- 19 states (plus the District of Columbia) have adopted decarbonization goals, however, not all have set policy for energy storage deployment.
- About 15 states have adopted some form of energy storage policy, which in all cases exists along with a renewables policy.
- Energy storage activity still driven mostly in states that have the following policies:
  - Utility **procurement mandates, targets or goals** (10 states: CA, OR, NV, VA, NJ, NY, CT, MA, ME, and MD.)
  - Financial **incentives / subsidies** (CA, MD, NJ, NY);
  - State-funded **demonstration projects** (MA, MD, NY, UT, WA)
- Requiring storage in **utility IRPs** is also becoming more common. (NV, NM)

Deployment:

- Installation has been mostly concentrated in CA-ISO and PJM regions (in states that have developed enabling policy frameworks) and in Texas, where development has been driven by business factors rather than policies.
- 8 GW of utility-scale battery storage as of 2022 expected to increase by a further 20.8 GW by 2025 (ERCOT, NYISO, and ISO-NE)

Deployment Considerations

Considerations driving ES/LDES deployments vary across states.

Vertically integrated states

- ✓ Utilities driven by cost-recovery concerns.
- ✓ Evaluating integrated resource planning (IRP) requirements to include ES investments by utilities.
- ✓ Adopting energy storage targets or mandates, and/or expanding renewable energy targets to align with storage objectives (obligations placed on utilities).
- ✓ Incorporating energy storage into distribution system planning and modeling simulations.

Restructured states

- ✓ Considerations for investments in energy storage will tend to be driven toward competitive-market services.
- ✓ For example, how will energy storage generate revenue and provide a return for investors (as opposed to necessary operational services, such as maintaining reliability on the distribution network).
- ✓ Due to the restrictions on utility ownership that are typical in restructured markets, third parties often become the primary owners of energy storage assets (as opposed to utilities).

Setting the stage for a discussion of LDES.

- Decarbonization by definition is dependent on an increasing reliance on variable renewable energies (VREs), primarily wind and solar resources.

- As the penetration of VREs increases incrementally and ultimately exceeds levels of greater than 50, 60 or 70% (studies vary), this will dramatically change grid operations and require significantly different profiles for demand and supply.
  - ✓ Power supply and demand imbalances
  - ✓ Changes in transmission flow patterns
  - ✓ Decrease in system inertia

- Decarbonization requirements will also very likely lead to over-capacity scenarios, resulting in curtailments.

- Despite a growing realization of the need for LDES technologies, a persistent gap of policy levers at the federal and state level creates a vacuum in terms of defining how and where LDES technologies can be utilized to support the electric grid.

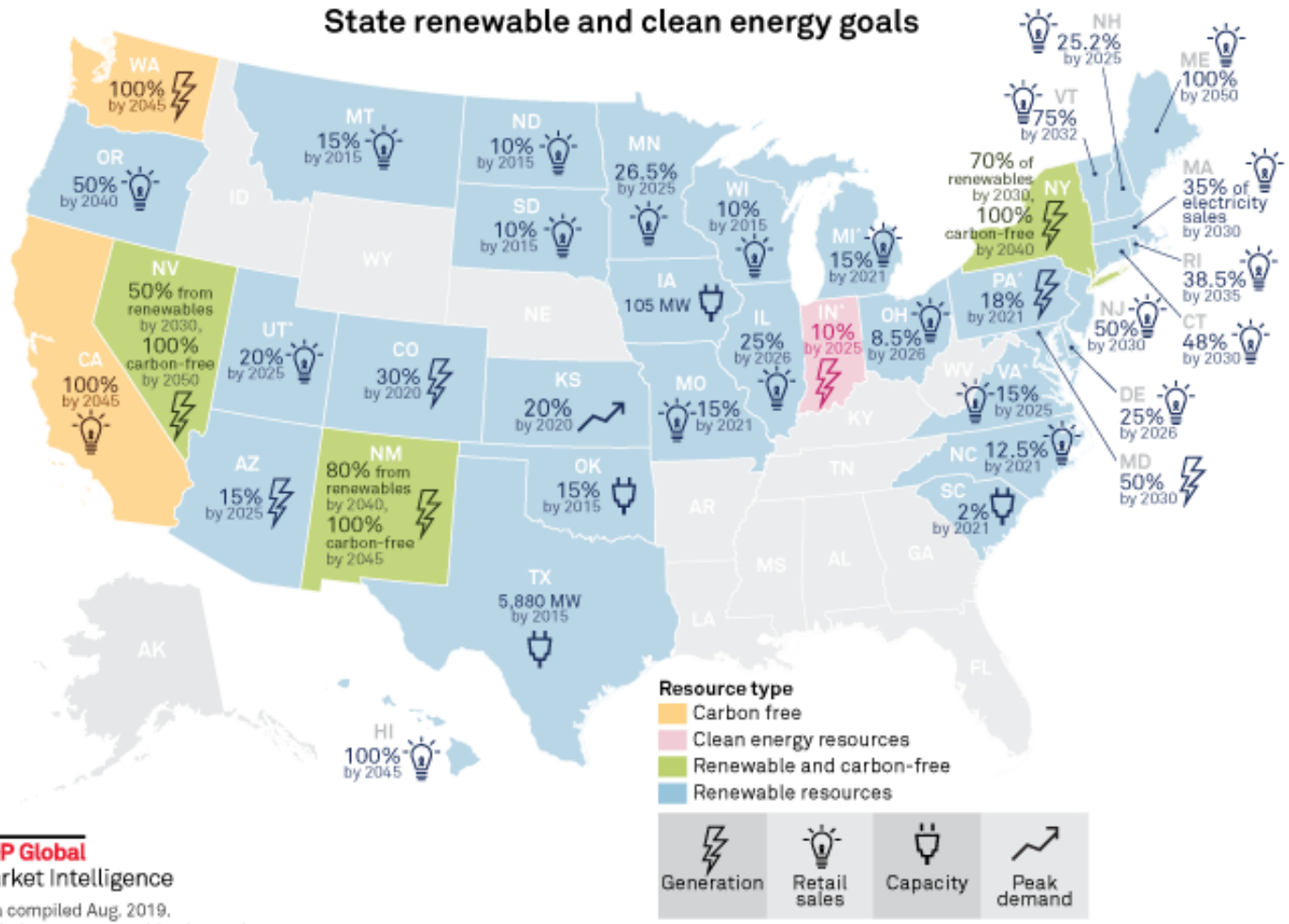
Additional context for LDES' (future) prominent role.

- Costs for fossil fuels remain volatile and costs for renewable energy technologies are falling.
- 19 states have now adopted 100% clean / renewable energy goals, with aggressive timelines. **Decarbonization** by definition includes a comprehensive move away from fossil fuels and toward renewables and clean energy.
- The **intermittency / non-dispatchability** of renewables drives a need for LDES.
- **Resilience and reliability** concerns are also driving a need for localized power supply, which will depend on energy storage /LDES.
- **Electrification** will increasingly become a driver for LDES. The EIA projects that electric vehicles will 31% of the global fleet by 2050. If these projections are correct, LDES will be needed to support this large increase in electrification.

The following states have adopted decarbonization / clean energy / renewable goals.

	STATE	DEADLINE	GOAL	CLEAR ROLE FOR ES/LDES
1	AZ	2070	100% carbon-free electricity	NO
2	CA	2045	100% carbon-free electricity	YES
3	CO	2050	100% carbon free electricity	Somewhat
4	CT	2040	100% carbon-free electricity	NO
5	HI	2045	100% renewable energy	Somewhat
6	IL	2050	100% carbon-free electricity	Emerging
7	LA	2050	Net zero greenhouse gas emissions	NO
8	ME	2050	100% clean energy	NO
9	MA	2050	Net-zero greenhouse gas emissions	NO
10	MI	2050	Economy-wide carbon neutrality	NO
11	NJ	2050	100% carbon-free electricity	Somewhat
12	NM	2045	100% carbon-free electricity	NO
13	NV	2050	100% carbon-free electricity	Somewhat
14	NY	2040	100% carbon-free electricity	Somewhat
15	OR	2040	Greenhouse gas emissions reduced 100 percent below baseline emissions	Somewhat
16	RI	2030	100% renewable energy	NO
17	VA	2045	100% carbon-free electricity	NO
18	WA	2045	100% zero-emissions electricity	Somewhat
19	WI	2050	100% carbon-free electricity	NO

The future need for LDES appears self-evident, but remains undefined.



S&P Global
Market Intelligence

Data compiled Aug. 2019.
˄ Includes non-renewable alternative resources.
Indiana, Kansas, North Dakota, Oklahoma, South Carolina, South Dakota, Utah and Virginia have renewable portfolio goals instead of standards.
Virginia's RPS goal is based on the volume of electricity sold in 2007.
Map credit: Ciaralou Agpalo Palicpic
Sources: S&P Global Market Intelligence; Sierra Club; Union of Concerned Scientists; Database of State Incentives for Renewables & Efficiency; and state public utility commission websites

https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/us-states-face-uneven-paths-in-movement-for-100-clean-energy-53419260

New large-capacity, long-duration energy storage solutions are needed to ensure grid performance* with increasing intermittent renewables and threats that current ES technologies (e.g., pumped hydro, batteries) alone cannot economically address.

*Stability, reliability, and resilience

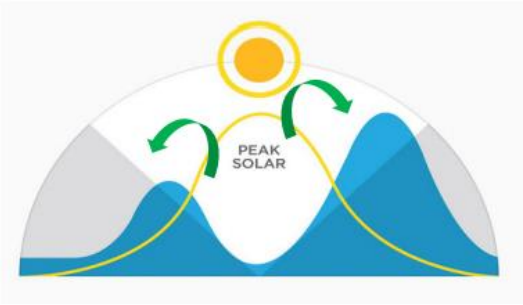
Key messages on LDES policymaking.

- Most states have not developed an LDES policy .
- Little agreement about where, how and why LDES will be deployed.
- Policymakers can address what is an existing gap regarding LDES through the following 4 action items:

1. Consider policies that are built to enable what is already known about the best use-case scenarios for LDES;
2. Require the inclusion of LDES in long-term system planning, particularly within the framework of established decarbonization goals;
3. Support the early deployment of LDES through incentives to market developers and/or ensuring cost recovery for utility pilot programs; and
4. Develop supportive market designs that begin to capture the full value of LDES, allowing it to play a greater role in resource adequacy requirements, capacity markets, and providing other ancillary services.

LDES can be supported by various technologies.

As non-programmable renewables increase, the need for long duration (>4-6 hours) is becoming a critical topic for the balancing of electric systems

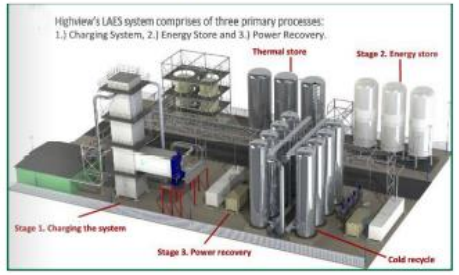


Currently, about 95% of the LDES in the U.S. consists of pumped-storage hydropower, but opportunities are limited by geography.

Today, lithium batteries represent the state of art for current needs of energy storage: they're fast, flexible, modular, and getting cheaper and cheaper (cost in 10 years is almost reduced by a 10x factor!)

Lab experiments, commercial developments and new market needs support the development of a portfolio of LDES solutions necessary to meet decarb goals.

…Liquid Air..



…Flow Batteries…

…Thermal Storage…

…Gravitational…

…Liquid CO_2…

Regardless of technology, LDES continues to face policy challenges.

- ***Challenge #1:*** Lack of policy consistency
  - Most states have not developed an LDES policy (CA is an exception)
  - Little agreement about where, how and why LDES will be deployed.

- ***Challenge #2:*** It's unclear what LDES should do, and where.
  - Most regions have only adopted a 4 hour-or-less energy storage requirement
  - Currently little need or value beyond 4 hours

- ***Challenge #3:*** Little consensus on how LDES should be valued or compensated.
  - In restructured markets, LDES needs to make money.
  - Efforts to define ISO/RTO, utility and customer services remain incomplete.

How LDES is defined varies by jurisdiction. 4+ hours, 10+ hours, seasonal?

The lack of consistency in defining LDES creates policymaking challenges.

California is an exception, and began actively developing LDES projects in 2020.

2020 – A Pivotal Year for Long-Duration Storage R&D

- $100M+ invested in energy storage in 2020 (CEC funding and match funding)
- Supporting new and emerging non-lithium-ion technologies
- 8 field demonstrations of 10 hours of non-lithium-ion long-duration energy storage
  - 2 demonstrations include 20+ hours of duration
- 3 applied research grants for 20 hours to 100+ hours of duration
- Two study grants to define how long-duration energy storage fits in CA future grid

State-sanctioned modeling identified that CA's interim goal of 60% renewable penetration by 2030 will require capacity additions of around 2 GW of LDES with duration of at least 10 hours.

Source: Mike Gravely, Team Lead / Supervisor
Energy Research and Development Division
California Energy Commission

Along with defining duration into statute, CA provides significant state financial support for LDES.

Incentives for Long-Duration Storage
Governor's Proposed FY 2022-23 Budget

- $380M proposed for Long Duration Energy Storage
- Deploy technologies on the verge of commercialization and position to scale to commercial deployment in the next 3 to 7 years.
- 3-5MWs for 8+ hours in duration (stretch goal of 20 to 100 hours)
- Does not include lithium-ion or pumped hydro
- Build on lessons learned from EPIC over the last 10 years
- Anticipate 10-15 Demonstration sites

The CEC's Electric Program Investment Charge (EPIC) program provides funding accelerate the transformation of the electricity sector to meet the state's energy and climate goals.

Source: Mike Gravely, Team Lead / Supervisor
Energy Research and Development Division
California Energy Commission

Summary of Policy Issues

- There is an absence of LDES policies in most every state / region in the U.S. (CA, AZ and NY are the exceptions).
- While there is optimism surrounding LDES' future, there is still little consensus about where and how it can be used, and its value to the grid.
- Policymakers can fill this gap by:
  - ✓ Defining fundamental LDES market components;
  - ✓ Creating a commodity market for LDES;
  - ✓ Creating valuation policies by defining MUAs & setting price values for specific LDES services; and
  - ✓ Setting policies that reduce risk for LDES developers

The three exceptions

Arizona offers a battery incentive program that is structured to encourage LDES/SES specifically, offering the full incentive only for ES technologies that offer discharge durations longer than five hours.

California offers $350 million of support for “pre-commercial long-duration storage projects” through the California Energy Commission (2020 GFO-19-308) - Assessing Long-duration Energy Storage Deployment Scenarios to Meet California's Energy Goals.

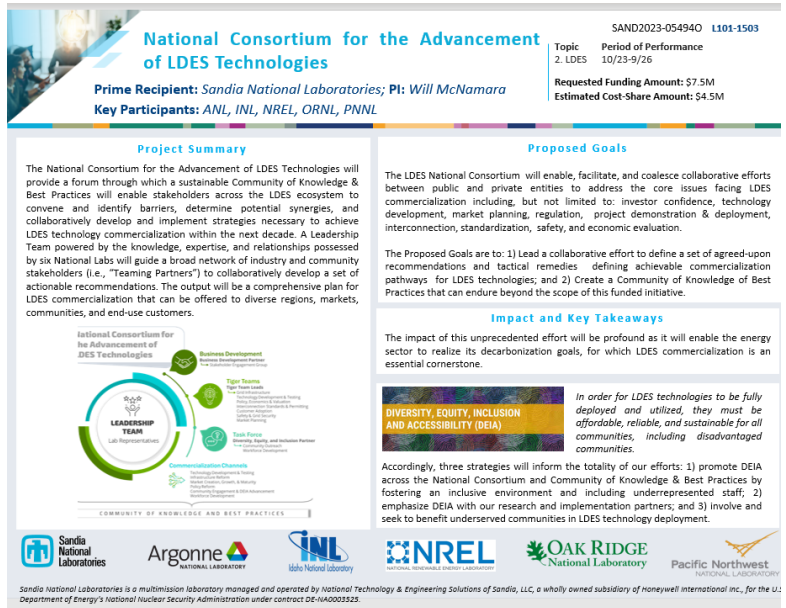
New York offers $12.5 million is being made available through NYSERDA for which only pre-commercial stage LDES/SES technologies are applicable and can include hydrogen, along with electric, chemical, mechanical or thermal storage technologies that are six-hours plus in duration.

The time is now to identify and address these gaps and barriers.

- The momentum has begun and is continuing, as state legislatures and governors have shown an increased interest in pursuing legislation designed to bolster the role of ES in achieving clean energy goals.
- High level goals are frequently handed down to regulatory commissions to implement, but the knowledge gap is steep at many commissions.
- While FERC is driving federal policy at the RTO level (e.g., Orders 841 and 2222) putting "steel in the ground" is often more directly impacted by what is happening at the state level.
- Disconnects between state and federal policy create confusion and will keep barriers in place.
- Lack of uniformity across states can create a "patchwork" marketplace for storage and prevent market developments.

Establishing the LDES National Consortium.

- Funding being offered through the DOE—Office of Technology Transitions (OTT) and Office of Clean Energy Demonstrations (OCED) with a $7.5 million grant .
- Purpose of the offering is that DOE recognized that achieving commercialization of new LDES technologies in this decade will require overcoming both technical and non-technical adoption barriers .
- Based also on the premise that 100% decarbonization cannot be achieved without LDES technologies.



National Consortium for the Advancement of LDES Technologies

SAND2023-05494O L101-1503

Prime Recipient: *Sandia National Laboratories;* **PI:** *Will McNamara*

Key Participants: *ANL, INL, NREL, ORNL, PNNL*

Topic	Period of Performance
2. LDES	10/23-9/26

Requested Funding Amount: $7.5M

Estimated Cost-Share Amount: $4.5M

Project Summary

The National Consortium for the Advancement of LDES Technologies will provide a forum through which a sustainable Community of Knowledge & Best Practices will enable stakeholders across the LDES ecosystem to convene and identify barriers, determine potential synergies, and collaboratively develop and implement strategies necessary to achieve LDES technology commercialization within the next decade. A Leadership Team powered by the knowledge, expertise, and relationships possessed by six National Labs will guide a broad network of industry and community stakeholders (i.e., "Teaming Partners") to collaboratively develop a set of actionable recommendations. The output will be a comprehensive plan for LDES commercialization that can be offered to diverse regions, markets, communities, and end-use customers.

Proposed Goals

The LDES National Consortium will enable, facilitate, and coalesce collaborative efforts between public and private entities to address the core issues facing LDES commercialization including, but not limited to: investor confidence, technology development, market planning, regulation, project demonstration & deployment, interconnection, standardization, safety, and economic evaluation.

The Proposed Goals are to: 1) Lead a collaborative effort to define a set of agreed-upon recommendations and tactical remedies defining achievable commercialization pathways for LDES technologies; and 2) Create a Community of Knowledge of Best Practices that can endure beyond the scope of this funded initiative.

Impact and Key Takeaways

The impact of this unprecedented effort will be profound as it will enable the energy sector to realize its decarbonization goals, for which LDES commercialization is an essential cornerstone.

DIVERSITY, EQUITY, INCLUSION AND ACCESSIBILITY (DEIA)

In order for LDES technologies to be fully deployed and utilized, they must be affordable, reliable, and sustainable for all communities, including disadvantaged communities.

Accordingly, three strategies will inform the totality of our efforts: 1) promote DEIA across the National Consortium and Community of Knowledge & Best Practices by fostering an inclusive environment and including underrepresented staff; 2) emphasize DEIA with our research and implementation partners; and 3) involve and seek to benefit underserved communities in LDES technology deployment.

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- All stakeholder organizations are welcome to participate in the LDES National Consortium as a "Teaming Partner."
- Contribute to a comprehensive set of recommendations that will be developed to address commercialization challenges facing LDES technologies.

Final Messages

- Consensus that LDES is the key that will help unlock global decarbonization.
- While there may be widespread agreement that 10-hour + LDES have a plethora of use cases, there is currently no market that reflects this.
- Regulators have the opportunity to create a level playing field for LDES that will be used for the coming decades.
- Continue to watch California, which is setting some policy precedents for LDES.
  - CPUC requirement that that the state's load-serving entities — including CCAs, investor-owned utilities and municipal utilities and co-ops — procure sufficient energy to ensure so-called 'Mid-Term Reliability' of the energy system.
  - This includes the requirements for these entities to procure or contract for at least 1GW of LDES.

Thank you!

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