

# Energy Storage – The Future is Here

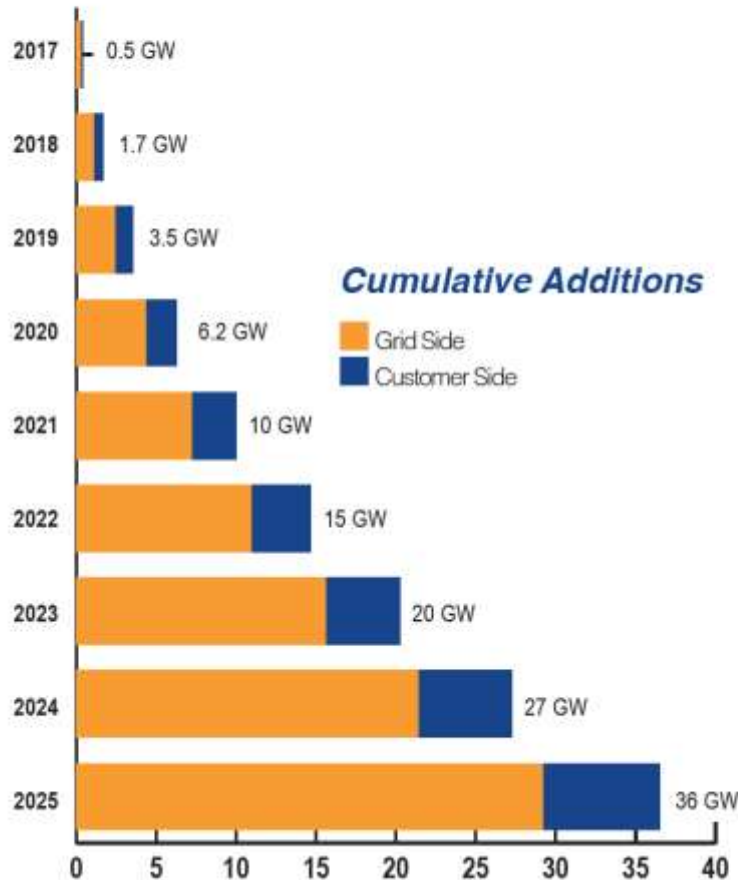
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# Ambitious Projections for Energy Storage in the US

*Chart 1.1 Cumulative and Annual U.S. Energy Storage Power Capacity Additions, Vision Case (2017-2025)*



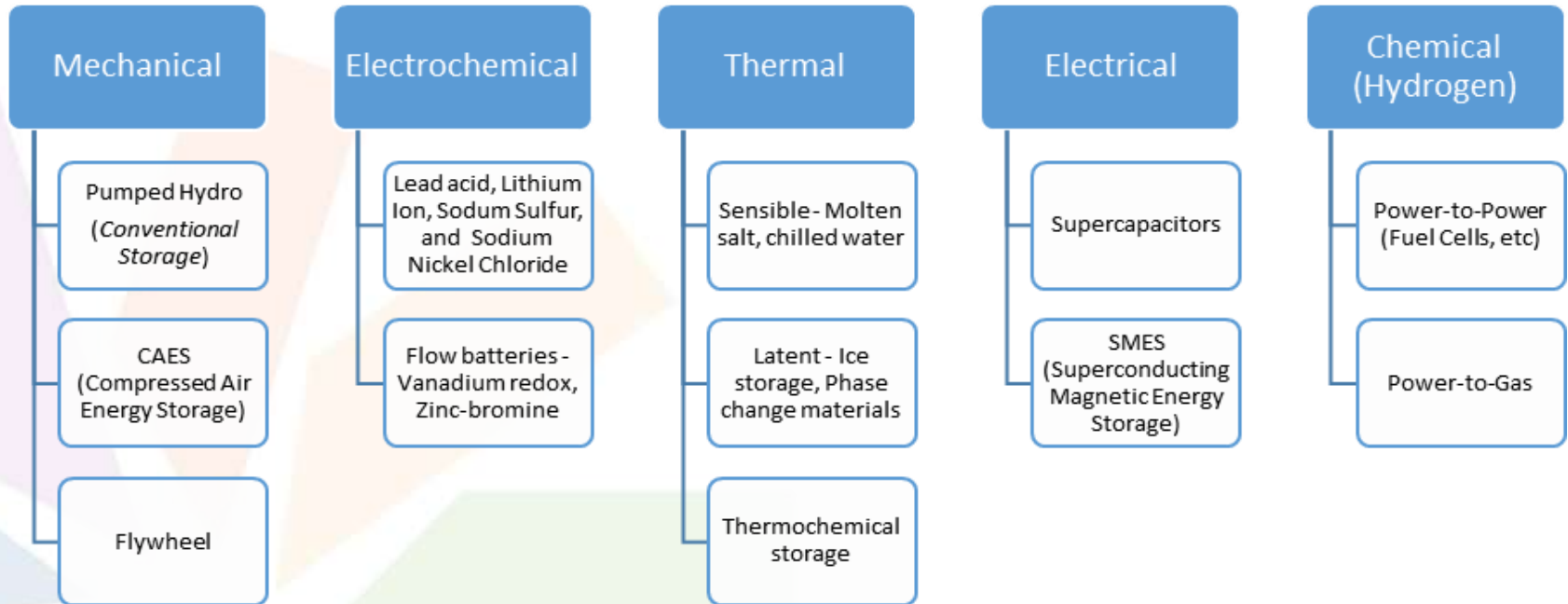
- ❖ *The costs are coming down...*
- ❖ *State and local governments are now understanding the multiple values that energy storage can provide, and are implementing programs and policies*
- ❖ *Utilities understanding the multiple benefits*
- ❖ *New Tariff structures*
- ❖ *Federal rules are changing to put energy storage on a level playing field*

*From: A Vision for 2025,  
November, 2017  
Energy Storage Association*

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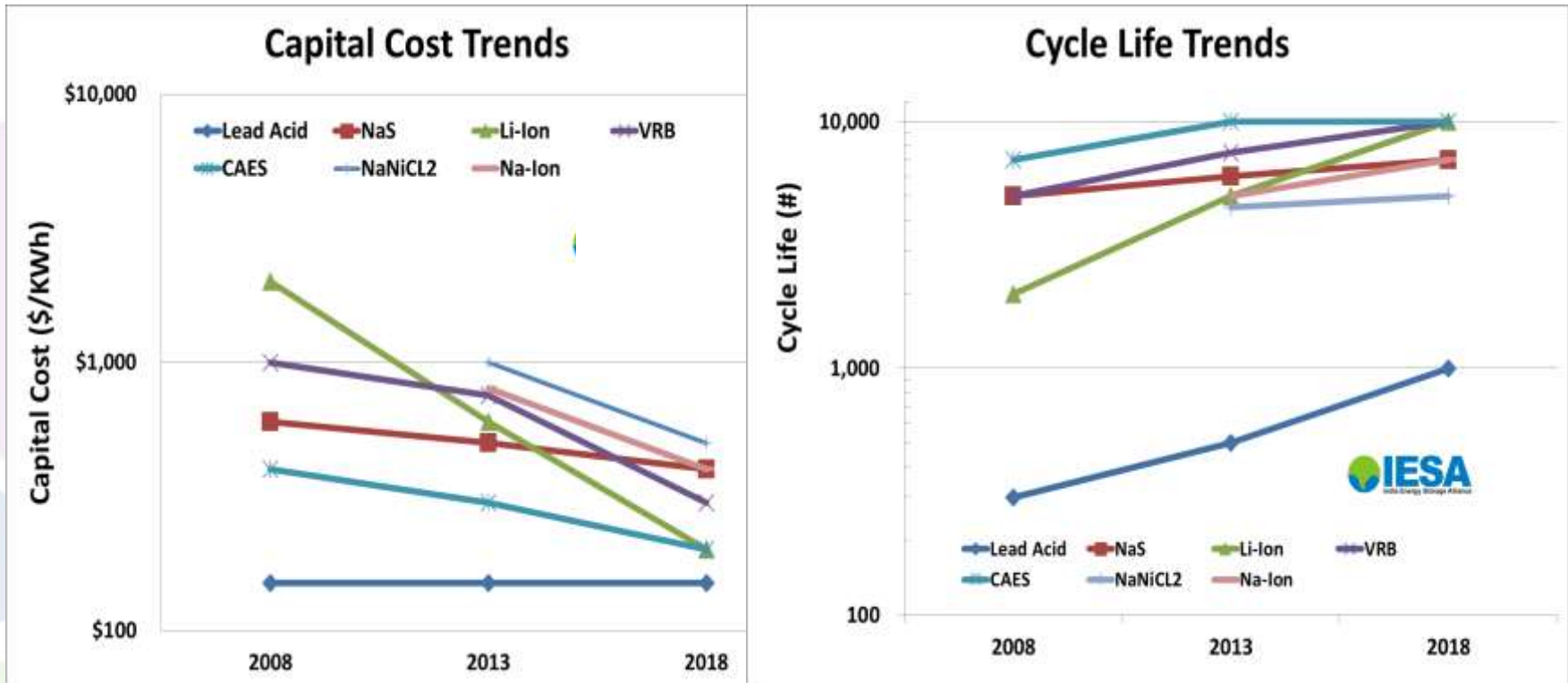
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# Energy Storage Technologies



**Primarily lithium-ion batteries** are declining rapidly in cost. Dropping by 50% every three to four years and projected to continue at this rate.

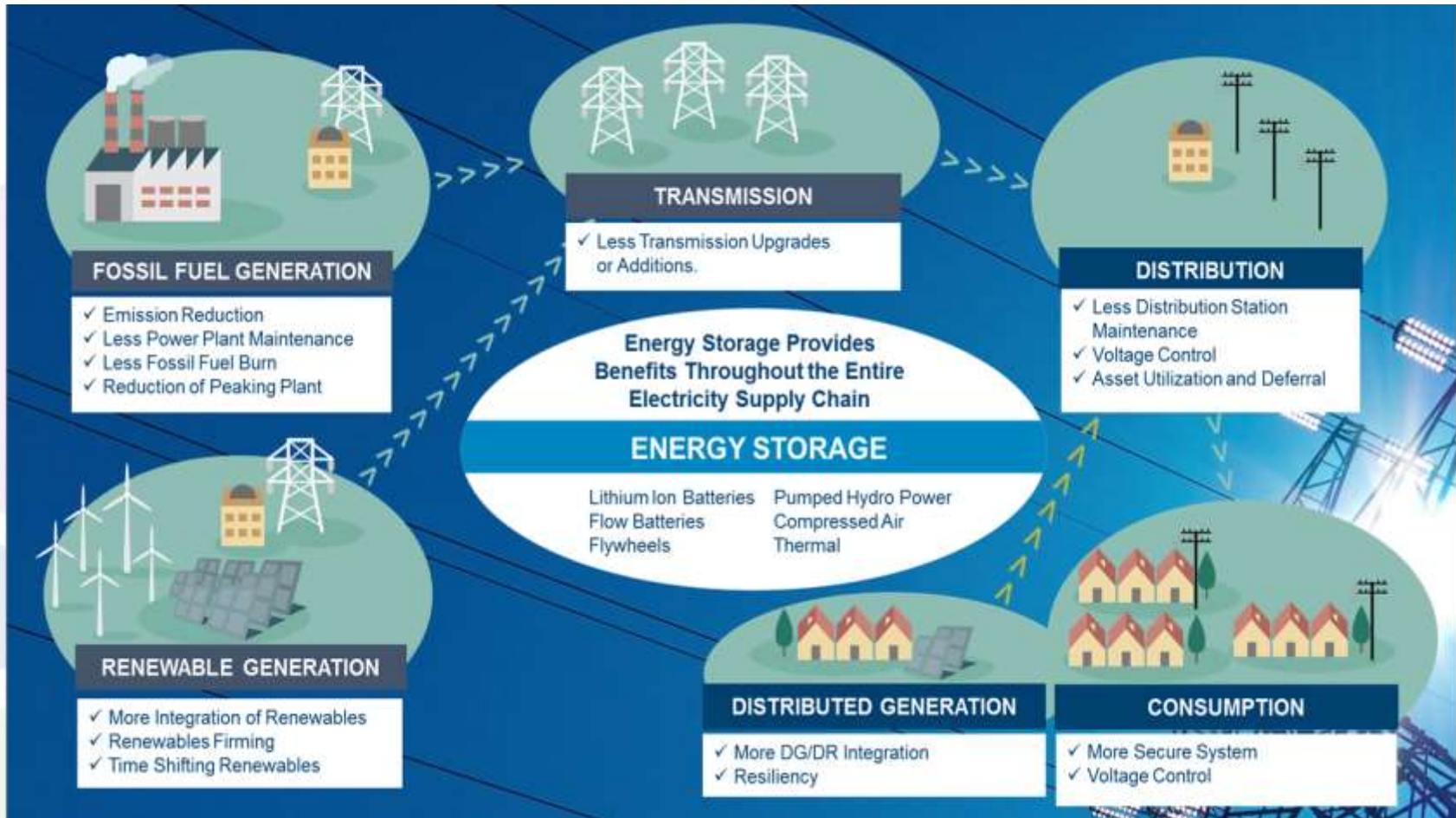
# Storage Cost & Performance Trends



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# Energy Storage is Being Implemented for Many Purposes





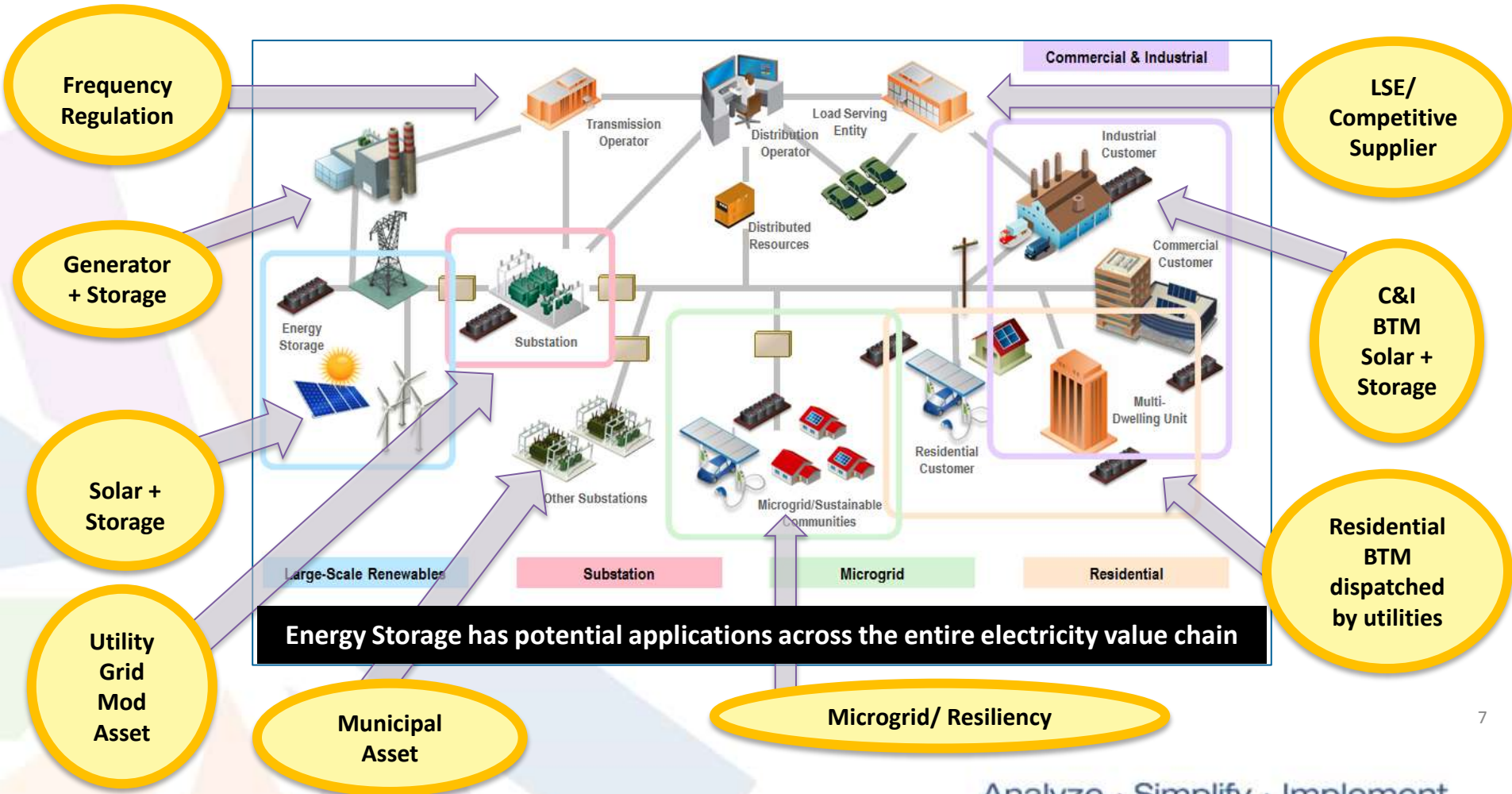
# System Benefits...Where are the Gaps?

## MA State of Charge Study Results

Benefit Categories	Benefit Description	
<b>Energy Cost Reduction</b>	Energy storage replaces the use of inefficient generators at peak times causing: 1) reduced peak prices which 2) reduces the overall average energy price. This also benefits the natural gas supply infrastructure.	<b>\$275M</b>
<b>Reduced Peak</b>	Energy storage can provide peaking capacity to 1) defer the capital costs peaker plants and 2) reduced cost in the the capacity market	<b>\$1093M</b>
<b>Ancillary Services Cost Reduction</b>	Energy storage would reduce the overall costs of ancillary services required by the grid system through: 1) frequency regulation, 2) spinning reserve, and 3) voltage stabilization	<b>\$200M</b>
<b>Wholesale Market Cost Reduction</b>	Energy storage can be a flexible and rapid tool that help generators operate more efficiently through: 1) less wear and tear, 2) less start up and shut down costs, and 3) reduced GHG emissions.	<b>\$197M</b>
<b>T&amp;D Cost Reduction</b>	Energy storage 1) reduces the losses and maintenance of system, 2) provides reactive power support, 3) increases resilience, and 4) defers investment	<b>\$305M</b>
<b>Increased Renewable Integration</b>	Energy storage reduces cost in integrating renewable energy by 1) addressing reverse power flow and 2) avoiding feeder upgrades	<b>\$219M</b>
<b>Total System Benefits</b>		<b>\$2,288M</b>

# Benefit to Cost Ratio: Greater than 1

The Study analyzed the economics and business models of ten storage use cases to inform specific policy and program recommendations



Energy Storage has potential applications across the entire electricity value chain

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# Energy Storage Attributes

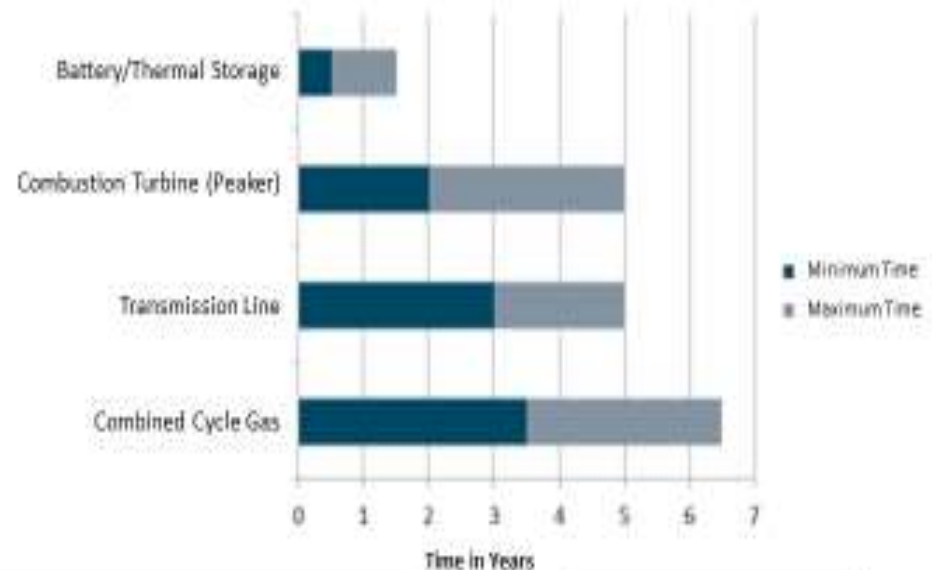
Energy storage resources can be installed much more quickly than traditional resources, reducing risk, and increasing technology flexibility

## ➤ Energy Storage is:

- Proven technology
- Modular and flexible in design
- Useful in multiple applications
- Quick to respond (dispatchable)
- Easy to site
- Quick to market



### Siting, Permitting, and Installation Time by Resource



Energy storage solutions will deliver smarter, more dynamic energy services, address peak demand challenges and enable the expanded use of renewable generation like wind and solar. The net result will be a more resilient and flexible grid infrastructure that benefits American businesses and consumers."

- M. Roberts, Executive Director, Energy Storage Association



# Proactive States Energy Storage

## California

- 1,325 MW of energy storage by the year 2020 to be procured biennially; 500 MWs more for Distributed
- Grants – SGIP, CEC EPIC
- Numerous RFPs for Energy Storage (Ancillary Services, Capacity, Energy)
- Planning - IRP and Resource Adequacy Considering Energy Storage Assumptions
- Aliso Canyon gas leak deficiency met with 104 MW of storage for peaking

Energy Storage Procurement Targets (in MW)

Storage Grid Domain (Point of Interconnection)	2014	2016	2018	2020	Total
<b>Southern California Edison</b>					
Transmission	50	65	85	110	310
Distribution	30	40	50	65	185
Customer	10	15	25	35	85
<b>Subtotal SCE</b>	<b>90</b>	<b>120</b>	<b>160</b>	<b>210</b>	<b>580</b>
<b>Pacific Gas and Electric</b>					
Transmission	50	65	85	110	310
Distribution	30	40	50	65	185
Customer	10	15	25	35	85
<b>Subtotal PG&amp;E</b>	<b>90</b>	<b>120</b>	<b>160</b>	<b>210</b>	<b>580</b>
<b>San Diego Gas &amp; Electric</b>					
Transmission	10	15	22	33	80
Distribution	7	10	15	23	55
Customer	3	5	8	14	30
<b>Subtotal SDG&amp;E</b>	<b>20</b>	<b>30</b>	<b>45</b>	<b>70</b>	<b>165</b>
<b>Total - all 3 utilities</b>	<b>200</b>	<b>270</b>	<b>365</b>	<b>490</b>	<b>1,325</b>



SCE and SDG&E Have Contracted 104.5 Megawatts of Energy Storage As Part of Aliso Canyon Procurement

*In Sept 2017, CPUC rejected the approval of the Elwood Peaker Plant in favor of solar plus storage*

***Solar and Storage determined more cost effective***

Source: GTM

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# States with Energy Storage Activities

- **New York**

- DER Roadmap
- NY Reforming the Energy Vision (REV) – Grid modernization and reposition to be “distributed system platform”
- Value of DER –Replacement for net metering tariffs
- Grants for Microgrids, Clean Energy Fund...
- Consideration of Target or Mandate

- **Massachusetts**

- Energy Storage Initiative (ESI), State of Charge
- Comprehensive Clean Energy Diversification Legislation signed August 2016 (H. 4568)
- Target for Energy Storage Implemented
- Grants for Energy Storage
- Incentive for Solar and Storage

# States with Energy Storage Activities

- **NEW MEXICO** - IRP rules to include storage
- **OREGON** – Mandate, and PGE and Pacific Power issue Storage Evaluation Plans; bill introduced to examine grid tech impacts
- **NEVADA** - Commission begins implementation of first of several 2017 energy bills;
- **MARYLAND** - Considering a storage tax credit program; state storage study group begins work
- **NORTH CAROLINA** - Governor approves comprehensive energy bill, including storage study
- **HAWAII** - Interconnection rules updates
- **CONNECTICUT** - Executive Order on resource assessment includes storage consideration
- **NEW JERSEY** - Signal of storage interest with New Jersey target bill  
(600 MW of storage capacity by energy year 2021 and 2,000 MW by energy year 2030.)
- **MINNESOTA** - Grid mod and Interconnection rules
- **VIRGINIA and PENNSYLVANIA**

# Storage is Getting Attention at Federal Level

*ISOs/RTOs: Everyone has a stakeholder process addressing energy storage*

**FERC:**

- **Energy Storage NOPR**
  - **FERC to Enable Full Wholesale Market Participation by Storage and DER**
- **Generation Interconnection**
  - Reform of Generator Interconnection Procedures and Agreements” (RM17-8)
- **Ancillary Services**
  - Primary Frequency Response (PFR)
    - Order 794 – “Frequency Response and Frequency Bias Setting Reliability Standard” (RM13-11)
    - Order 819 – “Third-Party Provision of Primary Frequency Response” (RM15-2)
    - “Essential Reliability Services and the Evolving Bulk-Power System—Primary Frequency Response” (RM16-6) - Notice of Inquiry (NOI) Feb. 2016, NOPR Nov. 2016
  - Reactive Supply/Power / Voltage Control/Support
- **Grid Resiliency**

***There are also several legislative bills being considered that contemplate energy storage***

# Regulators and Policy Makers Make it Happen

- **More stakeholder dialogue around energy storage to understand its capabilities**
- **Integration of energy storage assumptions into system planning with updated cost data**
- **New ways to model energy storage to consider its multiple contributions to the grid**
- **Implementation of new business models for system operations**

## THANK YOU