



**CleanEnergy**  
States Alliance

# Batteries 101, Part 1:

An Introduction to Energy Storage  
and Massachusetts' Battery Storage  
Programs and Policies

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May 15, 2024

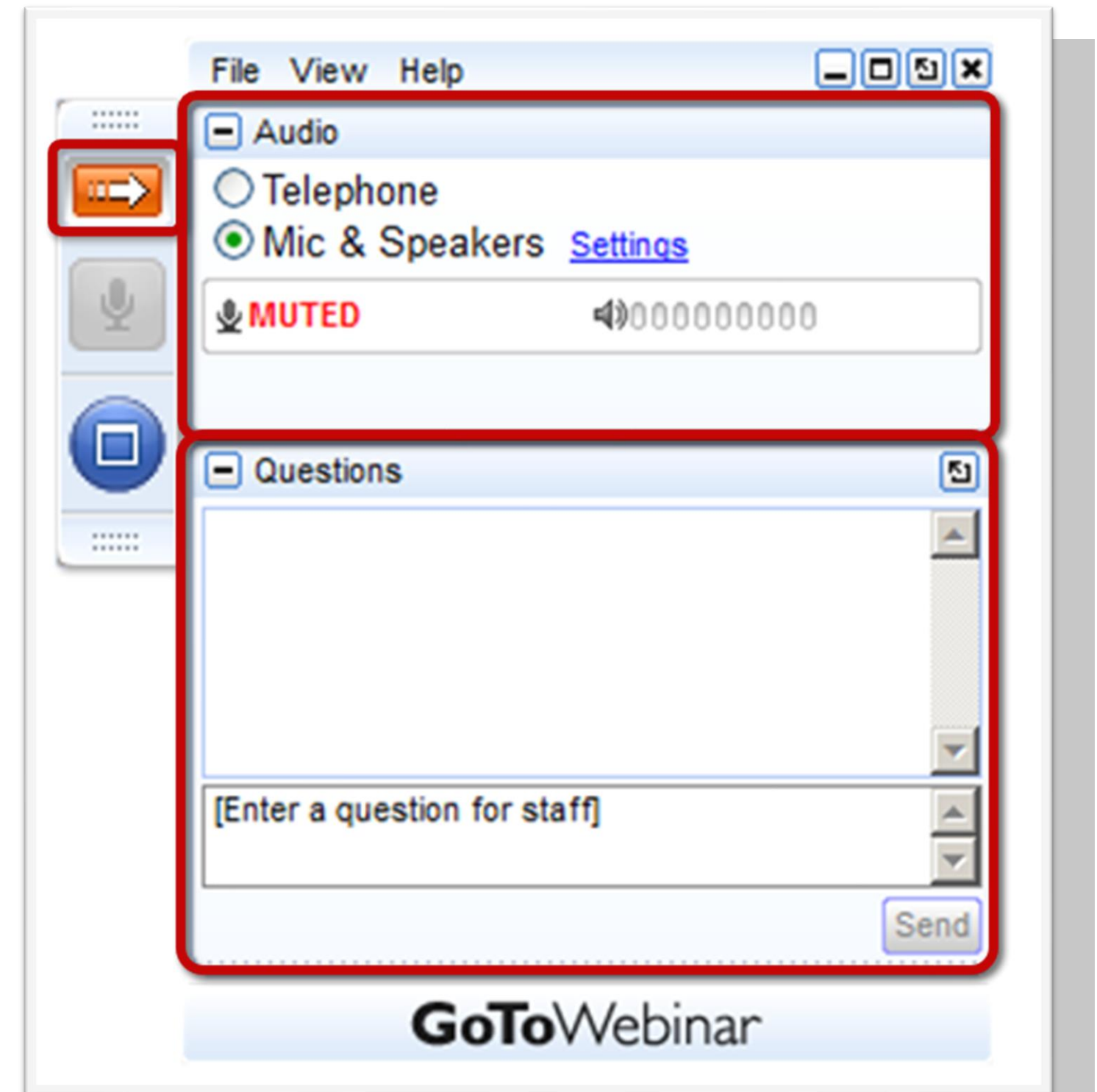
[www.cleangroup.org](http://www.cleangroup.org) | [www.cesa.org](http://www.cesa.org)

# Webinar Logistics

Use the orange arrow to open and close your control panel

Submit questions and comments via the Questions panel

This webinar is being recorded. We will email you a webinar recording within 48 hours. This webinar will be posted on CEG's website at [www.cleangroup.org/webinars](http://www.cleangroup.org/webinars)





Affordable, reliable, clean energy for all.



**Climate Resilience and  
Community Health**



**Distributed Energy Access  
and Equity**



**Energy Storage and Flexible  
Demand**



**Fossil Fuel Replacement**

# Resilient Power Project

Building the foundation for energy resilient communities.

**USDN** | urban sustainability directors network

footprintproject.org™

AMERICAN MICROGRID SOLUTIONS



**ELEVATE**



GEMINI ENERGY SOLUTIONS



Rooftop solar installation in Dorchester, MA. Credit: Resonant Energy



Celebrating 20 Years of State Leadership



The Clean Energy States Alliance (CESA) is a national, nonprofit coalition of public agencies and organizations working together to advance clean energy.

CESA members—mostly state agencies—include many of the most innovative, successful, and influential public funders of clean energy initiatives in the country.

# CleanEnergy States Alliance

[www.cesa.org](http://www.cesa.org)



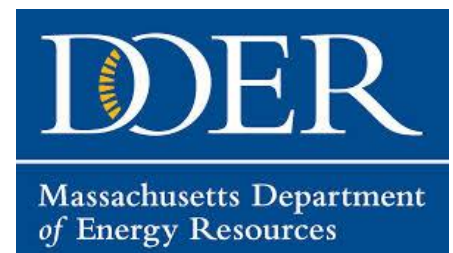
GOVERNOR'S Energy Office



Maryland Energy Administration



NYSERDA



# Energy Storage Technology Advancement Partnership (ESTAP)

Conducted under contract with Sandia National Laboratories, with funding from US DOE Office of Electricity.

- Facilitate public/private partnerships to support joint federal/state energy storage demonstration project deployment

- Support state energy storage efforts with technical, policy and program assistance

- Disseminate information to stakeholders through webinars, reports, case studies and conference presentations

[www.cesa.org/ESTAP](http://www.cesa.org/ESTAP)



U.S. DEPARTMENT OF  
**ENERGY**



Sandia  
National  
Laboratories

**CleanEnergy**  
States Alliance

# Energy Storage Policy for States

Providing support to CESA members engaged in developing energy storage policy, programs and regulation.

Activities include knowledge sharing, direct policy support, and independent analysis.

The project leverages other CESA and CEG efforts, including ESTAP and CEG's Resilient Power Project.

[www.cesa.org/projects/energy-storage-policy-for-states/](http://www.cesa.org/projects/energy-storage-policy-for-states/)



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# Webinar Speakers

*Batteries 101, Part 1: An Introduction to Energy Storage and Massachusetts' Battery Storage Programs and Policies*



**Todd Olinsky-Paul**

*Senior Project Director*  
Clean Energy States Alliance  
Clean Energy Group



**Melissa Mittelman**

*Assistant Secretary for  
Decarbonization*  
Massachusetts Executive  
Office of Energy and  
Environmental Affairs



**Tom Ferguson**

*Energy Storage Programs  
Manager*  
Massachusetts Executive  
Office of Energy and  
Environmental Affairs



**Sarah Cullinan**

*Senior Director, Net Zero Grid  
Program*  
Massachusetts Clean Energy  
Center



# Energy Storage 101 Webinar Series Outline

## **Webinar 1: Introduction to Energy Storage**

- What is energy storage? What are lithium-ion batteries?
  - Utility scale
  - Residential/commercial scale
- Why is storage important?
  - Role of battery storage in Massachusetts decarbonization plan
  - Resilience
  - Other applications
- Economic landscape for storage - State and federal incentives, market opportunities

## **Webinar 2: Energy Storage Benefits and Applications**

- Fossil fuel peaker plant replacement
- Energy and environmental equity
- Grid benefits
- Resilience

# Energy Storage 101 Webinar Series Outline (continued)

## Webinar 3: Considerations for Battery Siting

- Fire safety
- Environmental considerations
- Security

## Webinar 4: Municipal Considerations for Battery Installations

- Siting
- Permitting
- Planning
- Zoning
- Municipal best practices

NOTE: This webinar series is for informational purposes only. We will answer as many questions as possible, prioritizing questions from Massachusetts residents or about Massachusetts-specific topics.

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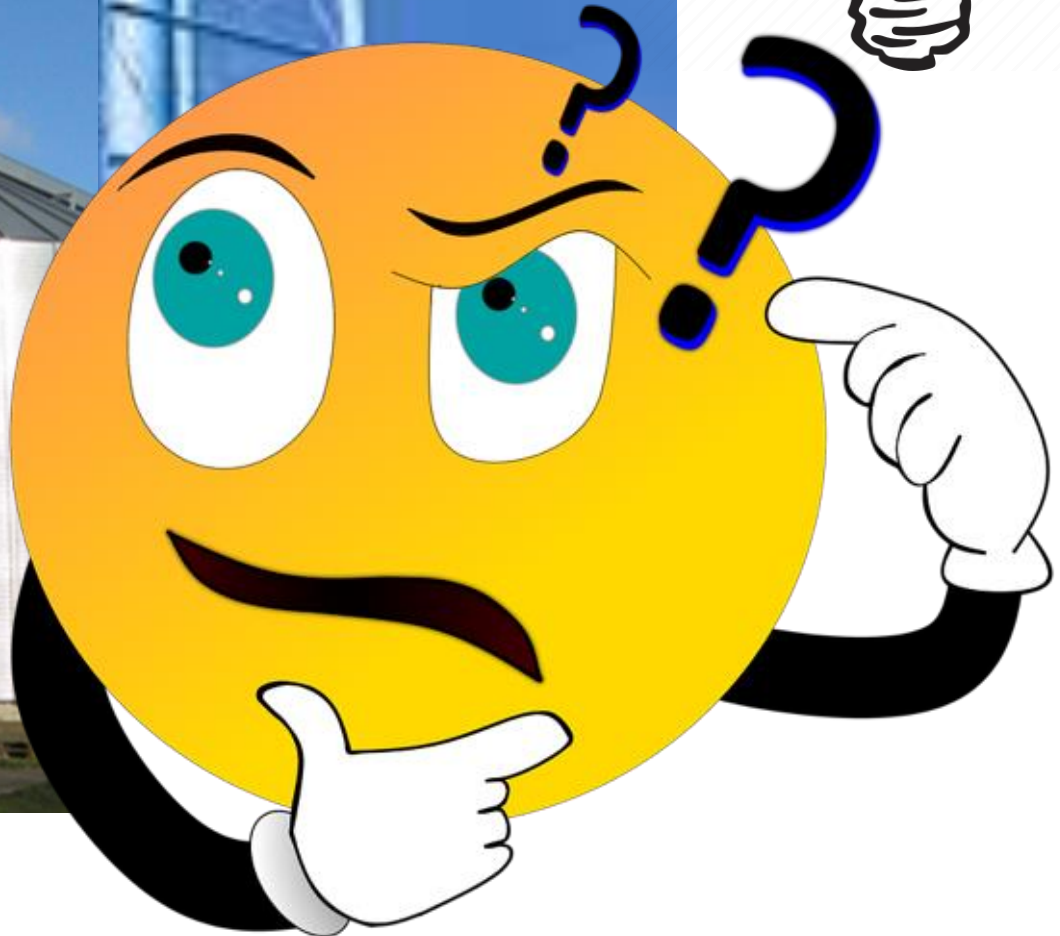
# Energy Storage 101: Some Basics



**Todd Olinsky-Paul**  
Senior Project Director  
Clean Energy Group  
Clean Energy States Alliance  
[todd@cleanegroup.org](mailto:todd@cleanegroup.org)



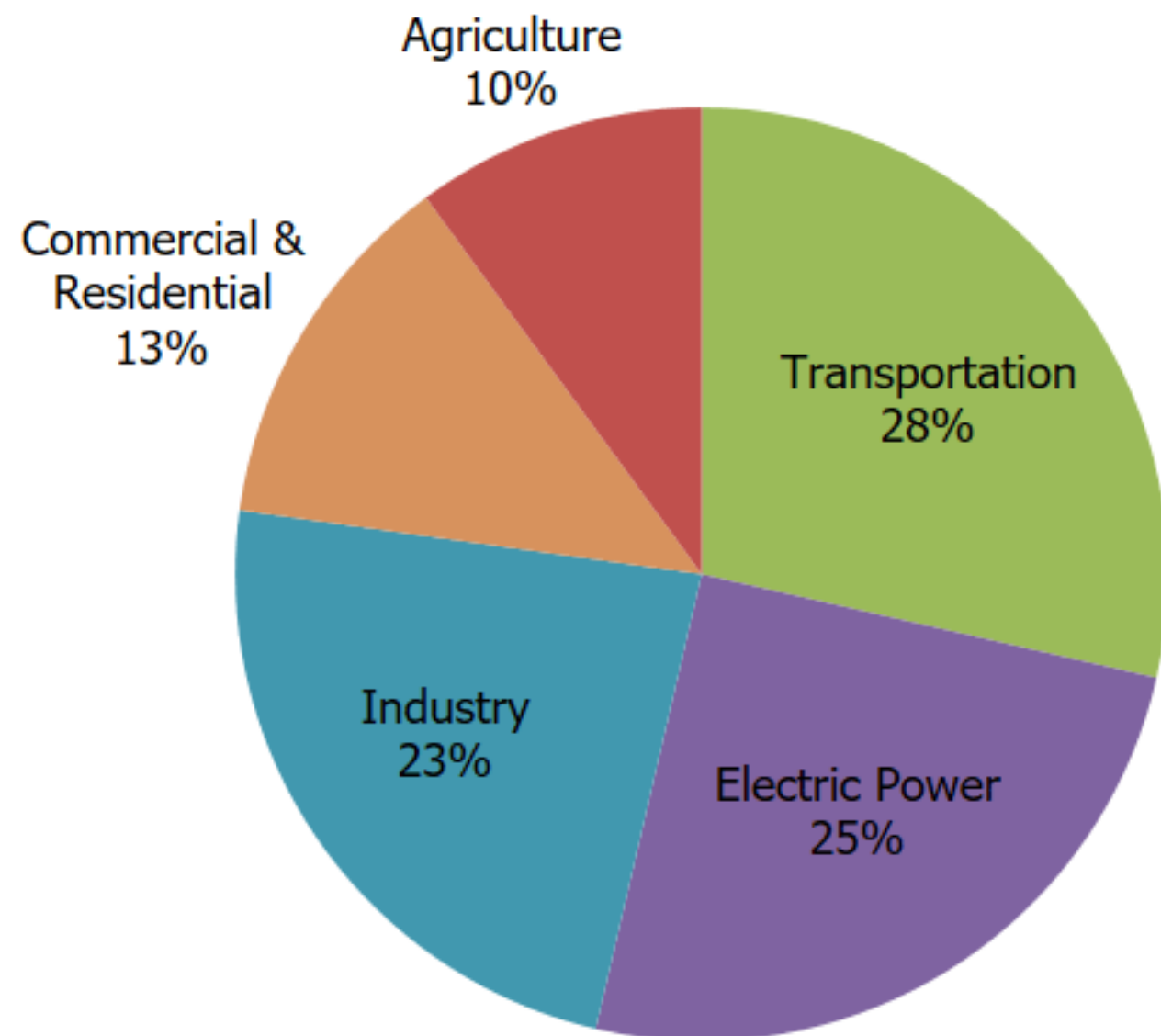
We are good at storing everything... except electricity!



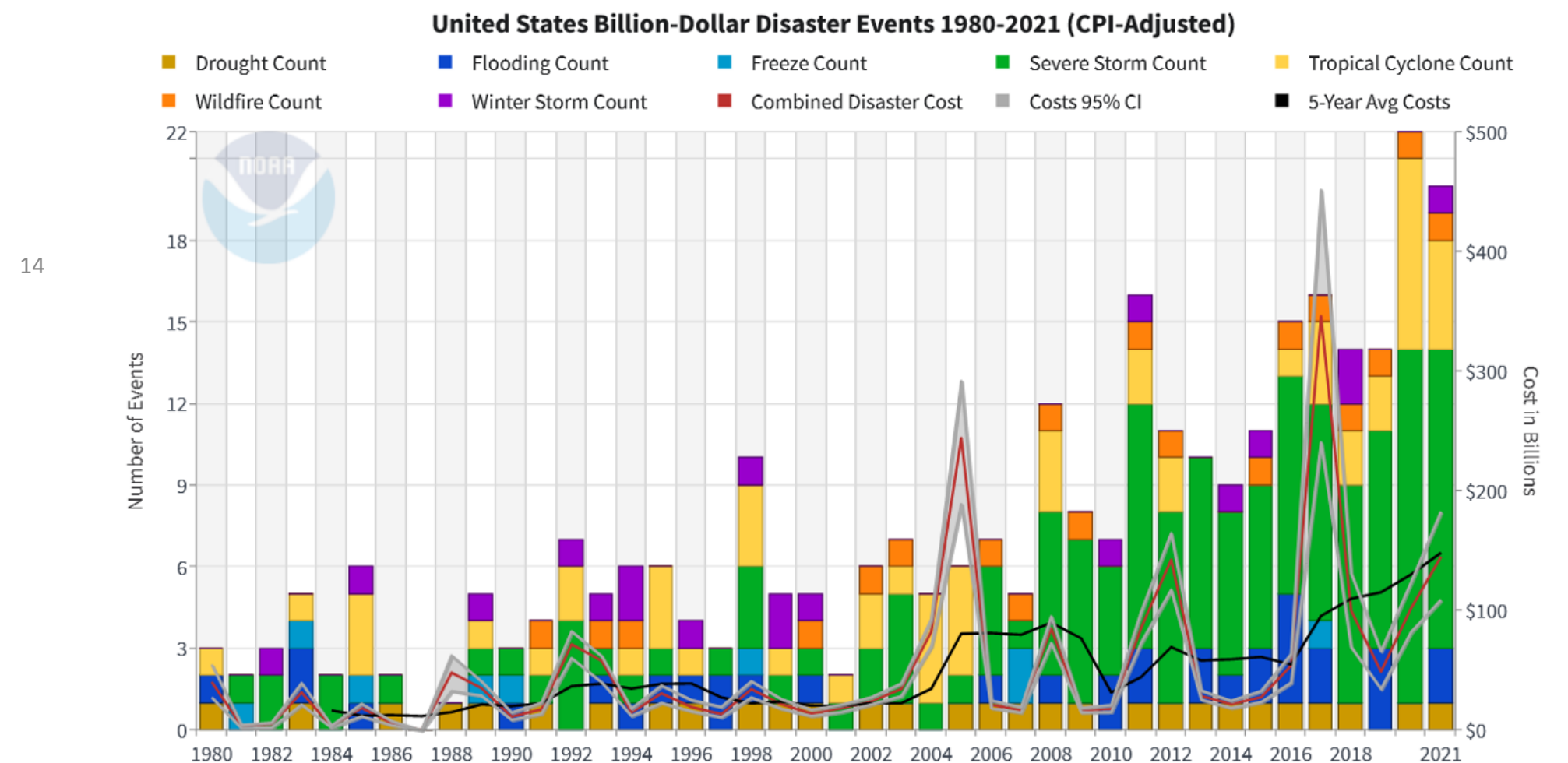
# Why Energy Storage?

## Climate and Decarbonization

**Total U.S. Greenhouse Gas Emissions by Economic Sector in 2021 (US EPA)**

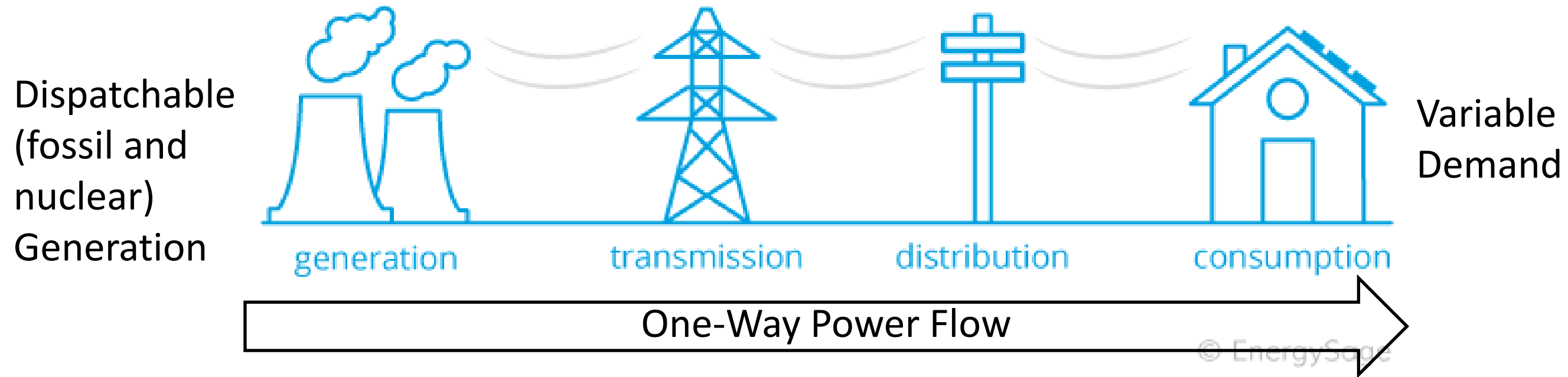


**US Billion-Dollar Disaster Events 1980-2021 (NOAA National Centers for Environmental Information (NCEI))**



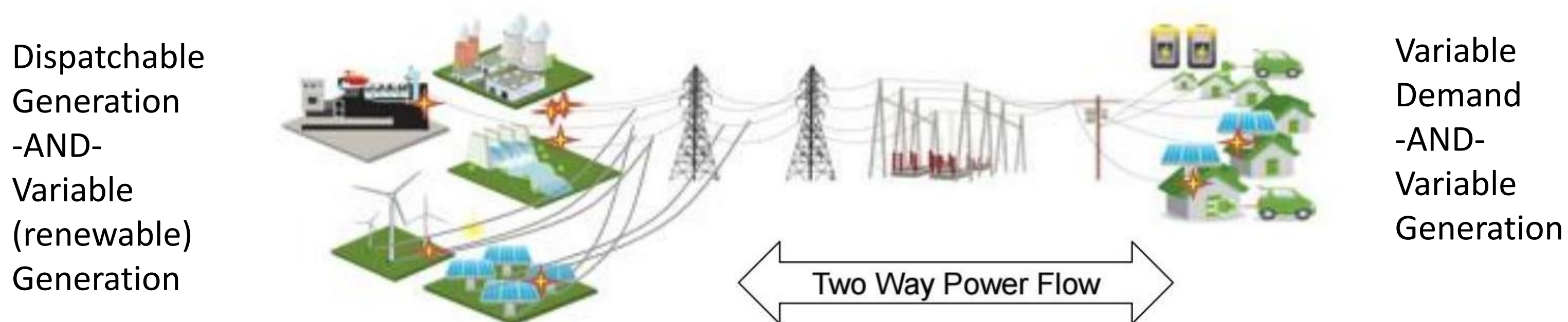
# Our Electric Grids are Changing!

## Old Power Grid (world's biggest just-in-time delivery system)



- One-way power flow
- Generation must equal consumption in real time
- Overbuilt to accommodate peak demand
- Cannot handle too much variable (renewable) or distributed generation
- Vulnerable to outages

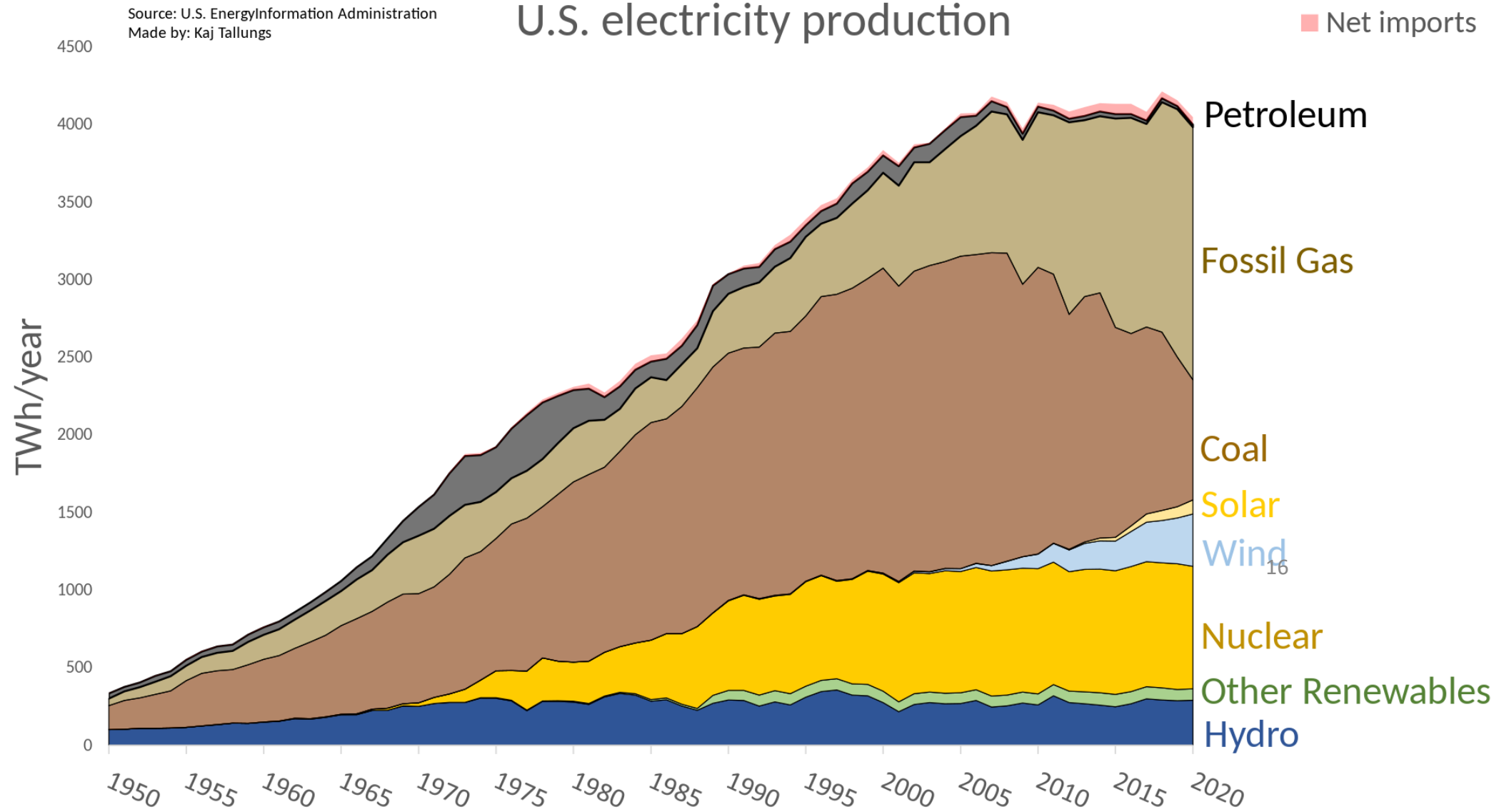
## Modern Power Grid (decentralized, flexible, resilient, highly variable)



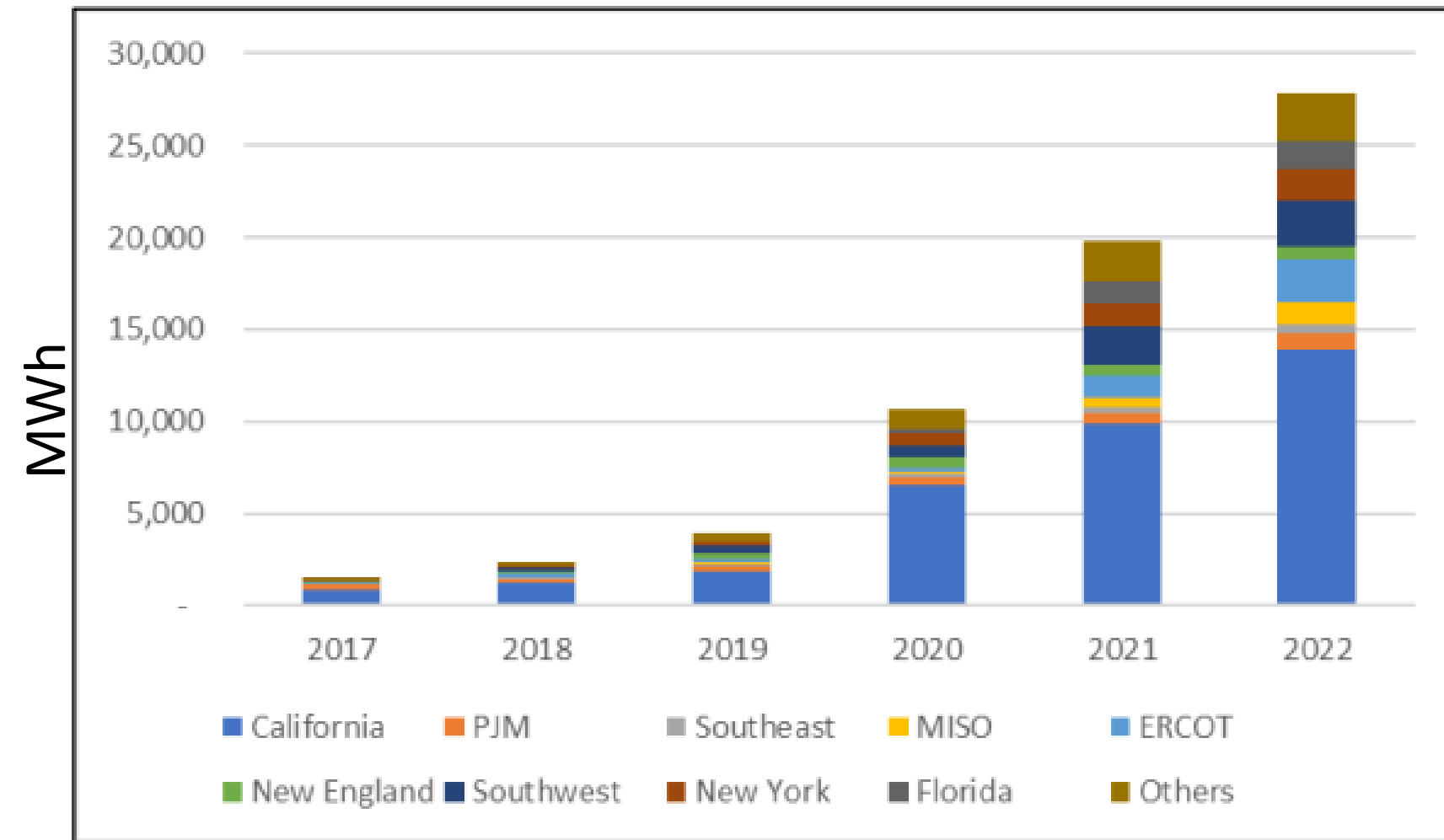
# US electric generation vs energy storage capacity

U.S. electricity production

Net imports



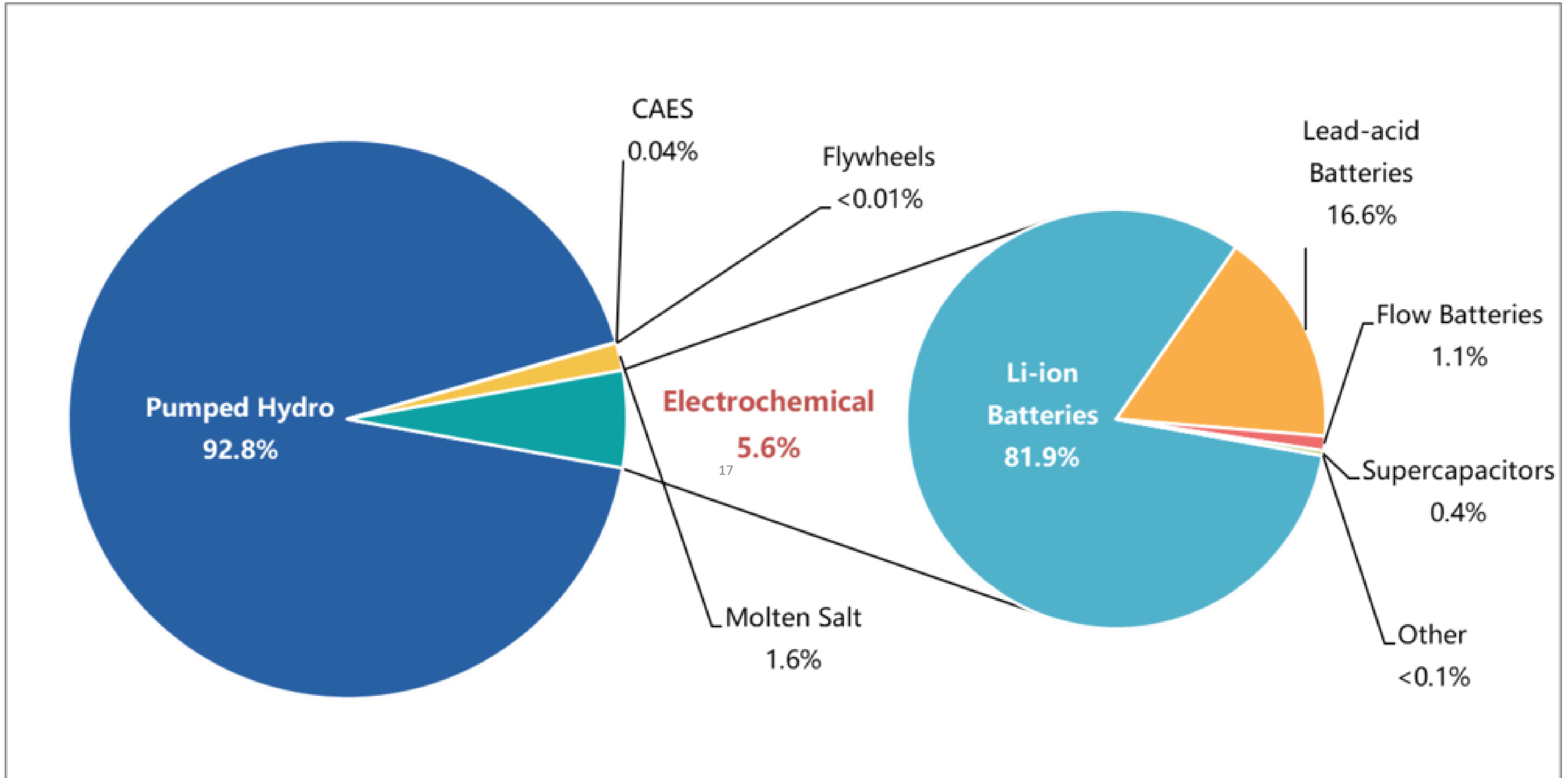
US energy storage capacity



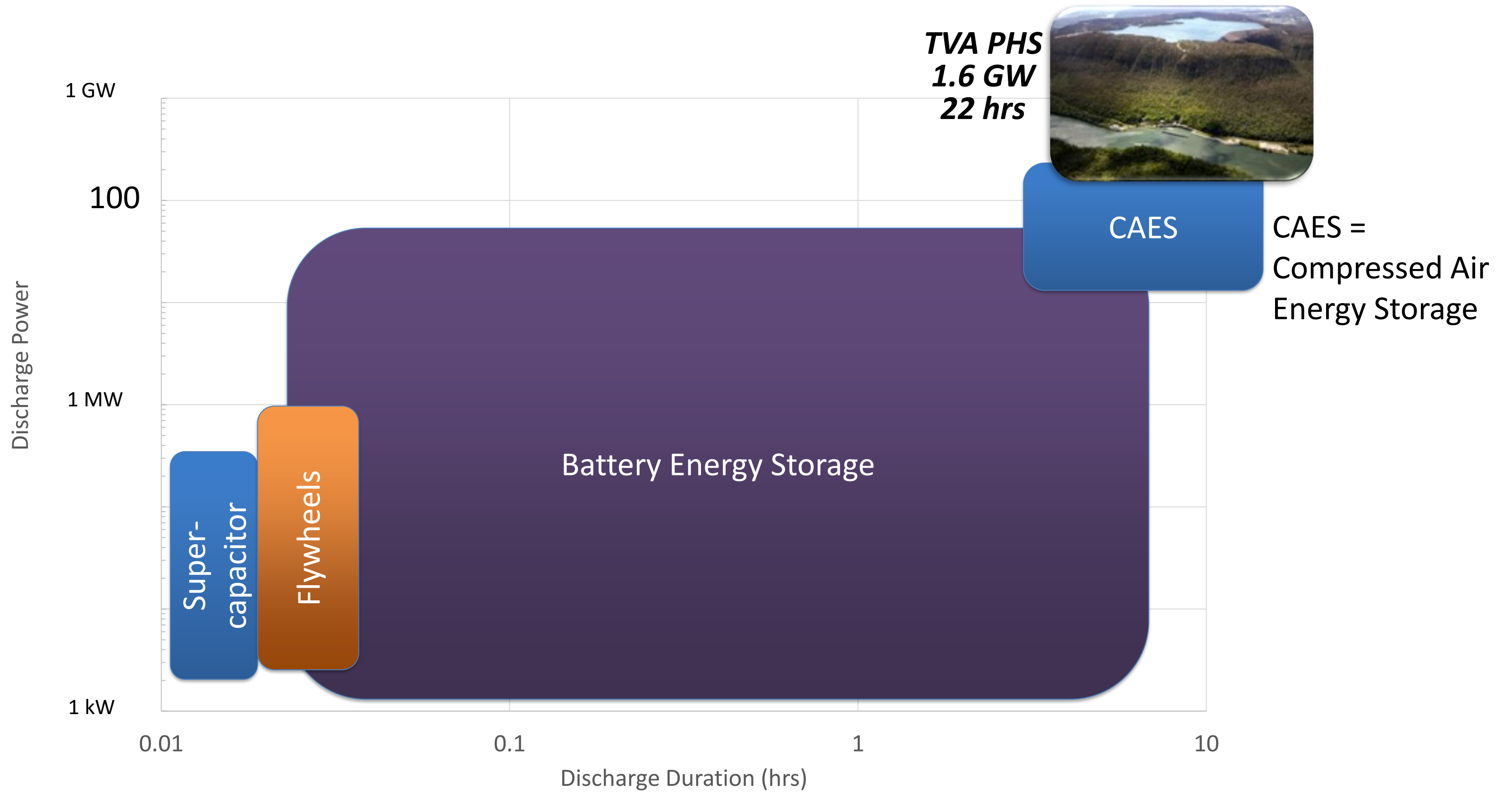
1 Terawatt = 1 million Megawatts



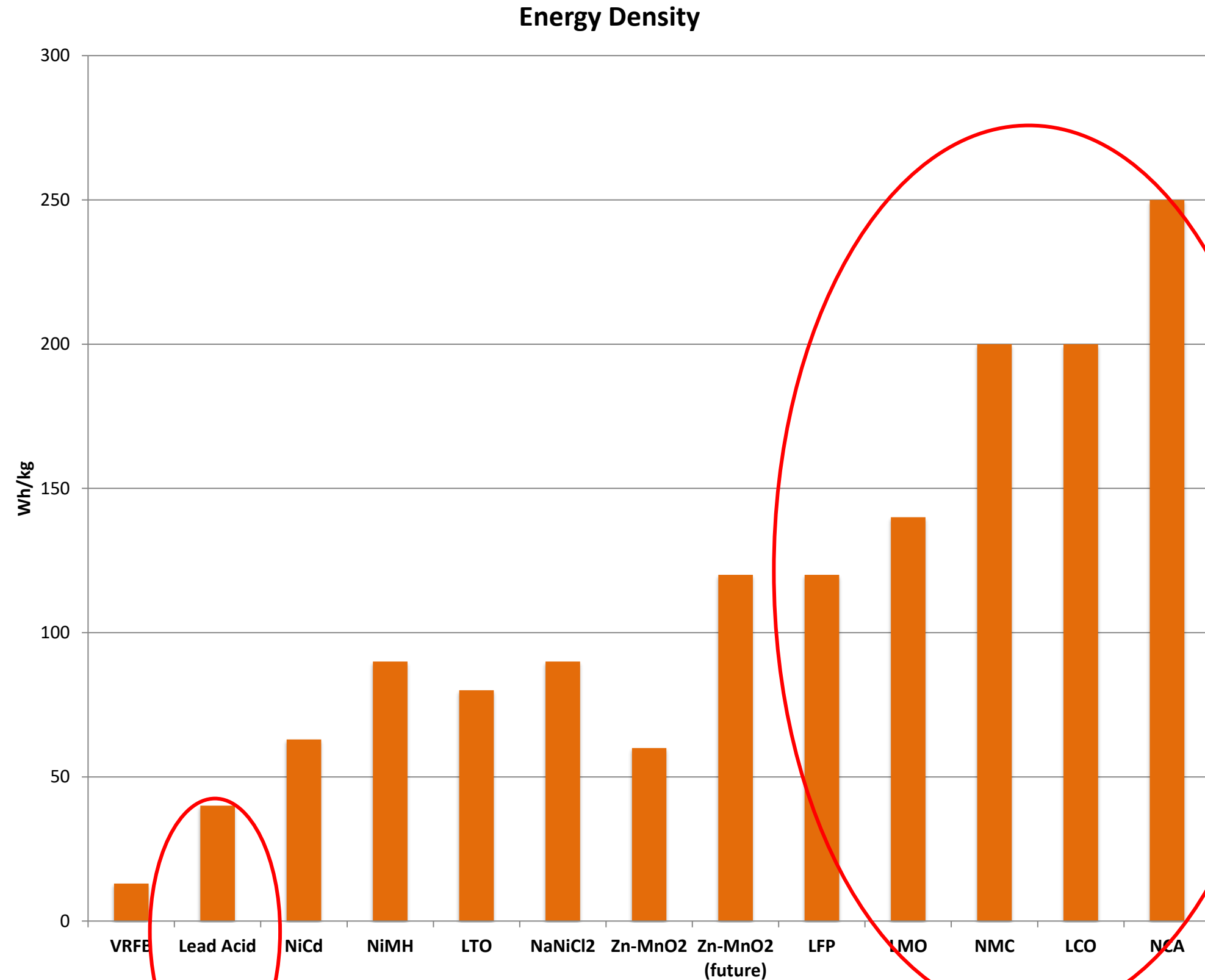
# Global operational energy storage (MW) 2020



# Energy Storage Performance Ranges



# Battery Technologies and their Energy Densities



Abbreviation	Name
VRFB	Vanadium Redox Battery
Lead Acid	Lead Acid
NiCd	Nickel Cadmium
NiMH	Nickel Metal Hydride
LTO	Lithium Titanate
LFP	Lithium Iron Phosphate
LMO	Lithium Ion Manganese Oxide
NMC	Lithium Nickel Manganese Cobalt Oxide
LCO	Lithium Cobalt Oxide
NCA	Lithium Nickel Cobalt Aluminum Oxide
Zn-MgO <sub>2</sub>	Zinc Manganese Oxide
NaNiCl <sub>2</sub>	Sodium Nickel Chloride (Zebra)

# Energy storage sizes

Residential Scale

Example: 13.5 kWh



Commercial/Industrial Scale

Example: 126 kWh



Utility Scale

Example: 8 mWh



# Tesla Battery Pack: 85 kWh



**7,104 cells**



<http://insideevs.com/look-inside-a-tesla-model-s-battery-pack/>  
<http://club.dx.com/forums/forums.dx/threadid.457734>

*18650 cell format used in 85 kWh  
Tesla battery*

Currently, global battery production is driven by the electric vehicle industry.



A system like this 20MW/80MWh utility-scale battery in Mira Loma, California requires at least 6.7 million of these 18650 cells

# Thank You



**Todd Olinsky-Paul**

Senior Project Director  
Clean Energy States Alliance  
[Todd@cleanegroup.org](mailto:Todd@cleanegroup.org)

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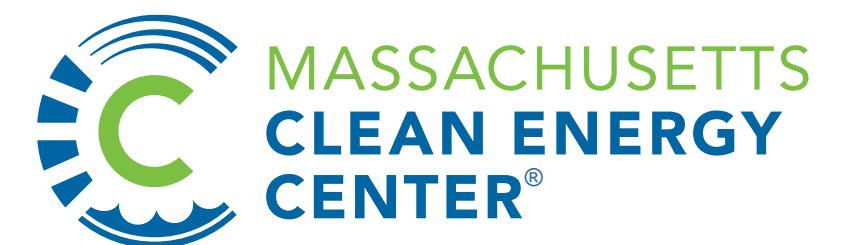
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# Upcoming Webinars

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Micro-Financing and Locally Led Development: A Scalable Model for Resilient Power in Rural Communities (May 16)

Energy Storage Interconnection – Challenges and Solutions (May 21)

Batteries 101, Part 2: Benefits and Applications of Battery Energy Storage in Massachusetts (May 30)

Read more and register at [www.cleanegroup.org/webinars](http://www.cleanegroup.org/webinars)



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