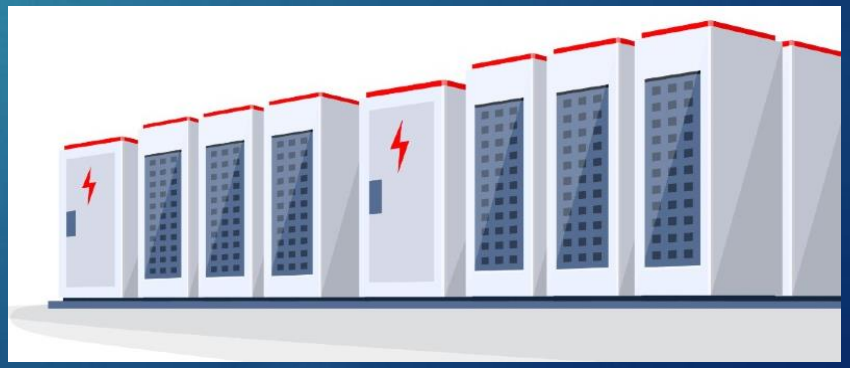
Battery Energy Storage Systems (BESS) Best Practices for Medway

Wednesday, February 16, 2022

Medway Planning and Economic Development Board

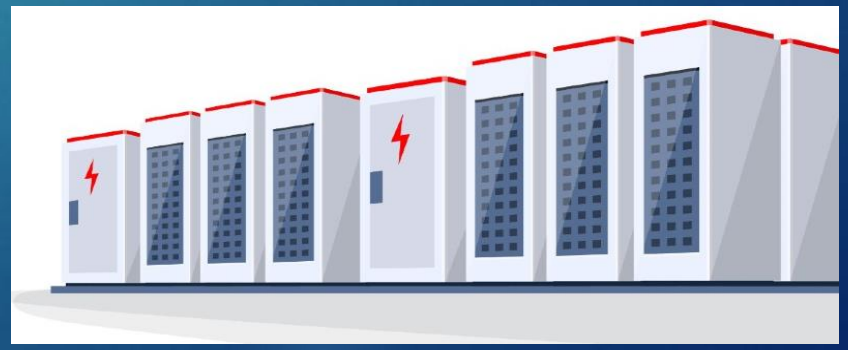
BESS Best Practices
Overview of Tonight's Meeting

- This is a meeting of 3 Town of Medway boards or committees – Planning and Economic Development Board (PEDB), Select Board, and the Energy and Sustainability Committee. The chair of each group will call their meeting to order. As this is a 100% virtual meeting, committee members must announce their names via roll call for the record.
- Meeting Recording – Medway Cable is recording this meeting which will be available on Livestream on Thursday.
- Context, how did we arrive at this point?
- Contract with Arup – Scope of Services
- Purpose of tonight's meeting
- Ground Rules for engagement
- Arup Presentation
- Questions and Answers



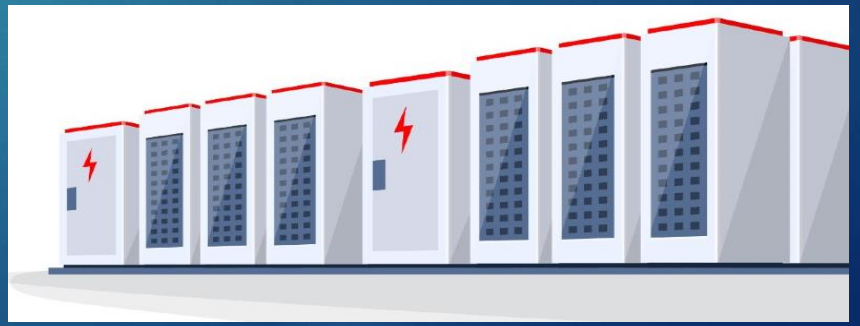
BESS Best Practices – Context

- Able Grid, an energy storage system developer and builder, is interested in constructing a battery energy storage system in Medway and approached the Town about amending its Zoning Bylaw to expand the Town's existing Energy Resource District (in and around the Exelon and Eversource facilities) to allow for such BESS use.
- May 2021 Town Meeting voted to direct the PEDB to conduct a review and study of battery energy storage systems (BESS) and to engage the services of consultants and other experts to provide information on all aspects of the operations, safety, security and technology of such systems, including the economic impact of a BESS facility if located in the Town of Medway, and to provide a report of the Board's findings and recommendations, to include but not be limited to, consideration of potential amendments to the Medway Zoning Bylaw.



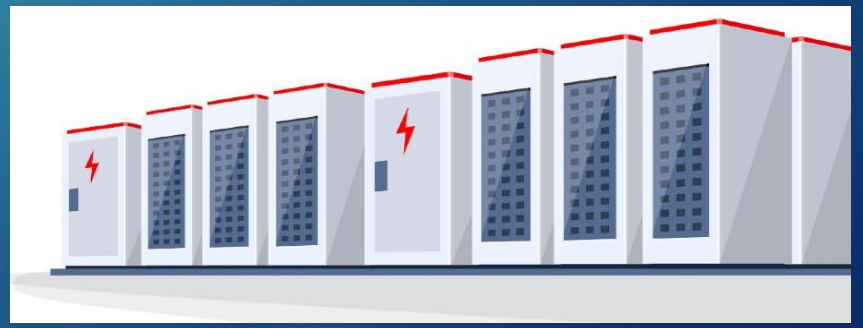
BESS Best Practices – Context

- In November, after conducting an RFP process, the Town contracted with Arup, a multi-disciplinary firm of engineers, designers, planners, consultants and technical energy specialists to serve as the Town's primary BESS consultant for technical energy consulting services. www.arup.com
- Arup's Scope of Work - 4 key elements
  - Research and prepare a Best Practices report
  - Research and prepare a zoning considerations report to identify key technical language to include in zoning bylaw amendments.
  - Prepare a memorandum of siting considerations for BESS facilities.
  - Prepare a review memorandum of Able Grid's BESS proposal at such time it is submitted.



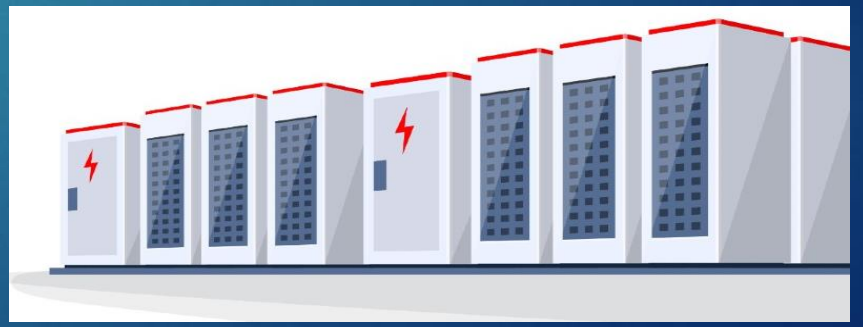
Purpose of Tonight's Meeting

- To present and discuss the first component of Arup's work for the Town.
- Arup has prepared a BESS Best Practices report. It is posted at the PEDB's web page. The link to the report is provided in the CHAT box.
- The scope of this meeting is the Arup Best Practices report. This is the opportunity to learn some basics about battery energy storage systems.
- Arup will provide an overview of the report. The primary presenters are:
  - Geoff Gunn, P.E. Associate Principal, Energy Lead
  - Victoria Grimes, P.E. Fire, Life Safety, and Process Safety Consultant
- Attendees may ask questions and offer comments about the Arup BESS Best Practices report. Other Arup staff are also available to answer questions.
- Tonight's meeting will not get into particulars of zoning Able Grid's project, or any specific site.



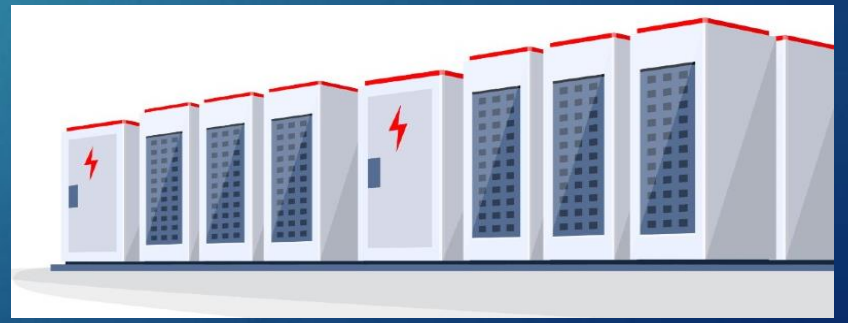
Ground Rules

- We would like to know who is present at tonight's meeting. Please go to the Zoom Participant List, find your name or identifier and indicate if you are a resident, business, or property owner and include any applicable organizational affiliation.
- Attendees will be muted.
- Arup consultants will deliver their presentation.
- During the presentation, please post any questions or comments in the Zoom CHAT feature.
- At the conclusion of the presentation, Town staff will facilitate answering the CHAT questions & comments.
- We will then open the session to additional comments. Please use the raise hand symbol and you will be called on.
- Conclude by 8:30 pm



Next Steps

- The Best Practices report will be revised based on tonight's discussion and will be reposted to the Board's web page.
- Arup will work next on a report on important considerations to include in any zoning bylaw amendments to address battery energy storage systems. A Zoom meeting on that report is planned for March 17, 2022. Stay tuned for details.



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Town of Medway BESS

Research and Test Practices Summary Presentation

Arup

February 16, 2022

Arup Team

Geoff Gunn, P.E.

Associate Principal | Energy Lead

Victoria Grimes, P.E.

Fire and Hazards Consultant

Jonathan Eisenberg, P.E.

Associate Principal | Science Lead

Hassan Hamdan

Associate Principal

Mike Lepisto, P.E.

Associate

Justin Roy, P.E.

Senior Engineer

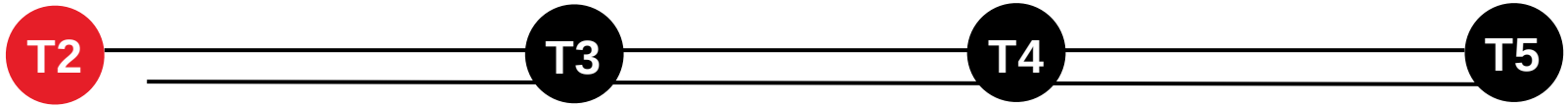
Scope of Project

Technical Summary of BESS

Technical BESS report summarizing best practices and technical information about the energy storage industry.

Technical Siting Considerations for BESS

Memorandum summarizing general siting considerations for BESS facilities.



Technical Considerations for BESS Zoning

Memorandum summarizing technical components of BESS for consideration as the Town of Medway reviews existing and proposed Energy Resource zoning bylaws.

Second PEDB meeting.

Review of Able Grid EFSB Submission

Technical review of Able Grid BESS project submission package to the EFSB.

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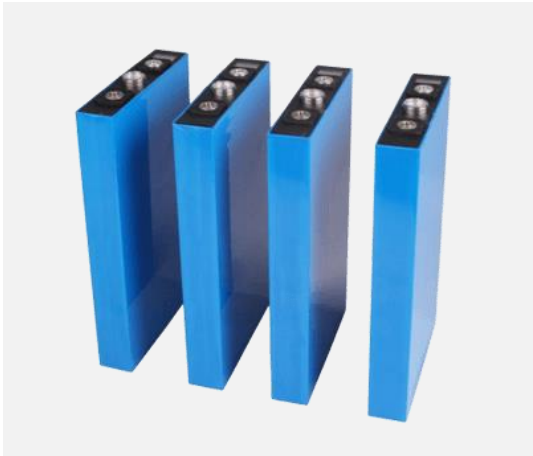
Agenda

- Battery Terminology Overview
- BESS Economics
- Benchmarking BESS Sites
- BESS Technical Overview
- Regulations and Available Guidance
- Component Selection, Testing, and Listings
- Siting Considerations
- Fire Remediation Actions and Response

Battery Terminology Overview



Cell

The basic electrochemical unit, characterized by an anode and a cathode, used to receive, store, and deliver electrical energy.

Module

A battery cell, including any exterior casing.

Array / Unit

A physical grouping of batteries. Sometimes referred to as a “cluster”. The capacity of batteries in an array is considered on a cumulative basis.

Battery Energy Storage System

A type of Energy Storage System consisting of an array of batteries intended to provide electrical power during outages and supplement available resources during times of high demand.

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Battery Terminology Overview

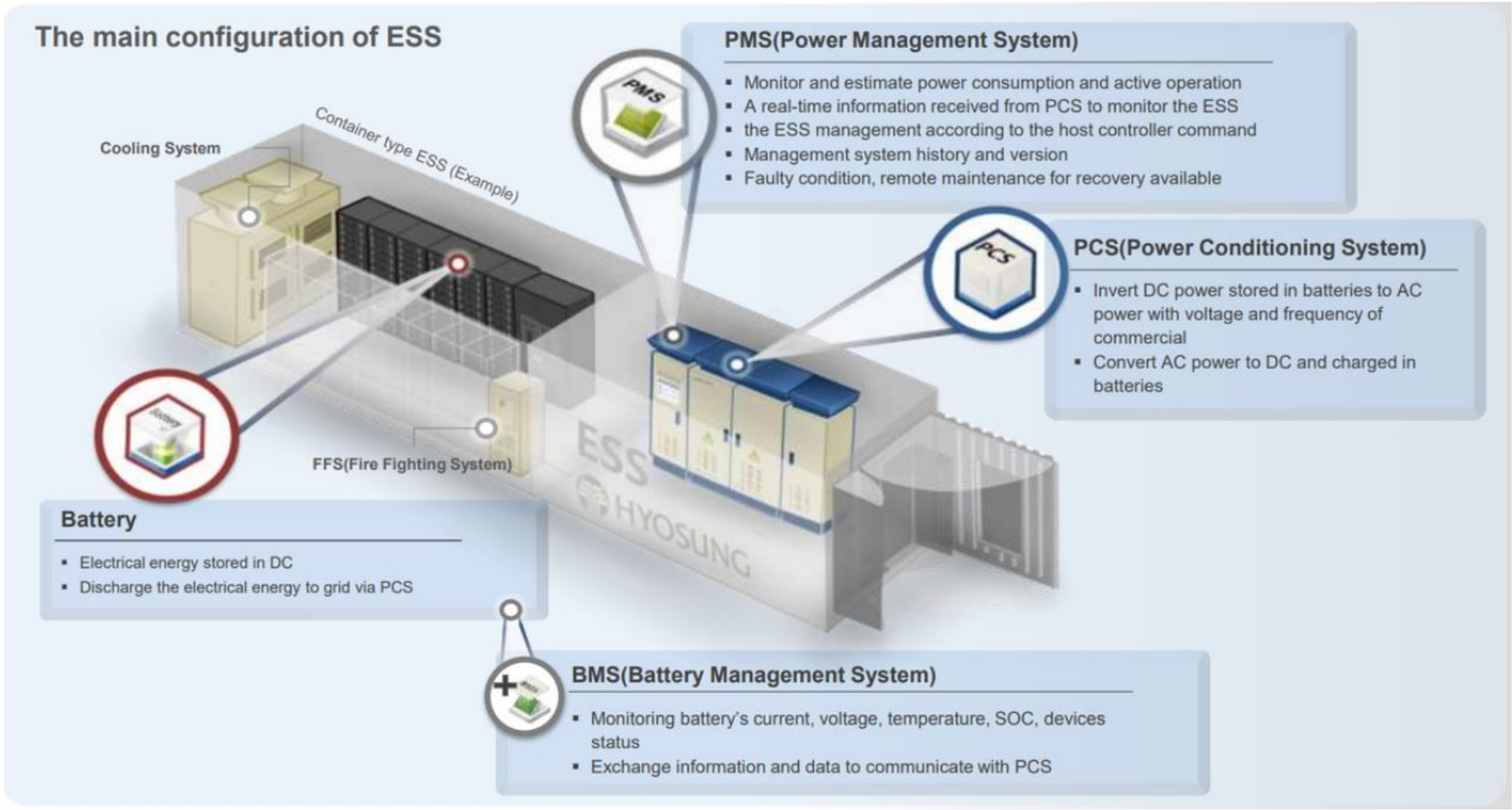

Image source: Hyosung Heavy Industries

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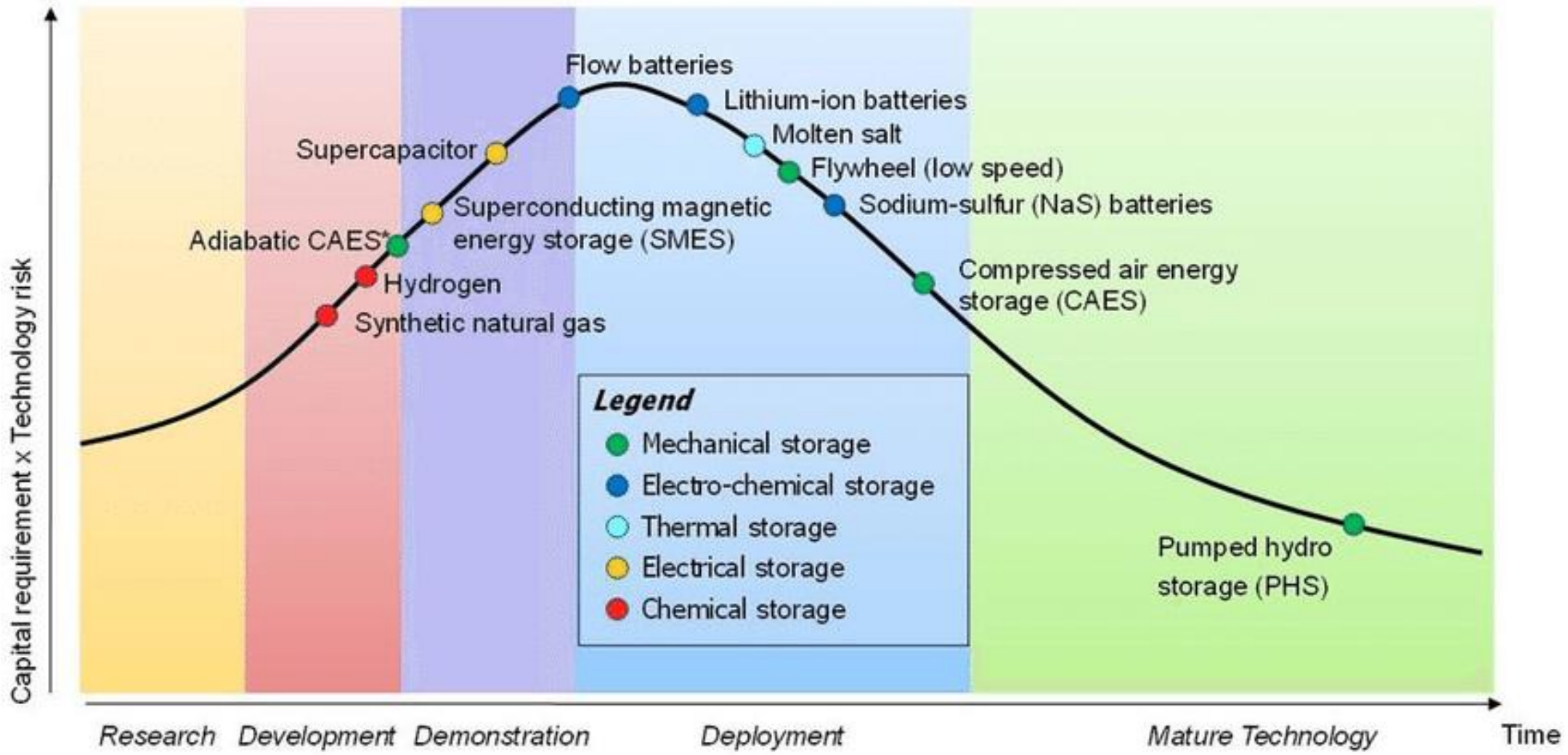
BESS Technology Overview



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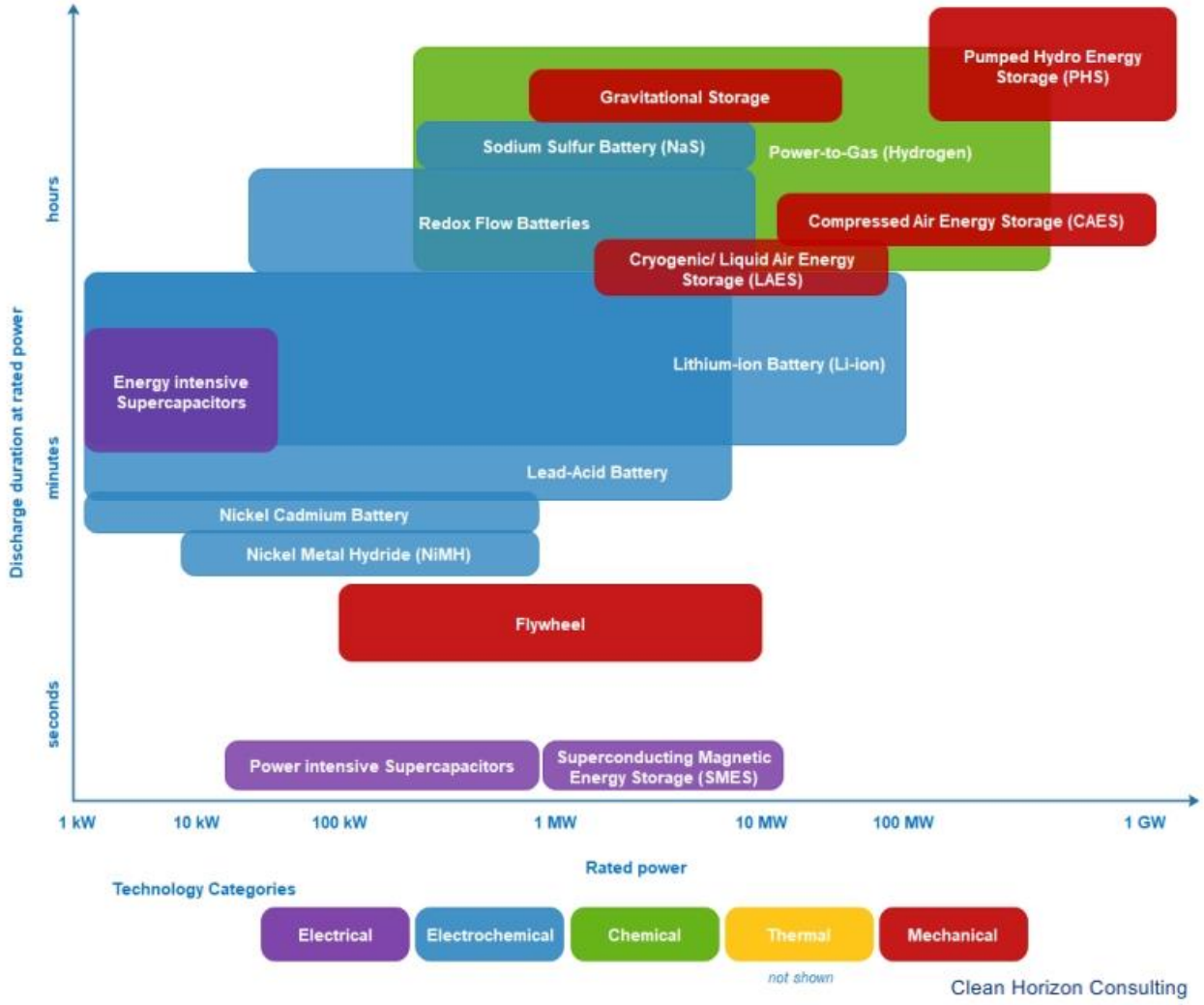
BESS Technology Overview



BESS Economics

Available BESS Revenue Streams for Developer / Owner

Tax savings

- Tax savings for entities with a tax appetite. Savings are maximized when coupled to on-site PV

Incentives

- MA Clean Peak Standard
- Connected Solutions and Daily Dispatch
- MA SMART when paired with on-site PV

On-bill savings

- Demand charge reduction
- Energy arbitrage through TOU
- ICap savings

Utility programs

- Ancillary services/grid stability
- Operating reserves
- Reduction of grid congestion
- Ramp rate control
- Energy arbitrage
- Capacity firming
- Peak shaving

BESS Economics

BESS Representative Capital Cost

Li-ion battery storage system

- Li-ion racks
- Containers (or buildings)
- Warranty and guarantee
- Power conversion system (PCS)
- Control system
- Commissioning
- Pad mounted transformers

Foundations

- Container pads
- Transformer pads
- Substation foundation

Electrical balance of plant

- Underground cables
- Grounding
- Pull wire
- BESS controls system
- Project substation and step-up transformers

Site works

- Site preparation
- Site management during construction

BESS Economics

BESS Representative Capital Cost

Owner’s development costs

- Land acquisition
- Permitting
- Financing
- Engineering / procurement
- Insurance

Grid interconnection

- Cost for utility interconnection equipment and utility-side upgrades

Testing and energization

- Equipment testing
- Wiring testing
- Control and Protection Testing

Operations and maintenance

- Remote monitoring
- Remote dispatch/dispatch control
- On-site maintenance and inspections

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BESS Benchmarking

- BESS facilities come in a wide range of sizes
- Serve a wide range of purposes
- Typically measured in electrical capacity (MW, or MWh)

BESS Application	Approximate Anticipated Capacity Ranges	Approximate # of Houses Powered
Investor-owned public utility	5-500 MW / 10-1,200 MWh	~330 – 40,000
Municipality-owned public utility	5-50 MW / 10-100 MWh	~330 – 3,300
Private landowner	0.25-2 MW / 0.5-8 MWh	~17 – 270
Private residential	0.002-0.005 MW / 0.005-0.015 MWh	~ 0.2 – 0.5

BESS Benchmarking

	Medway BESS	Cranberry Point	Minuteman Battery Energy Storage System	Moss Landing
Location	Medway, MA	Carver, MA	North Reading, MA	Montgomery County, CA
Size	250 MW / 500 MWh	150 MW / 300 MWh	5 MW / 10 MWh	400 MW / 1,600 MWh
Status	Design / Permitting	Design / Permitting	Operational – Jun. 2019	Operational – Dec. 2020

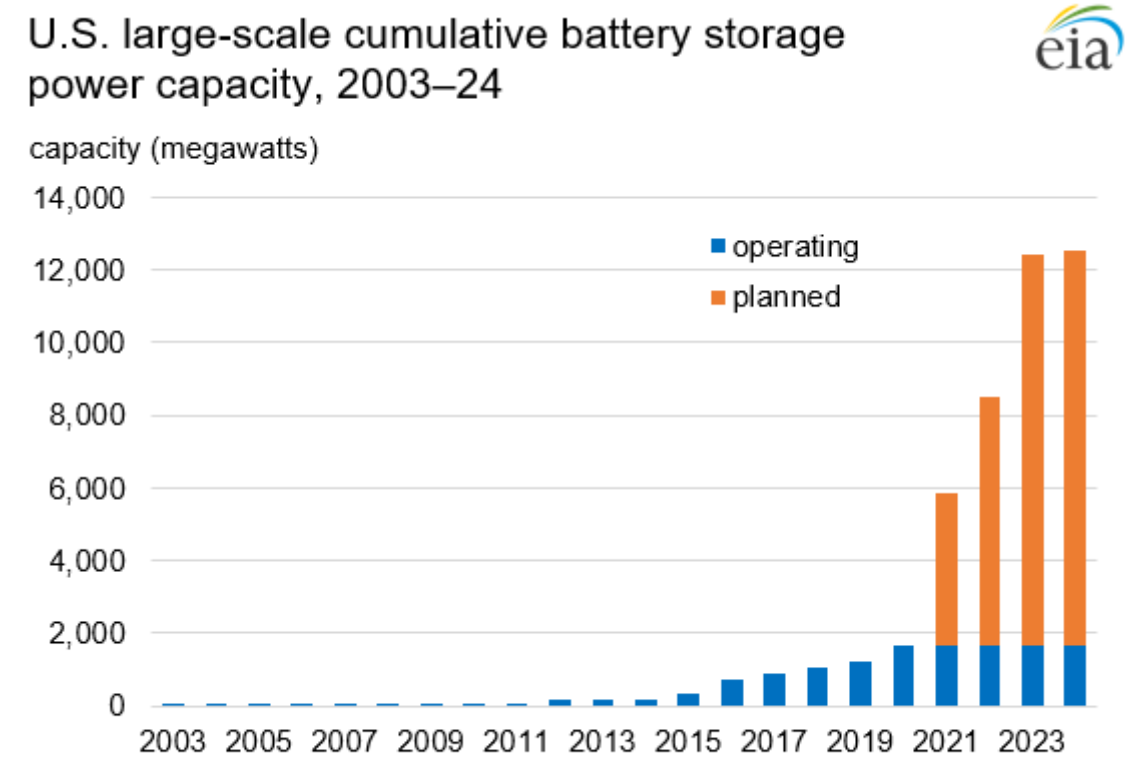

Image: EIA, Electricity Monthly Update.

BESS Benchmarking

BESS ≥ 100 MW

Pre-Construction: 255,500 MW (1051 projects)

Under Construction: 5,000 MW (23 projects)

Operating: 3,500 MW (20 projects)

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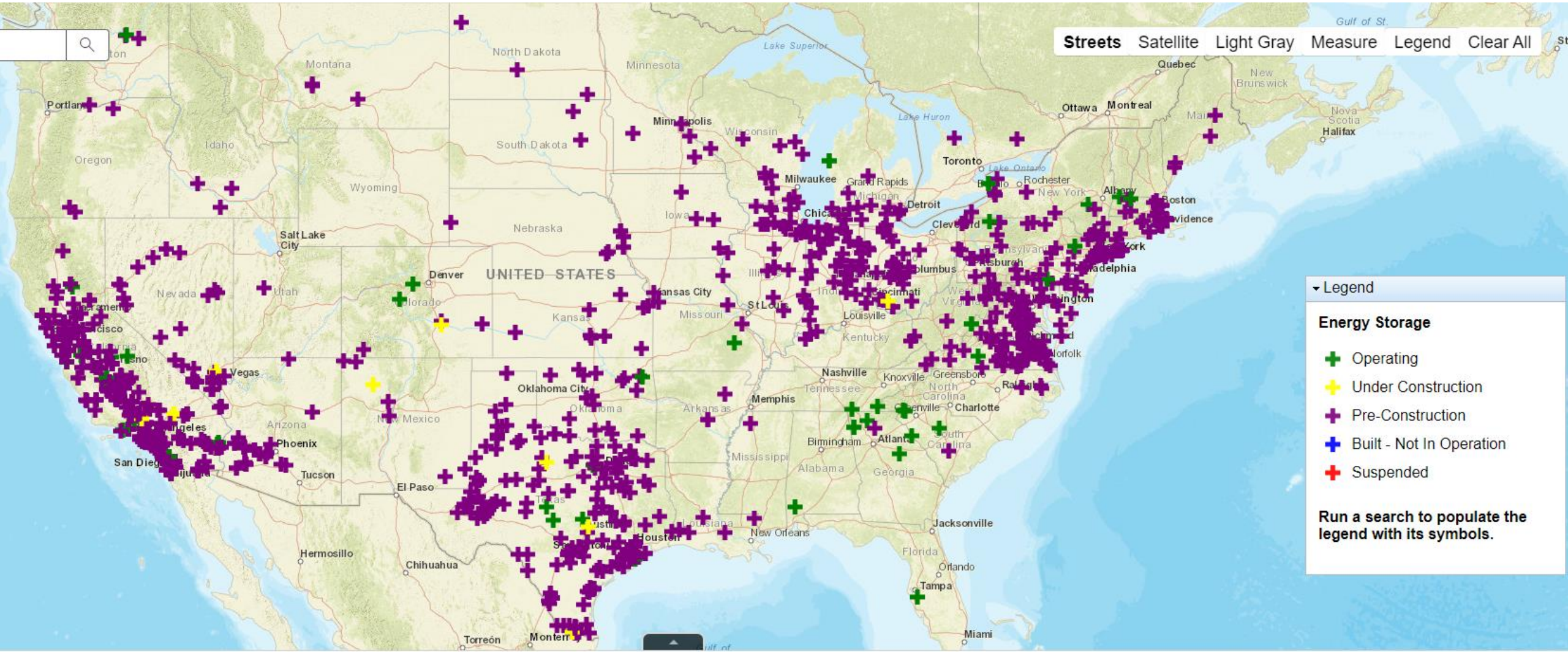

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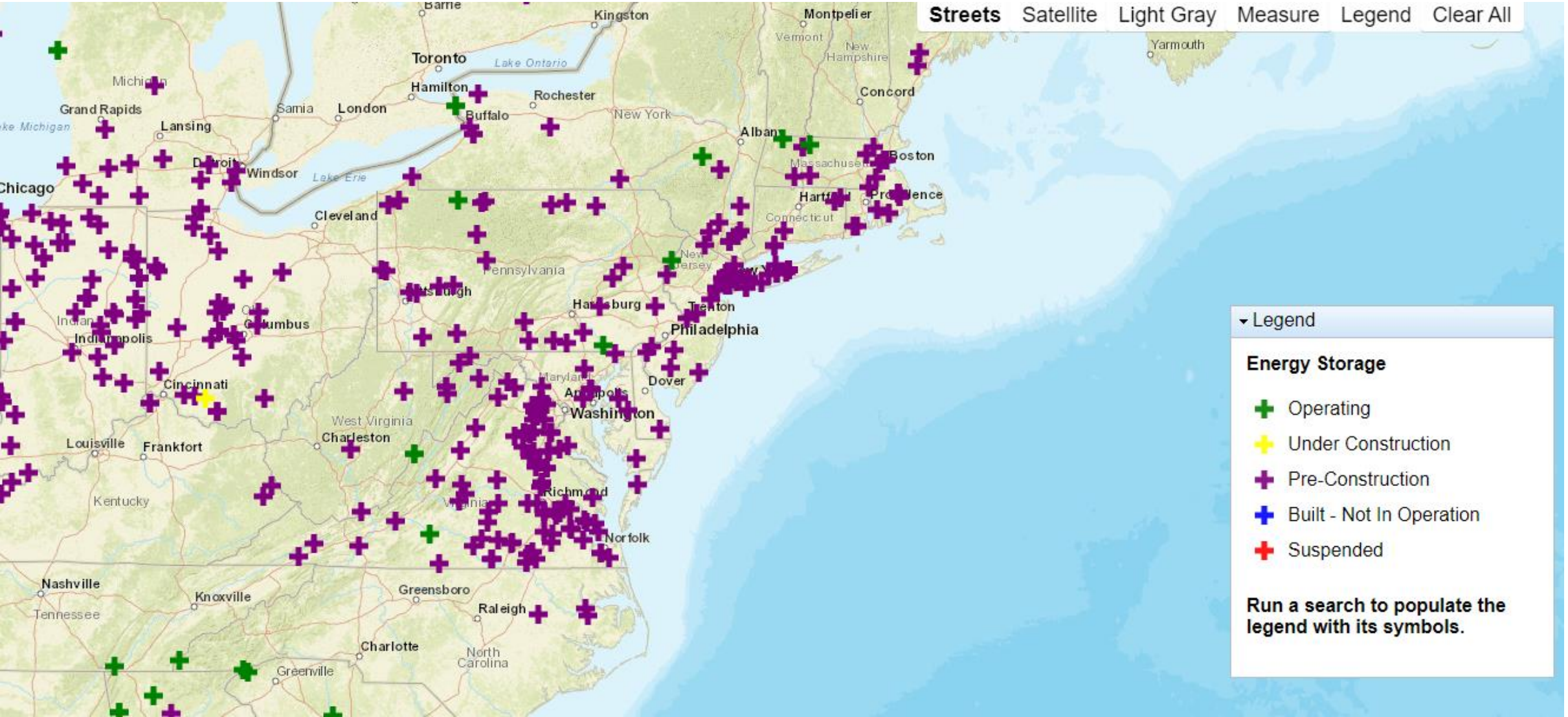
BESS Benchmarking

BESS ≥ 100 MW



Listings

- Listings tells you that a product or system is design and tested to a baseline standard

- Codes tell you how to install the system or product within a facility

Listings

Examples of Listed Products

- **Listed.**
  - A product included in a list by a published organization concerned with evaluation of products or services, whose listing states that either the product meets appropriate designated standards or has been tested and found suitable for a specified purpose.
- Examples of “listed” products

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Listings

Terminology

- **Nationally Recognized Testing Agency (NRTL):** Private testing agencies that are certified to test against specific standards.

Intertek Electrical Testing Labs (ETL)

United Laboratories (UL)

FM Global

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Listings

UL 9540 and UL 9540A

UL 9540: Applicable **listing** for BESS systems

UL 9540A: Applicable **testing standard** for BESS systems above a certain size.

UL 9540A test results provide AHJs and designers with the tools and information to evaluate BESS performance during fire events and inform design decisions such as:

- Location & separation distances
- Array / unit capacities
- Fire suppression systems
- And more

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Listings

Massachusetts BESS Listings

What listings and testing criteria can AHJs expect for lithium-ion BESS projects in Massachusetts?

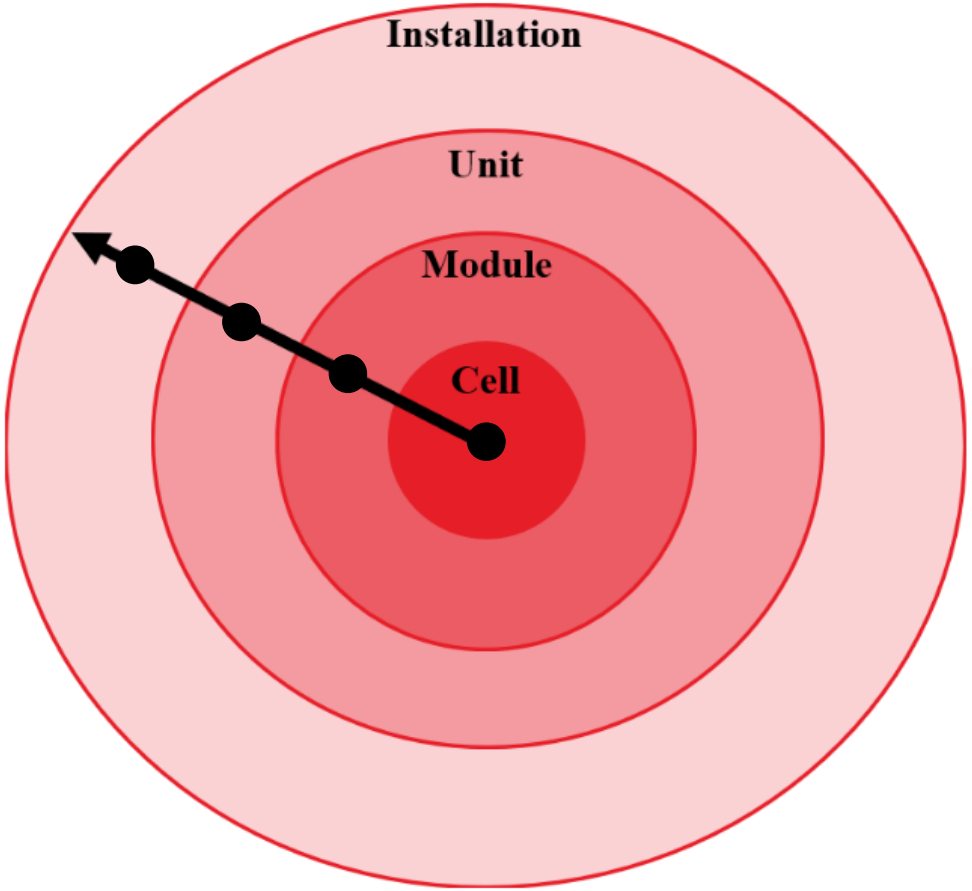
Li-ion Listed Pre-Engineered BESS System Capacity	Expected Listings
Individual Array Capacity **less than or equal to** 50 kWh	UL 9540 listed
Overall BESS Capacity **less than or equal to** 600 kWh	UL 9540 listed
Individual Array Capacity **greater than** 50 kWh	UL 9540 listed + UL 9540A tested
Overall BESS Capacity **greater than** 600 kWh	UL 9540 listed + UL 9540A tested

UL 9540A fire testing was added to the UL 9540 listing requirements in April 2021 for BESS exceeding the above thresholds.

Listings

UL 9540A Test Methodology

- Testing begins at cell level
- If fire propagation is not observed, testing does not continue to the next level
- If fire propagation is observed, testing continues to the next level



Publicly available database sponsored by UL for BESS tested per UL 9540A is available here.

Codes

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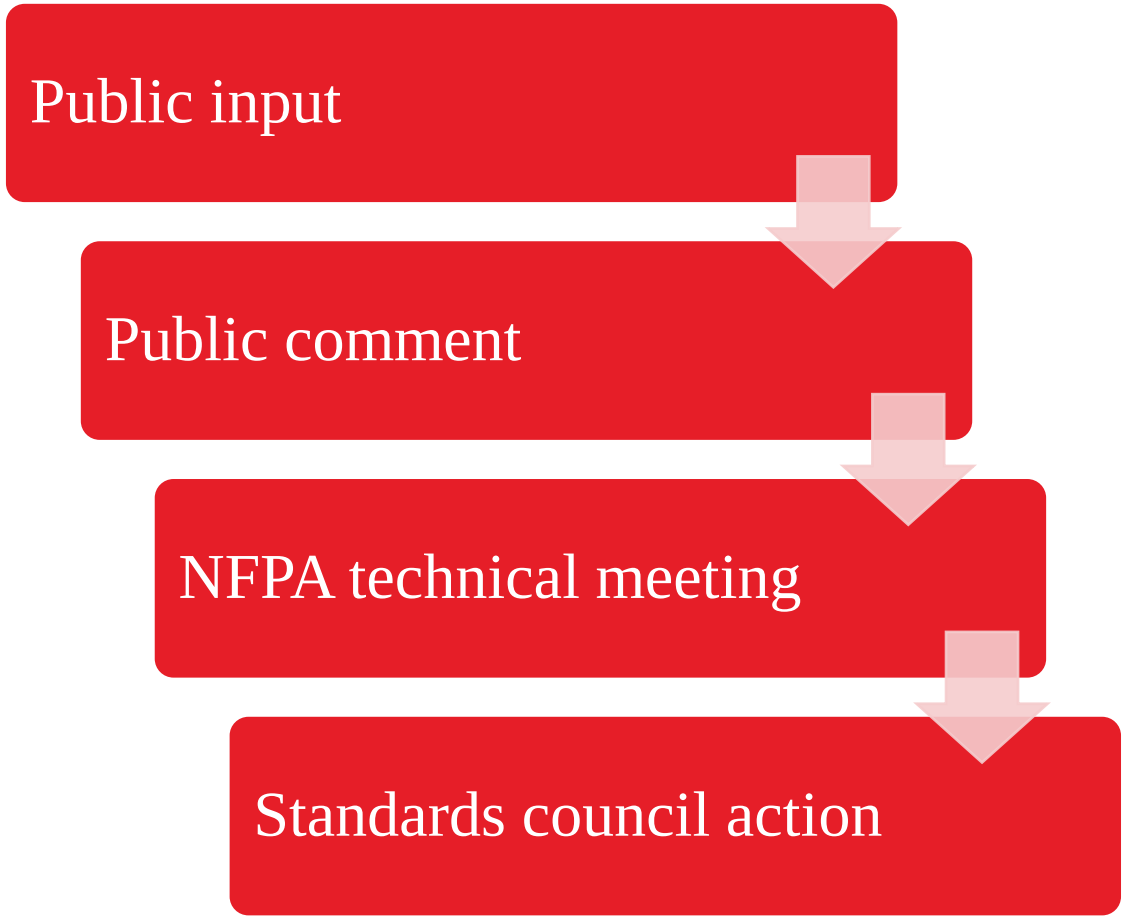
Codes

NFPA Code Development Process



NFPA Committee Member Classifications
Manufacturer (M)
User (U)
Installer / Maintainer (I/M)
Labor (L)
Applied Research / Testing Laboratory (R/T)
Enforcing Authority (E)
Insurance (I)
Consumer (C)
Special Expert (SE)

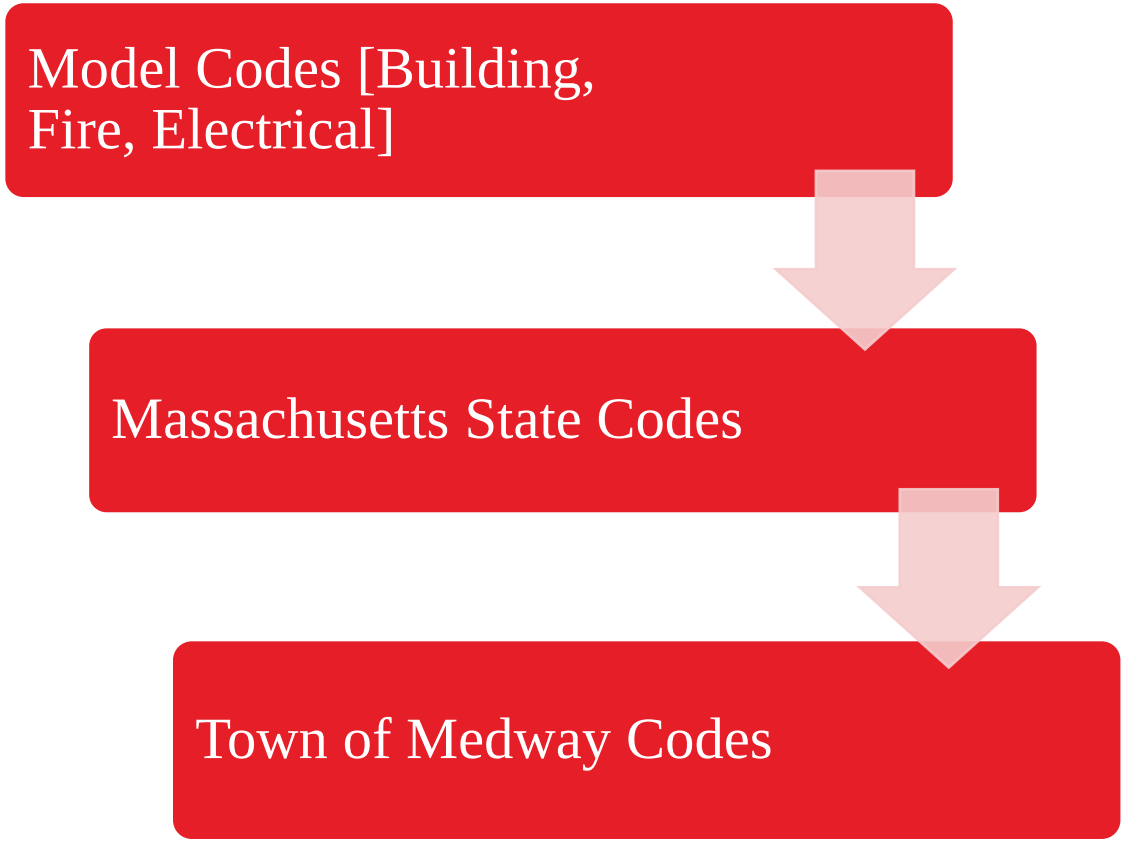
Codes

Massachusetts

- Massachusetts Comprehensive Fire Safety Code (MFSC)
  - Local fire department
- National Electrical Code (NEC)
  - Local building department
- Additional guidance:

NFPA 855

FM DS 5-33



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Codes

- Massachusetts Comprehensive Fire Safety Code
- NFPA 855, Standard on the Installation of Stationary Energy Storage Systems

Siting Considerations

Permissible Locations

Where are stationary BESS installations permitted?

Maximum Stored Energy

Based on the intended location, how big can these BESS installations be?

Separation Distances

Based on the intended location and size of the BESS, what are the applicable separation distances to adjacencies?

Environmental Considerations

What are additional environmental factors that should be considered during the design and permitting of a BESS facility?

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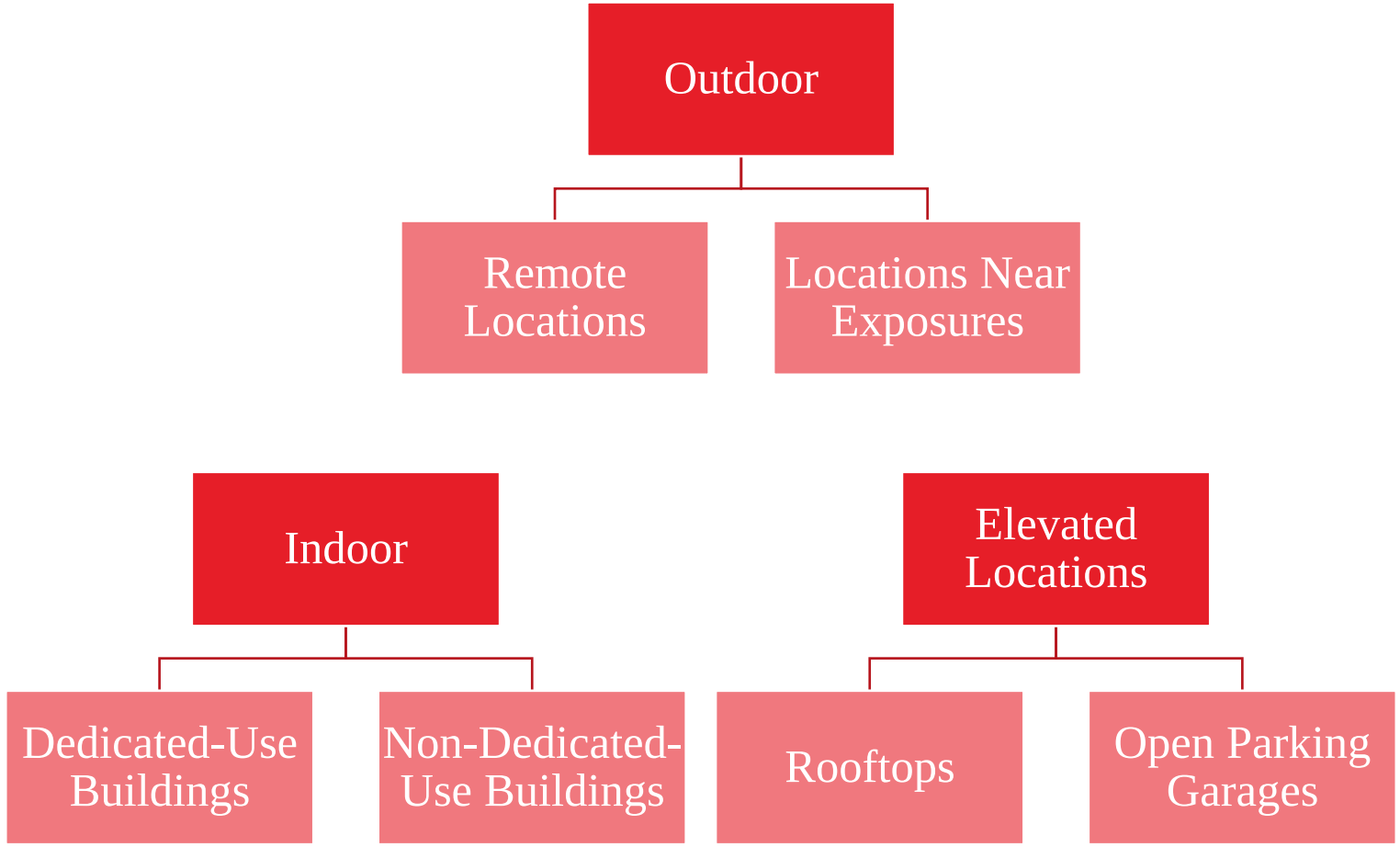
Life Safety Siting Considerations

Permissible Locations

Life Safety Exposures:

- Buildings
- Lot lines that can be built upon
- Public roads
- Stored combustible materials (e.g. ancillary outdoor storage or trash collection)
- Other exposure hazards not associated with electrical grid infrastructure



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Life Safety Siting Considerations

Permissible Locations

MFSC regulated BESS locations:

Location	Permitted in Massachusetts?
Outdoor Installations	Yes
Indoor Installations	Yes, where either of the following conditions apply: • In a dedicated room designated as a high-hazard (Group H) occupancy meeting the robust design requirements of the building and fire code • In a dedicated room separated by either 1-hour or 2-hour fire barriers, depending on the relative hazard of the building occupancy
Rooftop Installations	Only where the floor level is 75ft or less above lowest level of fire department access. Higher elevations require specific AHJ approval.
Below-grade Installations	Only where the floor level is 30ft or less below lowest level of fire department access

Life Safety Siting Considerations

Stored Energy Thresholds

1. Capacity of Individual Array
   - > **50 kWh**
2. Overall Capacity
   - > **600 kWh** for common battery chemistries (e.g. Li-ion, Flow, Sodium)

MFSC requires BESS to carry UL 9540 listing **and** UL 9540A fire test data

For larger utility-scale systems UL 9540 listing **and** UL 9540A fire test data is required

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Life Safety Siting Considerations

Separation Distances

Between battery arrays and…	Minimum Required Clearance – MFSC	Minimum Required Clearance – NFPA 855
Buildings	5 feet	10 feet
Property lines	5 feet	10 feet
Public roads	5 feet	10 feet
Stored combustible materials (e.g. ancillary outdoor storage, trash collection areas)	5 feet	10 feet
Other exposure hazards not associated with electrical grid infrastructure	5 feet	10 feet
Means of egress	10 feet	10 feet
Other arrays (where arrays > 50 kWh) *	3 feet	3 feet
BESS container walls *	Combustible walls – 3 feet Noncombustible walls – 0 feet	3 feet

* Unless UL 9450A supports reduced separation between arrays and between arrays and container walls

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Fire Remediation Actions and Response

1. Pre-Incident Planning
2. Emergency Response Plan
3. Training

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Fire Remediation Actions and Response

Pre-Incident / Emergency Planning

- **Primary hazards** associated with BESS (thermal runaway, electrical fires)
- **Battery Management System** (BMS) response and reporting capabilities
- **Site safety systems** including thermal runaway management systems, fire suppression, and fire detection
- **Shutdown procedures** for the BESS system specific to the battery technology; location of manual electrical disconnects
- **Manual fire-fighting response** for the specific battery technology
- Damaged BESS component **removal procedures**
- **Access routes**
- Manual smoke **ventilation**
- **Safety Data Sheet** (SDS) for battery cells; chemical composition; recommended fire suppression agents; reactivity of battery cell with various materials

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Thank you!

Questions?