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Principles and Options for Designing Battery Energy Storage Zoning Ordinances

July 2025

Devyn W Powell
Jeremy B Twitchell

U.S. DEPARTMENT OF ENERGY

Prepared for the U.S. Department of Energy
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Executive Summary

Deployment of battery energy storage (BESS) systems, both standalone and as part of hybrid systems paired with generation, has rapidly increased in the United States in recent years as utilities and communities have deployed storage to improve electric grid reliability and act as a cost-effective alternative to larger grid infrastructure. The modular nature of BESS technologies means systems may be built near other existing land uses, creating the potential for conflicts with neighboring landowners that can be managed and mitigated through zoning and permitting requirements established by local jurisdictions. While many cities and counties have adopted ordinances specific to BESS into their local zoning codes, these ordinances vary significantly in their requirements and level of detail. Meanwhile, many other jurisdictions, including those home to proposed or existing BESS projects, lack any specific language related to BESS in their zoning codes. Local planning and zoning officials have limited capacity and may lack the familiarity with BESS technologies needed to develop ordinances or otherwise make reasonable zoning decisions that balance safety, community impacts, and other goals. The resulting uncertainty at the local zoning level has led developers to withdraw projects in some areas and has spurred moratoria or bans on energy storage projects in others.

This report intends to provide practical resources for practitioners interested in reasonable and effective local regulation of battery energy storage. It does not present a model zoning ordinance, but rather provides additional context and analysis regarding the structure of energy storage zoning ordinances and the decision points for local officials. Zoning ordinances at the city, town, and county level across the U.S. were surveyed alongside two template model ordinances to identify common elements and options for regulating the zoning and siting of BESS. Common elements identified and analyzed include definitions and general requirements, including cutoffs or tiers used to apply regulations to different system sizes and the permitted zones where jurisdictions allow BESS to be sited; visual, noise, and aesthetic requirements, including property line setbacks, fencing and visual screening, noise, and lighting requirements; and safety and planning requirements, such as site plans, decommissioning plans or funds, and requirements for access by emergency services. The report also summarizes some of the more unique regulations, including those that place additional restrictions on BESS at the local level.

Acknowledgments

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Acronyms and Abbreviations

AHJ	Authority Having Jurisdiction
BESS	Battery Energy Storage System
dB	Decibel
EIA	Energy Information Administration
GW	gigawatt
IFC	International Fire Code
kW/kWh	Kilowatt/Kilowatt-hour
MW/MWh	Megawatt/Megawatt-hour
NFPA	National Fire Protection Association
PV	Photovoltaic
SDO	Standards-developing Organization

Contents

Figures

Tables

1.0 Introduction and Background

Local zoning and siting regulations for battery energy storage system (BESS) technologies are an often overlooked dimension of the rapidly developing energy storage industry. Officials at the city, town, or county level have the authority to determine where certain projects are permitted to be built, what size they may be, and other requirements that determine their approval.

Proposed energy storage projects often present a challenging conundrum for local zoning officials. Energy storage can offer multiple, tangible benefits to host communities: increased tax revenue, potential redevelopment of brownfield sites, and a local energy resource that can improve electric service quality and—in some instances—displace the need for more disruptive electricity infrastructure projects such as new power lines or generation facilities.

However, as the authors' previous work has concluded, energy storage projects can also impose safety, visual, auditory, and environmental impacts on host communities (Twitchell, Powell, and Paiss 2023). That report identified the potential community impacts of energy storage projects and tools that local jurisdictions can use to mitigate those impacts. This report will build on that work by presenting a more detailed study of the anatomy of energy storage zoning ordinances—what their elements are and how different jurisdictions have adapted those elements to different circumstances.

Deployment of BESS has accelerated rapidly in recent years, as shown in Figure 1 below. The United States had installed just over 26 gigawatts (GW) of battery energy storage capacity as of December 2024, a roughly 26-fold increase over the total installed storage capacity before 2020 (EIA 2025a). A record-breaking 10.3 GW of BESS capacity was installed nationwide in 2024, with 18 GW of additional capacity currently predicted by the end of 2025 (EIA 2025c). Many existing energy storage projects were built on favorable sites that had characteristics such as existing infrastructure, favorable zoning in place, and low potential for conflict with neighboring uses. Retired power plants, for example, have provided favorable conditions for many energy storage projects (EPRI 2023). But as more of these sites are taken by existing projects and as storage deployments continue to increase, future projects will have to turn to less favorable sites, increasing both the potential for conflict with neighboring land uses as well as the likelihood that a given jurisdiction receives an application for a storage project.

Zoning ordinances provide an opportunity for local jurisdictions to get ahead of the issue by directing storage projects to preferred zones, establishing filing requirements, and defining the procedure for reviewing storage applications. However, adoption of local zoning regulations for energy storage systems have yet to catch up with the pace of technology deployment.

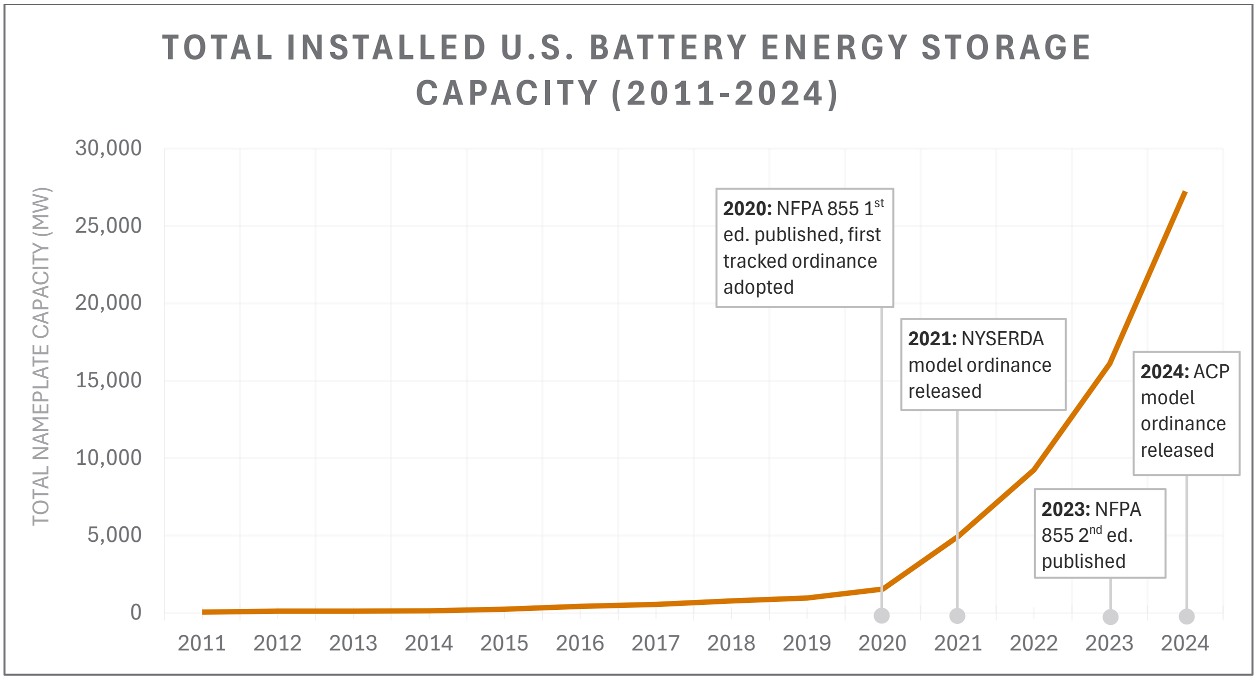


Figure 1: Total Installed U.S. Battery Energy Storage System Capacity, 2011-2024

(data source: EIA Form 860 https://www.eia.gov/electricity/data/eia860/)

Zoning ordinances provide an important function of “automating” certain land use decisions. By grouping similar functions and uses in proximity with one another, land use applications that conform with a zone’s standards can be quickly reviewed and approved. Only non-conforming uses need be closely scrutinized and considered for a conditional use permit (or similar) that will allow them to proceed.

This dynamic is particularly important for energy storage projects. Because there are many energy storage technologies and almost all of them are modular in nature, every storage project will differ in terms of size, footprint, and possibly technology. But by establishing zones for energy storage projects and setting threshold values for aspects such as safety requirements, emergency response planning, project element height, screening requirements, and noise, much of the application review process can be automated. Only storage projects that exceed threshold values or are proposed in a non-conforming zone need be submitted for extensive conditional use permit proceedings.

Absent proactive guidance for storage projects, every proposed project generally requires an extensive conditional use permit process. Conflicts arising from such processes have, in some cases, resulted in local governments choosing to adopt moratoria or outright bans on new storage projects in response to developer proposals (Hanna, Lamek, and Manning 2022). These moratoria are often adopted in response to safety concerns about BESS, in some cases in the wake of fires at battery projects. For example, Riverhead, New York enacted a BESS moratorium in 2023, citing concerns about fires; Jefferson County, Tennessee adopted a moratorium in 2023 in response to public safety concerns about a proposed 250-MW BESS project; and Solano County, California adopted—and then extended—their own moratorium under similar circumstances after a permit application was submitted for a large BESS project there (Civiletti 2023; Dusseault 2024; WBIR 2023). Many other similar recent moratoria and bans have been enacted in different cities, towns, and counties across the nation. In many cases, moratoria have been enacted to provide the jurisdiction with time to develop an ordinance.

Local planning and zoning officials may lack the familiarity with BESS technologies needed to make zoning decisions that balance safety and community impacts with the benefits of energy storage technologies. At the same time, the modular nature of common BESS technologies, including lithium-ion systems, means that BESS can more easily be installed near existing land uses than other energy infrastructure (Twitchell, Powell, and Paiss 2023). Limited resources currently exist to support local practitioners in adopting effective zoning ordinances for BESS. This report will serve as an additional resource by presenting a thorough analysis of energy storage zoning ordinances that identifies how energy storage zoning ordinances can be used to guide developers to submit projects that will be acceptable to the jurisdiction. It will also identify the aspects of energy storage project review that can be automated through ordinances and which aspects may need to be considered on a case-by-case basis. By using the principles identified in this report and adapting them to local conditions, zoning officials can develop ordinances that will allow their jurisdictions to harness the local benefits of energy storage while simplifying the review process.

Several entities, including state agencies and industry associations, have developed model zoning ordinances in recent years. This work does not propose another model ordinance, but rather is meant to complement existing models by providing a contextual framework that will assist local jurisdictions in analyzing those models and adapting them to their unique circumstances.

Section 2 summarizes the qualitative research methodology used to review illustrative examples of BESS zoning ordinances. Section 3 describes these ordinances in detail and summarizes both common elements found in many local codes as well as selected unique or outlier components of some regulations. Section 4 identifies the implications of the ordinances studied for local zoning officials in crafting energy storage zoning ordinances to meet the needs of their jurisdiction.

1.1 Methodology

This report does not attempt to offer a comprehensive review of the treatment of battery storage in county and municipal codes across the United States. Instead, it was structured to identify common elements and building blocks from selected examples to provide resources to practitioners and researchers. Ten of these selected examples are summarized in Table 1 in Section 3 of this report. These jurisdictions were selected as illustrative examples based on their inclusion of specific elements in their storage zoning ordinance that illustrate the different components of an ordinance and the options available to local zoning officials.

Of the selected codes highlighted in Table 1 below, three were selected based on the authors' personal knowledge of this subject. Another four were identified through Municode, which claims to be the largest online collection of local codes and ordinances in the United States, with 3,900 municipal codes and 190,000 individual ordinances in its database (Municode Codification and Online Code Hosting Software by CivicPlus n.d.). This database represents only a fraction of the cities, towns, counties, and other local jurisdictions in the United States, however—the U.S. Census Bureau reports that there are approximately 90,056 local governments, including counties and special districts, in the United States as of 2023, including approximately 19,500 incorporated places such as cities and towns (FAQs n.d.; Toukabri and Medina 2020). The Municode database was searched for key terms related to battery energy storage, such as “battery storage,” “battery energy storage,” and “BESS.” This search identified several city, town, and county codes that mentioned battery storage.

Next, to address gaps in Municode’s coverage, a brief Google search was conducted using relevant keywords, such as “energy storage” and “code of ordinances.” This search identified several additional codes and ordinances. The examples highlighted in Table 1 were then selected to highlight examples of detailed, unique, or otherwise notable ordinances.

2.0 Elements of an Energy Storage Zoning Ordinance

As discussed in Section 1, energy storage projects will interact with their host communities in many ways, and the resulting impacts on the community will vary based on the project characteristics, surrounding land uses, and community preferences. Even though a small number of local jurisdictions have adopted energy storage zoning ordinances, there is already observable variation in what issues those local jurisdictions have addressed and how they have chosen to address them. This section will summarize the 10 local ordinances reviewed in detail for this paper, alongside two model ordinances, and categorize them based on the elements that they include.

2.1 Categorizing Zoning Ordinances Addressing Energy Storage

The codes and ordinances surveyed for this paper address battery storage zoning in distinct ways but share many common elements. In some cases, municipal codes even use the same or similar language, often adapted from standard fire safety codes, zoning ordinances in other jurisdictions, or other resources.

This section focuses on codes that outline detailed, specific regulations about siting, zoning, and permitting for large-scale BESS at the local level. Some local codes adopt standard safety requirements for BESS by simply adopting all or part of an existing standard fire or building code, such as the National Fire Protection Association (NFPA) 855, into that jurisdiction's fire code. This can be a critical step toward ensuring that standard safety and planning requirements are adopted into local law, but it does not comprehensively address BESS zoning, as it does not address considerations such as noise, visual impacts, and potential impacts on neighboring land uses. Additionally, several states restrict the ability of cities, towns, or counties to adopt fire codes at the local level that differ from state requirements (HUD 2022). Local codes that adopt fire or building code standards without additional zoning regulations for BESS are not the focus of this report. Other counties or municipalities have adopted language that applies all or most of the same regulations for utility-scale solar photovoltaic (PV) systems to BESS (Twitchell, Powell, and Paiss 2023). These codes are also not analyzed in this report, as such ordinances do not address the unique impacts of energy storage technologies.

Table 1 below briefly summarizes 10 local zoning ordinances that regulate BESS. It also includes relevant language from the standard NFPA 855, which is not itself an ordinance but has been used to inform ordinance development, as well as language from two recently-developed template resources: New York State's Battery Energy Storage Model Law, published by the New York State Energy Research and Development Agency (NYSERDA) in 2021 (NYSERDA 2021), and American Clean Power (ACP)'s model ordinance, released in 2024 (American Clean Power Association 2024). These ordinance templates provide sample language and formatting for local governments and are intended to reduce barriers to siting and zoning energy storage systems. Of note, the NYSERDA template has also been adopted or adapted in several jurisdictions outside of New York.

Table 1: Selected Storage Zoning Ordinances and Key Elements

LOCATION	CITATION	DEFINITIONS	TIERS OR CUTOFFS?	PERMITTED ZONES	VISUAL, SETBACK, AND NOISE REQUIREMENTS	SITE PLAN, SAFETY, AND OTHER REQUIREMENTS
NFPA 855 *(Standard, not an ordinance)*	National Fire Protection Association (NFPA), 2023, Standard for the Installation of Stationary Energy Storage Systems, NFPA 855	Defines "battery," "energy storage system" (and various sub-types, e.g., electrochemical, mechanical, mobile, stationary), system components and supplements (e.g., "cell," "off-gassing," "fire area,"), "authority having jurisdiction (AHJ)," others	No tiers, but 600 kWh defined as "maximum stored energy" limit for certain locations (non-dedicated use buildings, outdoor areas near defined exposures, rooftops, mobile systems) and additional requirements apply to larger systems	N/A	ESS located outdoors shall be separated by at least 10 feet from lot lines, public ways, buildings, combustible or hazardous materials, etc. May be reduced to 3 feet if fire safety requirements are met. Emergency lighting required for egress doors. Standard does not address visual screening, noise, or other aesthetic requirements.	Standard outlines requirements for installation, ventilation, smoke and fire detection and suppression, access to water supply, spill control, remediation, etc. Requires system owners or agents to provide trained fire mitigation personnel to be on continuous duty to supplement work of public first responders after an incident if determined necessary by the AHJ. Outlines decommissioning plan requirements and requires AHJ to be notified before decommissioning.
New York State *(NYSERDA model law)*	N/A	Defines "battery energy storage system" with language adapted from NFPA 855, adds Tier 1 and 2 classifications; extensive definitions for additional related terms (Battery, Cell, Commissioning, Dedicated-Use Building, Energy Code, Fire Code, NRTL, NEC, NFPA, etc.)	Tier 1 systems <= 600 kWh and one technology only; Tier 2 systems > 600 kWh, or any size with multiple technologies	Tier 1: all Tier 2: to be filled in by adopting jurisdiction, may or may not require special use permit	Lighting limited to minimum required for safety and downcast from neighboring properties; 1-hour average noise not to exceed 60 dBA; 7-foot fence enclosure for all Tier 2 systems; views of Tier 2 systems to be minimized	Decommissioning plan and other standard safety and site plan requirements; one- or three-line diagram; vegetation clearing within 10 feet of all Tier 2 systems; applications subject to public hearing
American Clean Power Association *(model ordinance)*	N/A	Defines "energy storage" and "battery energy storage system (BESS)" using own definition adapted from NREL (Bowen, Chernyakhovskiy, and Denholm 2019; Bowen and Gokhale-Welch 2021). Also defines NEC, NFPA 855, UL 9540.	No - ordinance applies to all system sizes	Agricultural, industrial & commercial zones permitted by right; Public, mixed use, and residential zones need discretionary permit	Setbacks, buffers, and lighting must comply with NFPA 855 requirements (includes note that NFPA 855 setback requirements vary by system type and location). Perimeter fence must be at least 7 feet tall, in compliance with NFPA 70. BESS noise levels must comply with existing noise requirements in zone.	Decommissioning plan and financial assurance in the form of bond, guarantee, or letter of credit. Commissioning plan and site plan with diagrams, land use changes, etc. Environmental compliance permits if required by state law. Safety and emergency plans required as outlined by NFPA 855. Equipment certification must be listed in accordance with UL 1973 and UL 9540.

LOCATION	CITATION	DEFINITIONS	TIERS OR CUTOFFS?	PERMITTED ZONES	VISUAL, SETBACK, AND NOISE REQUIREMENTS	SITE PLAN, SAFETY, AND OTHER REQUIREMENTS
Amelia County, VA	Amelia County Code § 325-34.2 Solar Energy Systems	No definitions provided for battery energy storage.	No - ordinance applies to all system sizes	Permitted zones not defined, but BESS and utility-scale solar are not permitted within one mile of a "village development area" unless special exception permit issued.	BESS must comply with all requirements for utility-scale solar, including: fencing and structures not to exceed 15 feet; screening from ground view using vegetation, berming, architectural fencing, etc.; noise not to exceed 50 dBA at property line; downcast lighting. Additional BESS requirements: minimum 5,000-foot setback from roads and property lines, which may be reduced to no less than 1,000 feet.	Utility-scale solar requirements including decommissioning plan; land management plan; natural heritage and wildlife study with mitigation measures for environmental harms. Must be contained within a battery management system that monitors individual voltages and temperatures, etc.; must comply with most current adopted NEC, IFC, NFPA codes; must use best practices for emergency access, water availability, signage, emergency lighting, etc.
Beaumont, CA	Beaumont, CA Code of Ordinances § 17.11.150	Defines “battery energy storage system,” definition adapted from International Fire Code	No - ordinance applies to all system sizes	Manufacturing only	Enclosure by minimum 8-foot, maximum 15-foot wall made of concrete or decorative masonry, with anti-graffiti coating; lighting, noise levels, and landscaping to comply with existing general code requirements	Decommissioning plan and other standard safety and site plan requirements; decommissioning fund or bond made payable to city; on-site parking for employees or contractors
Hanover County, VA	Hanover County Code § 26-292.1	Adapts language from NYSERDA. Defines "battery energy storage system" and Tier 1 and 2 classifications; additional definitions for related terms.	Tier 1 systems <= 600 kWh and one technology only; Tier 2 systems > 600 kWh, or any size with multiple technologies	Tier 1: all Tier 2: Agricultural, limited industrial, light industrial, heavy industrial by conditional use permits	Lighting limited to minimum required for safety and downcast from neighboring properties; noise levels to comply with existing general code requirements; setbacks and building height requirements according to zone restrictions; no advertising or other unrelated signage	Decommissioning plan and other standard safety and site plan requirements; vegetation clearing within 10 feet of all Tier 2 systems; all utility lines to be undergrounded where feasible
Islip, NY	Town of Islip Code, Article XLII, § 68-456	Adapts language from NYSERDA. Defines "battery energy storage system" and Tier 1 and 2 classifications; additional definitions for related terms.	Tier 1 systems <= 80 kWh and one technology only; Tier 2 systems > 80 kWh and <= 600 kWh or smaller with multiple technologies; Tier 3 systems > 600 kWh	Tier 1: all Tier 2: Business 1, Business 2, Business 3, Industrial 1, Industrial 2, Industrial Corridor, and Industrial Transition Tier 3: Industrial 1, Industrial 2, and Industrial Transition	Tier 2 and 3 systems must be screened from view from adjacent properties. Screening methods must "harmonize with the character of the property and surrounding area." Tier 3 systems require minimum 6-foot fence unless in dedicated use building. All noise to comply with existing noise ordinance.	Decommissioning plan and other standard safety and site plan requirements; all utility lines to be undergrounded where feasible

LOCATION CITATION DEFINITIONS TIERS OR CUTOFFS? PERMITTED ZONES VISUAL, SETBACK, AND NOISE REQUIREMENTS SITE PLAN, SAFETY, AND OTHER REQUIREMENTS

Johnson County, IA	Johnson County Ordinance No. 08-24-21-02	Adapts language from NYSERDA. Defines "battery energy storage system" and Tier 1 and 2 classifications.	Tier 1 systems <= 600 kWh and one technology only; Tier 2 systems > 600 kWh, or any size with multiple technologies	Tier 1: all, but only systems up to 300 kWh allowed in all residential districts Tier 2: Agricultural, highway commercial, light industrial, and heavy industrial zones	Enclosure by minimum 8-foot fence; landscaping buffer preferably made of native trees and shrubs at least six feet tall; noise not to exceed 60 dBA	Applicants responsible for avoiding road damage and may be required to submit a public roads damage avoidance and mitigation plan; vegetation clearing within 10 feet; utility lines undergrounded where feasible; electrical diagram; decommissioning plan, specification sheet and other standard site plan and safety requirements
King George County, VA	King George County, Virginia Code of Ordinances § 4.19	Defines "battery energy storage facility" using language adapted from NYSERDA	No - ordinance applies to all system sizes	Industrial only	Facility may not be visible from any adjacent street, use, or building	Decommissioning plan and other standard safety and site plan requirements; property must have water access; access to be provided to fire and emergency services
Medway, MA	Town of Medway Zoning Bylaw § 8.12	Defines "Battery Energy Storage System (BESS)" expanding on adapted language from NYSERDA; extensive definitions for additional related terms	Tier 1 systems <= 1 MWh and > 10-70 kWh depending on technology; Tier 2 systems > 1 MWh. Ordinance does not apply to systems under Tier 1 size.	Tier 1: all Tier 2: by permit in "Energy Resource" (ER) zone only	Setbacks of 50 feet from property lines (or 100 feet from residential property lines); Tier 2 systems require enclosure with minimum 8-foot fence; views of Tier 2 systems to be minimized from adjacent properties	Decommissioning plan and other standard safety and site plan requirements; decommissioning fund or bond made payable to city; removal of combustible vegetation within 10 feet of Tier 2 systems; mitigation required for any disruptions to natural and historic resources; one- or three-line diagram for Tier 2 systems
Virginia Beach, VA	Virginia Beach Code of Ordinances § 225.02	Defines "energy storage facility" using own definition	No - ordinance applies to all system sizes	Industrial zones I-1 and I-2 by conditional use permit only.	100-foot setback from lot lines; visual/landscape screening; visual and environmental impacts considered as factors in approval.	Decommissioning plan and other standard safety requirements
Whatcom County, WA	Whatcom County Ordinance No. 2022-048	Defines "Battery energy storage system (BESS)" using own definition	>5 MW, but depends on zone	Up to 5 MW: Residential rural, residential rural island, rural 5 MW or over: light impact industrial, heavy impact industrial, public utilities	For all rural & residential districts: Landscape screening pursuant to existing general code requirements (25-foot-wide planted buffers of trees and shrubs); lights directed away from adjoining properties; setbacks of 25 feet from property lines; noise levels in compliance with state standards	*Decommissioning and site plan requirements specific to BESS not covered.*
Grand Prairie, TX	Grand Prairie Code of Ordinances, § 4.20.1	Defines "Battery Energy Storage Systems" using own definition	No - ordinance applies to all system sizes	Light and heavy industrial zones	Screening requirements: all systems shall be fully screened from view by "Type 1 masonry screening wall" or a "living screen" that is at least 8 feet tall	*Decommissioning and site plan requirements specific to BESS not covered.*

2.2 Notable Common Elements of Storage Zoning Ordinances

Many zoning ordinances that contain specific regulations for energy storage systems share similar language and elements. These components of standard ordinance language include definitions and general requirements, which may specify the size or type of BESS that the regulation applies to and clarify which zones certain systems are permitted in; visual, noise, and aesthetic screening requirements, such as minimum fencing height requirements, maximum noise levels, property line setbacks, and other requirements generally intended to minimize the system's impact on neighboring properties; and other safety and planning requirements, which often involve adoption of standards or other language related to system design, decommissioning, safety issues, and other standard considerations.

2.2.1 Definitions and general requirements

These ordinance elements describe the energy storage systems being regulated by defining what they are, the size or type of BESS covered by certain requirements, and where certain systems may be built with or without special use permits. Language for definitions and system size tiers may be adapted from standards or model ordinances, while permitted zones are likely to vary depending on a jurisdiction's existing zoning map, land use patterns, and local preferences.

2.2.1.1 Definitions

Most ordinances surveyed include some definition of "battery energy storage systems" or a similar term, such as "energy storage facility." These definitions are either included in the code of ordinances immediately before describing regulations for energy storage or housed in a general definitions section. Other codes also include definitions for other terms related to BESS used in the ordinance language, such as "battery" or "cell." Some of these definition lists are extensive, such as those offered in New York's model law and adapted in municipalities and counties both within and outside of New York. The model includes definitions of 18 terms, including "dedicated use building," "fire code," and "Nationally Recognized Testing Laboratory (NRTL)."

Definitions for BESS (or related terms) frequently come from code or standard language, although some jurisdictions have developed their own definitions. Some of these definition sources include the following:

- NFPA 855, the Standard for the Installation of Stationary Energy Storage Systems, is the most common source of definitions in the ordinances reviewed, and the standard's definition of "energy storage systems (ESS)" was adapted into NYSERDA's model law.[1] NFPA 855's definition of ESS is: "One or more devices, assembled together, capable of storing energy in order to supply electrical energy at a future time to the local power

[1] New York's adapted version of the NFPA 855 definition is: "BATTERY ENERGY STORAGE SYSTEM: One or more devices, assembled together, capable of storing energy in order to supply electrical energy at a future time, not to include a stand-alone 12-volt car battery or an electric motor vehicle. A battery energy storage system is classified as a Tier 1 or Tier 2 Battery Energy Storage System as follows: A. Tier 1 Battery Energy Storage Systems have an aggregate energy capacity less than or equal to 600kWh and, if in a room or enclosed area, consist of only a single energy storage system technology. B. Tier 2 Battery Energy Storage Systems have an aggregate energy capacity greater than 600kWh or are comprised of more than one storage battery technology in a room or enclosed area."

loads, to the utility grid, or for grid support." Versions of this language appear in all ordinances that adopted versions of the NYSERDA model.

- The American Clean Power Association offers its own definition of "Battery Energy Storage System (BESS)" in its model ordinance as "electrochemical devices that charge, or collect, energy from the grid or a generation facility, store that energy, and then discharge that energy at a later time to provide electricity or other grid services," using language adapted from the National Renewable Energy Laboratory (Bowen, Chernyakhovskiy, and Denholm 2019; Bowen and Gokhale-Welch 2021).

- The International Fire Code (IFC) defines "Battery System, Stationary Storage" as "a rechargeable energy storage system consisting of electrochemical storage batteries, battery chargers, controls and associated electrical equipment designed to provide electrical power to a building. The system is typically used to provide standby or emergency power, an uninterruptable power supply, load shedding, load sharing or similar capabilities." This definition was used in at least one ordinance, in Beaumont, CA.

Examples of some additional terms defined in ordinance language are included in Table 1 above.

2.2.1.2 Size tiers or cutoffs

Many ordinances separate BESS into two or three "tiers" based on the system's capacity. Other ordinances do not define tiers but do specify a capacity threshold over which a system must comply with the ordinance or with additional requirements. One such framework found in a few of the surveyed codes was to define systems equal to or less than 600 kWh as "Tier 1" systems and any larger installations, or a system of any size that uses more than one battery technology, as "Tier 2" systems subject to more stringent regulations. The concept of and language describing Tier 1 and 2 systems, the 600 kWh cutoff, as well as the exact language of the definition of those systems also appears in New York's model ordinance, and other municipalities and counties both in and outside of New York appear to have adapted it.

The 600 kWh threshold for Tier 1 systems originates from NFPA 855. The standard establishes 600 kWh as the maximum allowable quantity of stored energy a system can have in certain locations, and requires that any systems with a capacity greater than 600 kWh undergo hazard mitigation analysis and fire testing (NFPA 2023). A 600 kWh system is likely to be much larger than a residential system but much smaller than a utility- or grid-scale system. According to Energy Information Administration (EIA) data, the median nameplate energy capacity of installed utility-scale BESS projects as of January 2025 is 10 MWh (or 10,000 kWh), and only about 2% of the installed utility-scale BESS projects in the United States have a nameplate energy capacity of 600 kWh or less (EIA 2025b), meaning that a proposed utility-scale BESS project is likely to be a Tier 2 system under the NYSERDA framework.[2] Conversely, only approximately 10-90 kWh is needed to provide a few days of backup power to an average American home (Gorman et al. 2023); BESS used to provide power to a community resilience center, hospital, or other facility will fall between residential and grid-scale system sizes, and

[2] BESS capacity is measured in both power capacity and energy capacity. Power capacity is measured in kilowatts (kW) or megawatts (MW) and refers to the maximum power a system can charge or discharge at a point in time. Energy capacity refers to the total amount of electrical energy a system can charge or discharge over a given duration. For example, a 20 MW/80 MWh battery could provide 20 MW of power per hour over a four-hour period. The EIA reports both nameplate capacity (MW) and nameplate energy capacity (MWh) for utility-scale BESS.

these "community-scale" storage systems have the potential to be larger or smaller than 600 kWh depending on the project in question.

Additionally, the physical size of BESS varies by technology and manufacturer, and there is not a standard physical size for a 600 kWh system. Variation in physical size can be significant. According to specifications from several battery manufacturers, a 600 kWh lithium-ion BESS installation at its largest is likely to fit in a standard 40' x 8' x 8'6" shipping container or facility of similar size. Other 600 kWh systems may fit into containers half that length or smaller, however, and some manufacturers can fit five times that capacity in a 40-foot container (EGbatt Energy 2024; ESS Inc. n.d.; Microgreen 2025; Sunbelt Rentals n.d.).

Some variations on the NYSERDA tiered approach have been adopted elsewhere. The town of Islip, New York adapted the NYSERDA language to create three tiers instead of the original two, with a smaller capacity cutoff (equal to or less than 80 kWh in capacity) for Tier 1. Medway, Massachusetts uses the "tiers" language as well, but sets a larger cutoff of 1 MWh of capacity separating Tier 1 and 2. Other areas, such as Whatcom County, WA, specify that certain zoning restrictions apply only to systems with a power capacity of 5 MW or greater. Several other ordinances do not specify tiers or cutoffs, meaning that the subsequent regulations apply to BESS of any size.

2.2.1.3 Allowed zones by right or permit

Most, but not all, county or city codes that address energy storage systems specify the zones in which BESS are permitted to be built. As with many other ordinance elements described here, zoning generally varies by system tier or size, with smaller systems generally permitted in more zoning areas than larger ones. Another point of variation is whether BESS is allowed in a zone by right (meaning that a project that complies with established rules can be built without additional review) or by permit (meaning that all projects are subject to in-depth review, even in permitted zones).

These zoning requirements can vary significantly in their restrictiveness. Some jurisdictions allow smaller or Tier 1 systems in any zone, including residential areas, with some variations. Johnson County, Iowa, for example, defines Tier 1 systems with the common maximum size of 600 kWh, but further specifies that only systems up to 300 kWh may be sited in residential zones.

In places that have defined tiers or cutoffs, Tier 2 or larger systems are generally only permitted in industrial, manufacturing, or public utilities zones. In some cases, BESS of any size are subject to these restrictions. Beaumont, California, for example, only permits BESS to be sited on land zoned for manufacturing purposes, and King George County, Virginia, similarly permits them only in industrial zones. Medway, Massachusetts allows BESS only in a special "energy resource" zone that allows electric generators and other public utility facilities in addition to electric vehicle chargers and some offices.[3]

While the above codes are examples of by-right zoning, other codes utilize by-permit zoning, which means that BESS projects must secure a special or conditional use permit even in permitted areas, effectively ensuring that every proposed BESS project is thoroughly reviewed. In Virginia Beach, Virginia, for example, BESS of any size are allowed only in I-1 and I-2 industrial districts and must also receive a conditional use permit to be sited there.

[3] According to Medway's code of ordinances, the "Energy Resource" zone was renamed from "Industrial II" in 2017.

Two existing model ordinances—NYSERDA's and ACP's—each offer suggested language on permitted zones for BESS. NYSERDA suggests that Tier 1 systems be permitted in all zones, while suggesting that any adopting jurisdictions use their own discretion to determine which zones should allow larger Tier 2 systems. ACP's more general model ordinance suggests that BESS of any size be permitted by right in agricultural, industrial, and commercial zones, and be allowed in others by discretionary permit.

2.2.2 Visual, noise, and aesthetic requirements

This category includes ordinance elements that regulate requirements related to appearance, noise, lighting, and other aesthetic requirements, such as property line setbacks, fencing, and lighting. These requirements may be universally applied to all regulated BESS projects, or may vary by system size, zone, or both.

2.2.2.1 Property line setbacks

Most ordinances surveyed require property line setbacks for BESS. Setbacks between any structure and neighboring property lines or codes are commonly required to maintain safety, privacy, and aesthetics. The size of setbacks required for BESS in the ordinances surveyed varies, ranging from 25 feet in Whatcom County, Washington to 5,000 feet (with the option to reduce to no less than 1,000 feet via special permit) in Amelia County, Virginia.

Extensive setbacks like Amelia County's have at times been used as a tool to heavily restrict energy projects or other infrastructure within a given jurisdiction (O'Neil et al. 2022). For example, towns in Maine adopted ordinances requiring property setbacks of one mile for wind turbines in an effort to restrict development of wind projects in response to local concerns (Curtis 2010b, 2010a; Powell 2022).

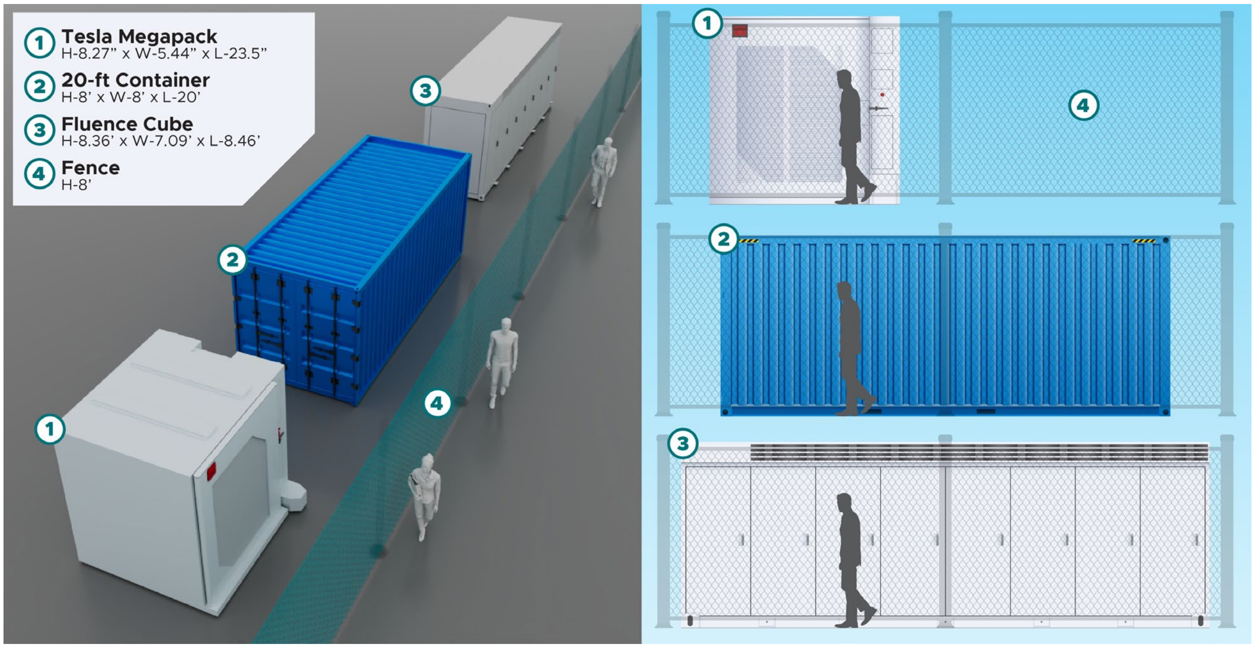
In some cases, the size of a required setback varies by zone. Some ordinances that have established tiers or capacity cutoffs will also only require setbacks for Tier 2 or larger systems, while others do not specify them for BESS at all.

2.2.2.2 Fencing and visual screening

Fencing and visual screening are common requirements, especially for larger BESS systems. As with other elements, some ordinances' visual screening requirements vary or become more stringent by tier or system size.

Fencing, other visual screening, or both are commonly required, especially for larger or Tier 2 systems. Minimum required fencing height is generally 6-8 feet. Some ordinances additionally specify a maximum height: Beaumont, California, for example, requires that all BESS (regardless of size) be surrounded by a fence with a minimum height of 8 feet, but also specifies that fences and other structures may not exceed 15 feet in height. The shipping containers often used to house batteries have a standard height of 8 feet tall, which is a likely driver of the common 8-foot minimum fence height. Figure 2 offers a rough illustration of common BESS systems as compared to an 8-foot visual screening fence.

Figure 2: Illustration of common utility-scale BESS installations as compared to the height of an 8-foot screening fence



Some codes require that systems be fully hidden from view of all neighboring properties. Others, often in addition to a full visual screening requirement, specify that fencing or other screening be constructed from particular materials or meet specific aesthetic characteristics for the purpose of maintaining the visual character of a neighborhood or zone. These fences and screens may be generally required to “harmonize with the character of the property and surrounding area,” as is the case in Islip, NY. They may also be restricted in the material allowed: Beaumont, CA, for example, requires the minimum 8-foot fence that encloses any BESS to be constructed from concrete or decorative masonry and be treated with anti-graffiti coating or other preventative measures.[4] In some cases, visual screening in some or all areas must be vegetative: Whatcom County, Washington requires “buffering plantings” that are 25 feet wide. Johnson County, Iowa requires both 8-foot fencing and a “landscaping buffer” of native trees or shrubs.

2.2.2.3 Noise and lighting

Noise and lighting requirements are other common elements of ordinances addressing BESS, both of which are intended to mitigate potential disturbances to neighboring properties. Lighting may be required to be shielded or downcast, and noise levels may be limited to a certain level,

[4] “Energy storage facilities shall comply with the site design requirements set forth below in addition to all other applicable chapters of the Beaumont Municipal Code: (a) The site shall be fully enclosed by a minimum eight-foot, non-scalable solid wall. Walls shall consist of either decorative concrete masonry block or decorative concrete tilt-up walls. Decorative masonry block means neutral colored slump stone block, split-face block, or precision block with a stucco, plaster, or cultured stone finish. Decorative concrete tilt-up wall means concrete with a combination of paint and raised patterns, reveals, and/or trim lines. (b) Solid walls surrounding facilities which are below grade of an adjacent street or property shall incorporate a berm/slope along the entire length of the wall to ensure facilities are not visible from public view. (c) Anti-graffiti coating or equivalent measure to prevent graffiti shall be provided for all solid screen walls.” (Beaumont, CA Code of Ordinances § 17.11.150)

such as 50 dBA in Amelia County, Virginia. Several ordinances simply require BESS to comply with existing, general noise and lighting requirements for other industrial or energy facilities.

2.2.3 Safety, planning, and other permitting requirements

This category includes requirements related to permitting, safety requirements, and decommissioning procedures. Standards or codes such as NFPA 855 or updated versions of the International Fire Code contain provisions for some of these elements, such as decommissioning plans and requirements for ventilation, water supply, unit installation, and first responder access to ensure safety. Some jurisdictions may choose to adopt and refer to these codes or standards, while others may adapt language for inclusion in the text of their code of ordinances.

2.2.3.1 Decommissioning plans and funds

Almost all codes include requirements for decommissioning plans, with some requiring an additional decommissioning fund. These sections generally require BESS operators to describe all steps, roles, and responsibilities needed to remove all components of a system and mitigate any waste. Standard language on decommissioning plans and their requirements is available in existing codes, including in detail in NFPA 855 and IFC 2021 Section 1207. IFC or NFPA language is often either adapted or copied directly into BESS ordinances in jurisdictions that have not adopted current versions of these code into their state or local fire codes. Medway, MA, for example, is one of several counties or cities that have copied decommissioning plan language from IFC 2021 1207.2 directly into their BESS ordinance.[5]

Both ACP's and NYSERDA's model ordinances also include language about a decommissioning fund, and both propose that it be allowed to take the form of a fund, bond, or letter of credit. In adopted ordinances, Medway, MA and Beaumont, CA both require BESS operators to maintain a fund subject to local government approval, to be used when the system needs to be decommissioned and removed.

While NYSERDA's model ordinance explicitly requires a decommissioning plan to include an estimate of all decommissioning costs, no clear consensus has yet emerged on the costs of decommissioning a BESS. Costs will vary based on the project size, site characteristics, years in service, assumed inflation rate, and which cost elements are included (for example, some studies include battery recycling costs in the decommissioning study and others do not). The result is a wide range in the expected cost of decommissioning; a review of four publicly available decommissioning studies identified costs ranging from about $3,400 to $27,000 per installed megawatt-hour of battery storage (HDR 2023, Stantec 2023, Convergent 2020, New Leaf Energy 2022).

2.2.3.2 Site plan requirements

For a BESS to be permitted, local codes generally require the submission of a site plan with specified elements. A decommissioning plan may be considered part of this site plan. Standard requirements include specification sheets; contact information for project owners and installers;

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[5] "Decommissioning shall be performed in accordance with the decommissioning plan that includes the following: 1.A narrative description of the activities to be accomplished for removing the ESS from service, and from the facility in which it is located. 2.A listing of any contingencies for removing an intact operational ESS from service, and for removing an ESS from service that has been damaged by a fire or other event…" (Town of Medway Zoning Bylaw § 8.12)

system specifications; and emergency plans. They may also require one- or three-line diagrams of the system or remediation plans for environmental impacts. NFPA 855 describes diagrams, plans, and specifications that should be submitted to an AHJ for approval and is a source for some language on site plan requirements for local planners to adapt into ordinances.

2.2.3.3 Additional common safety requirements

Other common elements adapted from standard NFPA and IFC code language address basic safety concerns with language focused on protecting community safety and enabling quick first responder access in the case of a fire. These requirements can include the clearing of all vegetation within 10 feet of a system to avoid fires; requiring that the facility have access to water in case of emergencies; and acceptable access for fire or emergency services.

The NYSERDA model ordinance requires an Emergency Operations Plan from storage developers that includes, among other things, detailed information about the battery system provided to first responders and city officials, procedures for responding to a battery fire, and training for local emergency responders. NFPA 855 contains similar requirements for training and coordination with local first responders.

2.3 Unique or Restrictive Elements in Selected Ordinances

While many of the ordinances surveyed share common characteristics, some included unique approaches. In most cases, these additions create incremental restrictions on where and how battery energy storage systems can be sited. Some examples:

Requirements for mitigation of impacts to natural, cultural, or historical resources: Medway, MA, for example, requires developers to mitigate any impacts to loss of carbon sequestration capabilities, forest habitat, trail networks, or historic resources as a result of construction of any BESS project. Amelia County, VA also requires a natural heritage and wildlife management study to be conducted for all utility-scale solar or BESS projects. Similar language

Large and restrictive property setback requirements: Most zoning ordinances surveyed require BESS to have setbacks from property lines between 15 and 100 feet, with setback requirements in some cases varying by zone. One outlier is Amelia County, Virginia, which requires setbacks of 5,000 feet, or just under one mile, from property lines for BESS of all sizes.

Stringent enclosure wall or screening requirements: Some ordinances require very specific characteristics for fences or visual screening. For example, Beaumont, CA requires fences to made from concrete or decorative masonry and to be treated with graffiti-resistant coating. As noted above, Johnson County, Iowa requires BESS to be screened by a buffer comprised of native plant species. King George County, Virginia requires screening that ensures no BESS facilities are visible at all from any nearby streets or buildings.

Requirements to bury power lines: Johnson County, Iowa is unique among jurisdictions surveyed in that it requires all power and communications lines that connect BESS to other structures or that connect BESS units to each other to be buried underground “to the extent feasible.” The ordinance does permit a system’s main service connection line to be above ground and allows the same for other lines if the landscape, infrastructure, or distance prohibit undergrounding.

3.0 Implications for Local Jurisdictions

As Section 2 illustrated, an energy storage ordinance consists of multiple component parts and jurisdictions have flexibility in designing each of those components to meet local needs and ensure conformity with existing zones. While many ordinances studied were patterned after the NYSERDA model ordinance, most of those jurisdictions made adaptations to fit their local contexts and preferences. These adaptations occurred across all elements categorized in this report, including definitions, permitted zones, system size tiers, setback distances, and visual screening requirements.

The objectives of an energy storage zoning ordinance are to guide projects to appropriate zones and minimize conflicts with neighboring zones, including any risks to safety or well-being. What appropriate zones may be and what potential risks are most important to manage may vary between regions: rural agricultural areas, for example, may have different considerations than more densely populated cities or towns, and these areas' zoning maps are likely to look very different from each other. How the ordinance defines energy storage, how it differentiates between projects of varying sizes and technologies, and how it is applied to those different classes of storage are all key factors in achieving the most balanced outcome for any given jurisdiction.

As Table 1 demonstrated, almost all the jurisdictions studied adopted a definition for BESS and half of them divided battery projects into different tiers. Many of the ordinances were based on the NYSERDA model ordinance, which contains a technologically agnostic definition of BESS that captures all forms of battery energy storage and divides BESS projects into two tiers separated at the NFPA-defined threshold of 600 kWh.

Two jurisdictions demonstrated how definitions and tiers can be adjusted to meet local objectives. The Town of Islip, NY sub-divided the lower NYSERDA tier to have a Tier 1 for systems under 80 kWh, a Tier 2 for systems between 81 and 600 kWh, and a Tier 3 for systems over 600 kWh. This allowed Islip's ordinance to allow Tier 1 systems (representing small, customer-sited batteries) in any zone, Tier 2 systems in commercial zones (with a special use permit required for any BESS within 200 feet of a residential zone or facility), and Tier 3 systems in industrial zones subject to a special use permit in all cases. The creation of another tier allowed local zoning officials to more specifically recognize the different types of projects that may be deployed in the community and map each of them to the appropriate zones.

Another consideration for local officials is whether and how to write ordinances that explicitly accommodate different battery technologies. No ordinances reviewed established substantive technology-specific requirements or variations, and the definitions used for BESS in the ordinances reviewed are technology-agnostic. Some jurisdictions have used NFPA 855 or similar language that acknowledges the existence of different battery types: for example, in Medway, MA, local zoning officials adapted the NYSERDA model ordinance to specify how the town's ordinance would apply to different BESS technologies. Medway's ordinance identifies six different technologies: lead-acid, nickel, lithium-ion, sodium nickel chloride, flow, and "other," drawing from the list of BESS technologies specified in NFPA 855. While Medway only defines these different technologies for the purpose of setting technology-specific size thresholds at which the ordinance would apply, the use of technology-specific definitions could theoretically also be used to differentiate tiers based on risk profile. For example, commercially available BESS technologies are subjected to a testing process (UL 9540A) that assesses their flammability risk. The testing process stresses a battery to see if it will go into thermal runaway—a situation in which the battery loses control of its chemical reactions and ignites—

and then measures the impacts of that thermal runaway. Some technologies, such as flow batteries, do not enter thermal runaway, but may have other risks like a less severe mechanical fire or leakage. Some of these considerations are included in the installation and maintenance requirements in NFPA 855.

The vast majority of BESS installations in the United States are still lithium-ion (EIA 2023). However, by adopting zoning ordinances that differentiate by technology based on the risk profile and community impacts of different technologies, local jurisdictions can stay ahead of the rapidly changing battery technology landscape and can also send signals to developers to consider other technologies that may better align with the jurisdiction's preferences. However, no adopted or model ordinances reviewed for this report yet outline this type of distinct zoning requirement based on the specific technological or safety considerations of different battery technologies, likely because of the continued market dominance of lithium-ion batteries to date. Effective adoption of such language will likely require the development of additional models and resources to help planners understand relevant considerations as new battery energy storage technologies emerge.

4.0 Summary and Conclusions

Energy storage is a key enabling technology in a reliable and resilient electric grid, and investments in large energy storage projects are continuing to grow at a rapid rate. Local jurisdictions play a key role in determining how and where those projects can be built, and storage applications will become increasingly common as the need for storage grows and developers look for new sites.

Having energy storage zoning ordinances in place can proactively inform storage developers about the location and project characteristics with which a jurisdiction is comfortable, resulting in project applications that are better aligned with local policies and preferences and that reduce the need for extensive, and often controversial, use permit proceedings. Where zoning ordinances are absent, developers will engage in a guessing game to find viable sites and every application will be for a conditional use permit that will likely result in an extensive proceeding that ties up the community’s resources and residents. While this report does not attempt to provide a comprehensive review of local zoning ordinances that regulate BESS, it does draw from a diverse selection of case studies to illustrate the landscape of local energy storage regulation and highlight common regulatory building blocks that local jurisdictions can use and adapt in crafting energy storage zoning ordinances that will serve their communities.

Most local jurisdictions have yet to adopt specific regulations for energy storage, especially when compared to the widespread adoption of zoning ordinances for solar PV. Of zoning codes that do include ordinances specific to energy storage, shared elements and language emerged that may contribute to growing consensus on key components. These shared building blocks include definitions of BESS and other key terms; the establishment of size tiers or cutoffs to determine which system sizes are subject to regulations; permitted zones for siting BESS projects; visual, noise, and aesthetic requirements like fencing height requirements, noise maximums, lighting regulations, and property line setbacks; and standard safety and planning requirements, such as decommissioning plans, site plans and system specifications, and plans for responding to emergencies.

While few templates and resources currently exist for local regulators interested in adopting a zoning ordinance for BESS, the prevalence of the format and language of New York state’s Battery Energy Storage System Model Law in communities both in and outside of New York illustrates interest in templates, shared language, and information on best practices. Further research, resource development, and ongoing stakeholder engagement may be beneficial in offering clarity to local officials.

The inclusion of BESS in local zoning codes is likely to become more common as technology deployments increase. However, growth in proposals for larger-scale BESS projects near existing land uses may also drive an increase in the existing trend of local bans or moratoria on energy storage. These moratoria have often been adopted in response to genuine safety concerns about BESS that may be addressed through support, education, and resources for local regulators and community members. With these dynamics in mind, this analysis is intended to offer some resources for practitioners interested in adopting, updating, or further studying local zoning regulations for energy storage systems.

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Pacific Northwest National Laboratory

902 Battelle Boulevard
P.O. Box 999
Richland, WA 99354
1-888-375-PNNL (7665)

www.pnnl.gov