Fact Sheet: Battery Energy Storage Systems and Land Use

GREAT PLAINS INSTITUTE

Battery energy storage systems (BESS) are becoming a common feature in both rural and urban landscapes across the US. This fact sheet provides planners, local officials, and community members with context for how BESS align with and depart from land use considerations associated with existing energy storage-related land uses, such as gas stations, grain elevators, and propane facilities.

Battery energy storage systems are grounded in a long history of community-based storage

Communities have long accommodated facilities that store or manage energy and commodities for later use:

- Gas stations store liquid fuels for distribution to consumers.
- Propane facilities store liquefied gas for heating or industrial applications.
- Grain elevators serve as bulk storage and transfer points for agricultural commodities with substantial energy content and associated risks.

Each provides a form of energy storage that is essential to community and regional economies.

Similar to these large-scale storage facilities, in terms of basic land use function, BESS are designed to store electricity from the grid or energy-generating sources and discharge it when demand peaks or when energy generation drops.[1] Ownership and regulation of BESS facilities are also similar to such facilities, where projects are typically privately developed and, depending on project scale, are operated under local or state-level oversight.

Key things to know about battery energy storage systems and land use:

- A BESS is not a fundamentally new land use; it shares many attributes with existing energy storage facilities familiar to rural communities.
- Primary differences lie in the type of health and safety risks, emergency response, and use cases.
- Zoning updates can classify BESS under “public utility” or “energy infrastructure” categories with performance standards and siting processes, just like any other energy facility.[2]

Learn more at betterenergy.org or contact us for more information: info_renewable_energy@gpisd.net

Planning considerations for battery energy storage systems

Regulatory and permitting considerations for BESS also parallel existing land uses. Most communities already regulate fuel depots, propane tanks, and agricultural chemicals and products through conditional use permits or performance-based zoning standards. These frameworks can be readily adapted to battery storage by focusing on key site plan elements such as setbacks, fire safety access, noise limits, drainage, and screening.

Because a BESS has minimal operational impacts, it often qualifies as a low-intensity industrial or utility use.[3] In some jurisdictions, storage systems are categorized under "essential services," "utility installations," or as an accessory to solar or wind generation.[4]

States such as Minnesota, Michigan, and Iowa are developing model zoning approaches that treat BESS as compatible with agricultural and industrial areas, similar to electrical substation equipment.

Land use characteristics:
Typical stand-alone BESS use modular containers arranged in rows on concrete pads, with a footprint of 0.03-0.1 acres/MW.[5]

With only periodic maintenance visits, these systems generate little to no daily traffic (deliveries in and out are not via truck or rail) and have a low visual profile.

Health and safety precautionary measures

Regarding public safety, all energy storage land uses require structured risk management and coordinated emergency response planning. While both BESS and traditional fuel sites are classified as hazardous materials installations, their risks differ. Fuel storage involves external combustion hazards, whereas BESS involve internal heat and chemical stability.

The primary safety concern for BESS is the risk of "thermal runaway," a condition that can lead to localized fires within battery units.[6] However, these risks are mitigated through advanced containment systems, remote monitoring, and automatic suppression technologies, as outlined in national fire codes. Similar to technologies at gas stations or propane facilities, BESS facilities operate under controlled conditions designed to lower human and environmental risks. Local emergency coordination and training remain key safety measures, similar to those used for other energy storage or hazardous material sites.

Conclusion: Looking ahead to community-based planning for battery energy storage systems

The land use considerations for BESS reflect the ongoing evolution of how communities have historically balanced energy infrastructure, public safety, and land management. For planners, integrating BESS into local codes can draw on existing precedents while ensuring that emergency response, screening, and relevant performance standards reflect the specific technology. With proper siting and regulatory clarity, BESS can be understood as a contemporary counterpart to the familiar facilities that have long supported local economic activity and consumer needs.

Resources for communities on battery energy storage and land use

- **Learn about recommended practices and considerations for planning and zoning BESS** in the article, "Battery Energy Storage Systems," by GPI's Brian Ross and Monika Vadali in the March 2024 issue of *Zoning Practice*, volume 31, available at https://planning.org/zoningpractice/2024/march/battery-energy-storage-systems/.

- **Learn about zoning frameworks and sample ordinance language for integrating BESS into local land use codes** in this guide, "Planning & Zoning for Battery Energy Storage Systems: A Guide for Michigan Local Governments," by the University of Michigan Graham Sustainability Institute, available at https://graham.umich.edu/project/bess-guide.

- **Learn about how communities nationwide are regulating and permitting energy storage systems** in this report, *Energy Storage in Local Zoning Ordinances,* by Jeremy B. Twitchell, Devyn W. Powell, and Matthew D. Paiss, published by Pacific Northwest National Laboratory in October 2023, available at https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-34462.pdf.

Endnotes

1. Thomas Bowen, Ilya Chernyakhovskiy, and Paul Denholm, *Grid-Scale Battery Storage: Frequently Asked Questions*, NREL/TP-6A20-74426 (National Renewable Energy Laboratory, September 2019).
2. Tad Heuer, "Permitting Perils: Navigating Zoning Law Challenges for Battery Energy Storage Projects," *Energy & Climate Counsel*, Foley Hoag, June 13, 2024.
3. Heuer, "Permitting Perils: Navigating Zoning Law Challenges for Battery Energy Storage Projects."
4. Heuer, "Permitting Perils: Navigating Zoning Law Challenges for Battery Energy Storage Projects."
5. Sarah Mills and Madeleine Krol, Planning & Zoning for Battery Energy Storage Systems: A Guide for Michigan Local Governments (University of Michigan Center for EmPowering Communities, 2024), 7.
6. Brian O'Connor, "Battery Energy Storage Hazards and Failure Modes," National Fire Protection Association, December 3, 2021.