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INTRODUCTION TO

BESS

A guide to understanding
BESS: **B**attery **E**nergy **S**torage **S**ystems

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INTRODUCING BESS

A Note from Emily Williams, CEO, Geenex

As electricity demand grows across our region, so does the responsibility to ensure our power grid remains strong, stable, and reliable. At Geenex, we believe energy development must be thoughtful, transparent, and rooted in long-term partnership with the communities we serve.

For more than a decade, our team has worked alongside landowners, local leaders, and residents to responsibly advance utility-scale energy projects. Battery energy storage systems represent the next step in strengthening our grid, helping balance supply and demand, supporting reliability during peak periods, and ensuring power is available when it is needed most.

We understand that new infrastructure brings questions. That is why safety, environmental stewardship, and open communication guide every project we pursue. Modern battery storage facilities are designed with multiple layers of monitoring and protection, and we are committed to meeting or exceeding all regulatory standards.

This booklet is intended to provide clear, straightforward information about how battery energy storage works, how it is designed, and how it operates safely within a community. We hope it serves as a helpful resource as you learn more about this technology and its role in strengthening our energy future.

Sincerely,

Emily Williams

Emily Williams
Chief Executive Officer

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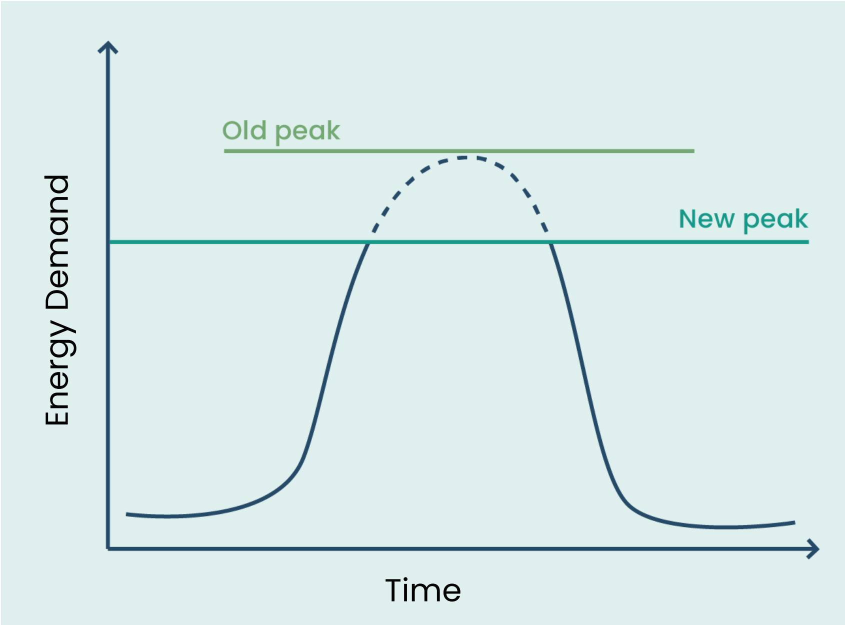
USES OF BESS

Battery Energy Storage Systems (BESS) take excess energy off the grid, store it, and then discharge the energy back onto the grid during peak demand. This ensures supply and demand of energy are in alignment and grid operations run smoothly.

Peak Shaving

- BESS can reduce peak demand cost increases by discharging stored energy during high-demand periods.

- From a utility consumer's perspective, demand premiums are charged based on the single highest power usage, or peak. This can be for as little as 15 minutes in a billing cycle and often only occurs a few times per year. Lowering the usage peak can result in a reduction of the consumer's utility bill.



- In the capacity market, BESS facilities are paid for their availability to supply power during times of grid stress, ensuring reliability by having a backup source ready.

- From a transmission and distribution perspective, the peak demand can exceed the systems' capacity to deliver power. A BESS system can be used to mitigate these short-term needs and help avoid costly transmission upgrades such as new fossil fuel generation, new transmission towers or new substations.

APPLICATIONS FOR BESS

Storing Backup/Excess Power

- BESS can provide reliable power during outages or extreme weather events, reducing the need for backup generators for critical loads.
- Enables grid restart without external power sources by supplying initial energy to bring generation facilities back online after a blackout.
- Reduces reliance on centralized peaker plants and makes the grid less vulnerable to single points of failure.

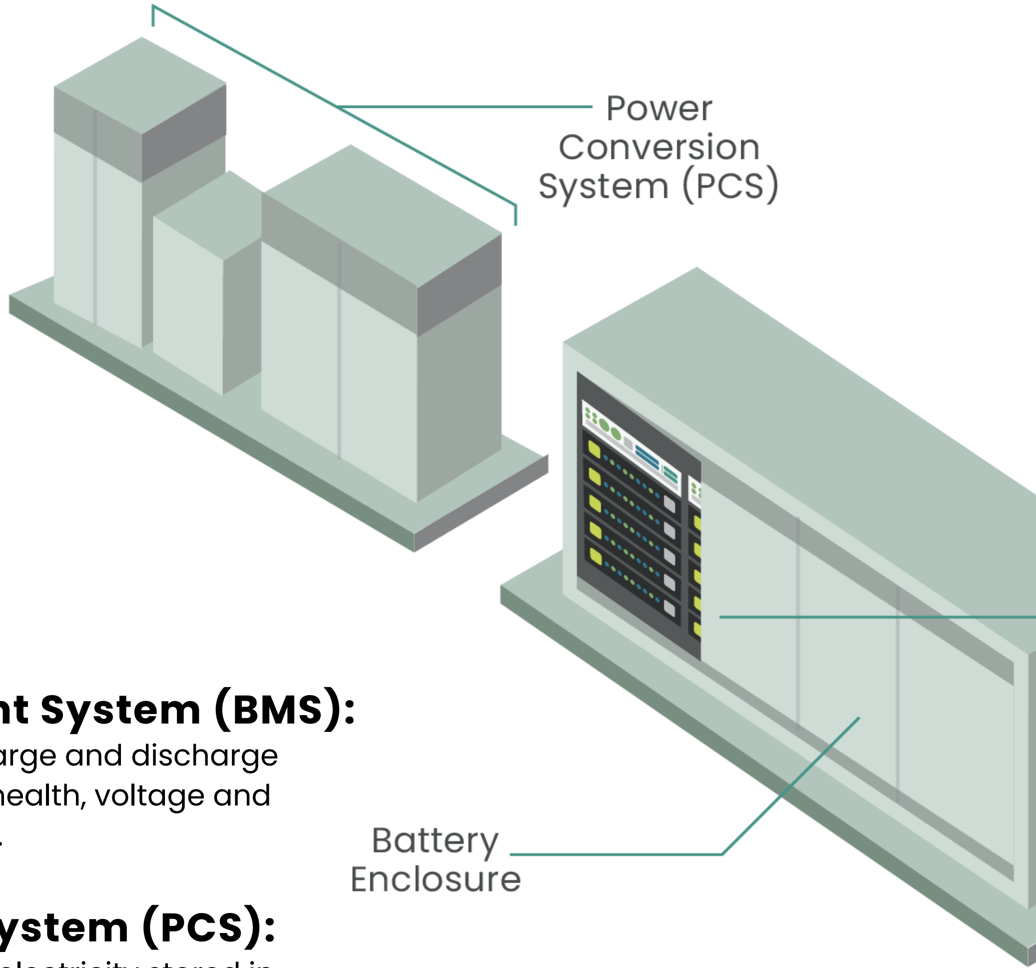
Frequency Regulation

- BESS can rapidly respond to fluctuations in grid frequency, helping to maintain a stable electricity flow.
- The US grid operates at a set frequency of 60 Hz. If energy demand exceeds supply, the frequency drops. If energy supply exceeds demand, the frequency rises. These small deviations from the set frequency of 60 Hz can damage equipment and even trigger blackouts.
- BESS can inject or absorb power in milliseconds, which is much faster than traditional power plants. When frequency falls, the BESS discharges power on the grid and when frequency rises the BESS absorbs power from the grid.

Arbitrage

- Purchasing low-cost off-peak energy and selling it during periods of high pricing. This can be hourly, daily or during emergency needs.

COMPONENTS OF A BESS

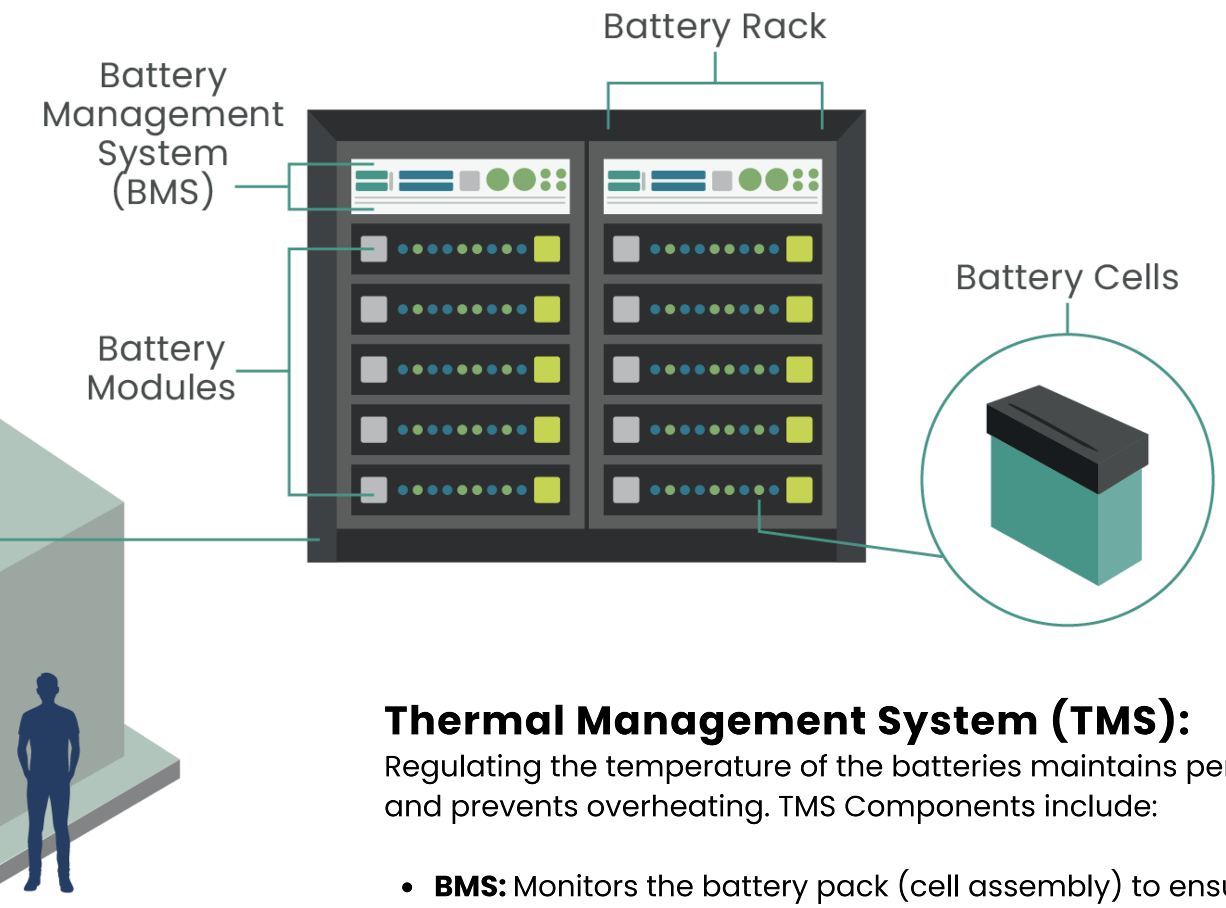


Battery Management System (BMS):
This system manages the charge and discharge cycles and monitors battery health, voltage and temperature to ensure safety.

Power Conversion System (PCS):
Converts Direct Current (DC) electricity stored in batteries to Alternating Current (AC) to be sent to the grid. When the battery is charging, the PCS converts AC from the grid into DC so energy may be stored within the battery.

Energy Management System (EMS):
Optimizes energy usage, controls the operation of the system, schedules charging/discharging, and handles interaction with the grid.

Control Interface:
Allows operators to monitor, control, and manage the BESS operation, either locally or remotely.



Thermal Management System (TMS):

Regulating the temperature of the batteries maintains performance and prevents overheating. TMS Components include:

- **BMS:** Monitors the battery pack (cell assembly) to ensure correct charging (avoid overcharging) and disconnects the system if the battery exceeds its temperature ranges.
- **PCS:** Including inverters etc. that charge/discharge batteries, require independent monitoring to ensure proper functionality.
- **Container management:** Ensures proper HVAC, pressure release valves, venting, gas monitoring and fire suppression in the event of a failure.

Communication System:

- Facilitates communication between components (BMS, PCS, EMS) and external monitoring systems.
- Notify O&M of potential battery issues and prompt service technicians to swap out degrading battery packs.

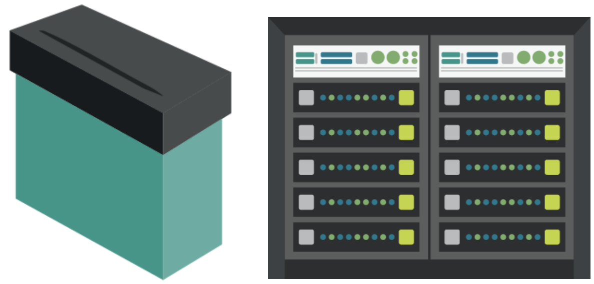
DESIGN OF A BESS FACILITY

Cells

Each DC cell has an anode, a cathode, and an electrolyte with positive and negative terminals.

Packs & racks

Cells are connected together to make packs, which are then stacked into racks.



One cell, left, and one rack of packs, right

Modules

Many racks are connected to create a DC module. The DC module will often be housed in an area or a container of its own. Each module will have a cooling system and a fire suppression system and a BMS controller.

BESS

Many modules are connected together, to connect to a PCS which converts the power from DC to AC. The PCS and DC modules are controlled by a BMS and referred to in their entirety as a BESS.

Power plant

Many BESS, usually 1-2 MW in power capacity each, will be connected together on the AC side to form a power plant. The entire power plant will be controlled and communicate with the grid by an EMS control system.

More core components

- **Battery Cells/Modules:** The building blocks (like AA batteries but utility-scale) that store energy.
- **Racks/Containers:** The modules are stacked inside enclosures (such as shipping containers) that keep them safe, ventilated, and climate controlled.
- **Transformers and Switchgear**: Steps up the voltage and connects to the local substation/grid safely.

Layout

- Looks like rows of containers or cabinets, often in a fenced-in area similar to a small substation.
- Includes access roads, fire access, and security fencing. Often time includes retention ponds.

Design Safety Considerations

- Protection and Safety Systems: Includes circuit breakers, fuses, fire suppression, and isolation mechanisms to prevent damage and ensure safety.
- Fire Suppression System: Built-in systems to detect and contain thermal issues.
- Monitoring and controls: 24/7 remote monitoring for temperature, voltage, and performance.
- Row spacing: Federal standards have been adjusted based on research and in-service BESS incidents.

TECHNOLOGY

Battery performance depends heavily on the type of chemistry used. Each chemistry offers trade-offs between cost, energy, lifespan, safety, and performance.

LFP (Lithium Iron Phosphate)

- 90% of current market
- Excellent safety, long lifespan, and stable performance
- Often used in grid storage and electric buses

NFPP (Sodium Ion) Emerging chemistry

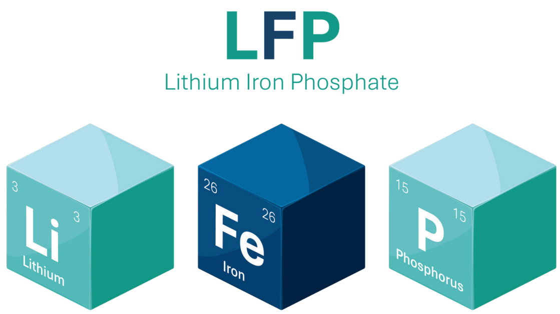
- Lower cost, non-toxic, and uses abundant materials
- Lower energy density, but promising for large-scale energy storage

NMC (Nickel Manganese Cobalt)

- High energy density, commonly used in EVs
- Balances performance, cost, and safety

NCA (Nickel Cobalt Aluminum)

- High specific energy and long range
- Popular in premium electric vehicles like Tesla



__LFP__ is the dominant battery chemistry in energy storage due to its lower cost and longer cycle life compared to other chemistries.

LTO (Lithium Titanate - Lithium Ion)

- Very high safety and long cycle life
- Lower energy density but great for fast charging and heavy-duty use

Li-S (Lithium Sulfur)

- High specific energy and lower weight
- Still under development, not yet widespread

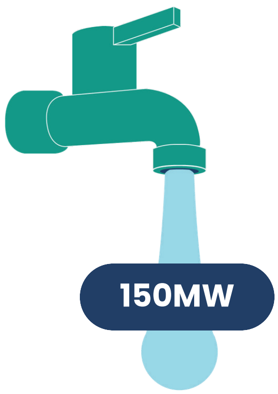
BATTERY POWER VS. ENERGY

How battery storage systems deliver electricity

Think of battery storage like water: flow vs. volume

POWER
Megawatts (MW)

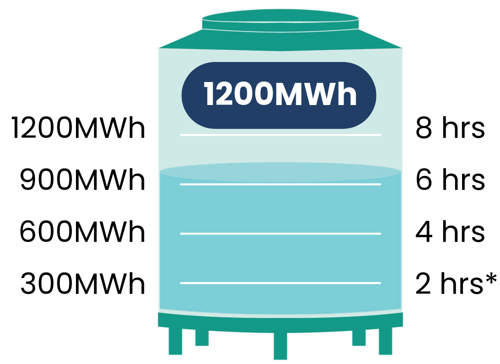
How fast electricity flows



Power = Speed

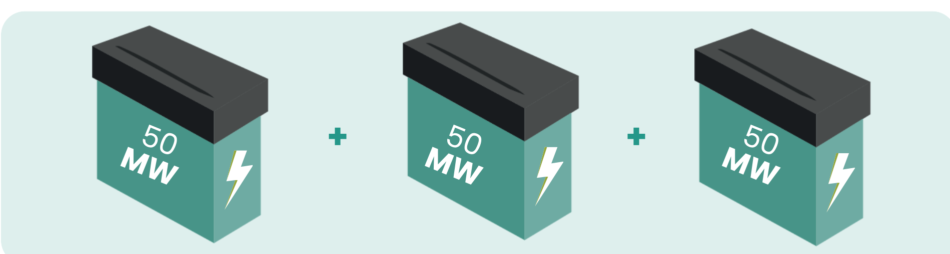
ENERGY
Megawatt hours (MWh)**

How much electricity is delivered over time

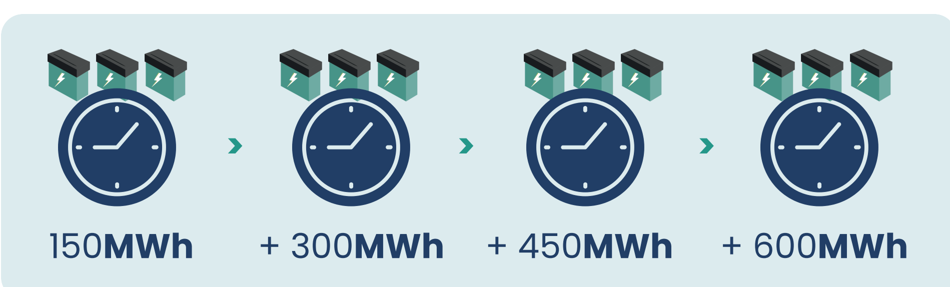


Energy* = Duration

**For illustration purposes only: 150MWh of energy can power a small town for about 2 hours.*



= 150**MW of power**



= 600**MWh of energy**

***1,000kWh equals 1MWh. Power consumption is billed in kWh.*

BENEFITS OF BATTERY STORAGE

While battery storage benefits the entire community by making the energy grid more reliable and efficient, it also contributes directly to the resiliency of our ever-expanding grid.

Grid Stability

BESS helps balance supply and demand in real-time, reducing the chance of a rolling blackout.

Disaster Resilience

Reduces strain during peak demand by discharging stored energy, helping avoid blackouts and expensive energy generation.

Deferred Infrastructure Investment

Utilities can delay upgrading transmission and distribution infrastructure by using BESS to manage load more efficiently.

Economic Savings

BESS helps lower energy costs over time by reducing expensive peak demand charges and stabilizing electricity prices.

Community Economic Benefits

Tax revenue from the facility will be paid by the owner and operator of the facility for the life of the project to key taxing authorities. These types of projects also bring direct and indirect financial opportunities such as local job creation, local business utilization, and infrastructure improvements.

Energy Infrastructure Resiliency

By decentralizing electricity sources on our grid, BESS helps create a safer and more durable energy system to guard against intentional disruption or attacks on the grid.

BESS SAFETY

Safety is our top priority. Battery Energy Storage Systems are designed to meet rigorous safety standards at the state and federal level, similar to the safety measures for electrical infrastructure already existing in your community.

These systems are constantly monitored and equipped with multiple safety features, including design considerations, temperature control, fire prevention, and automated shutdown systems in case of an emergency.

We also make sure that local emergency responders are trained and informed about the technology to ensure they are ready to appropriately respond in the rare event of an emergency.

BESS Maintenance and Safety

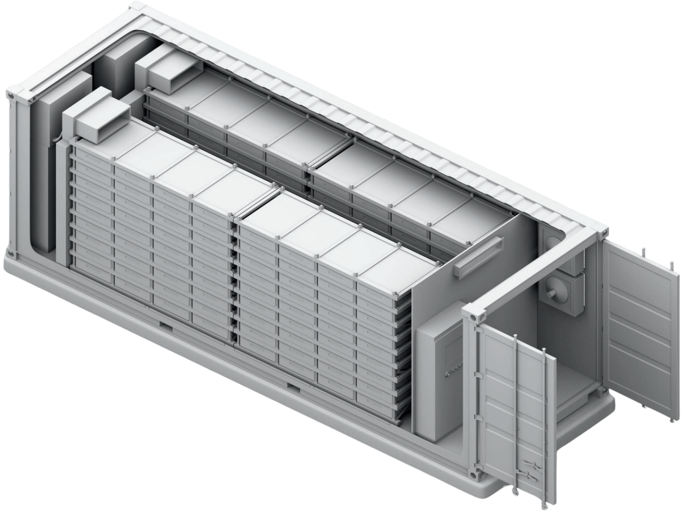
Regular maintenance and checks are conducted to ensure everything runs smoothly. In the rare case that there's an issue, an operations team is monitoring the BESS continuously and will address problems quickly.

Contingency plans will be in place to ensure that any potential issues are handled swiftly and safely. The project will coordinate with local fire and emergency services to create an emergency response plan that is unique to the site.

Effects On the Local Environment

We take environmental stewardship seriously. Battery storage systems are designed to have a minimal impact on the surrounding environment. The systems themselves do not produce emissions. We follow all local regulations and conduct thorough environmental reviews before moving forward with any installation.

Multiple layers of monitoring and protection maintain performance and safety.



NOISE & VISUAL IMPACTS

We understand that the aesthetics and peace of your community are important to you. Battery energy storage systems are enclosed in an exterior container, similar in appearance of a shipping container.

While the noise level generated by BESS systems is relatively low, increased setbacks and more robust vegetative screening are tools to be used to ally community concerns.

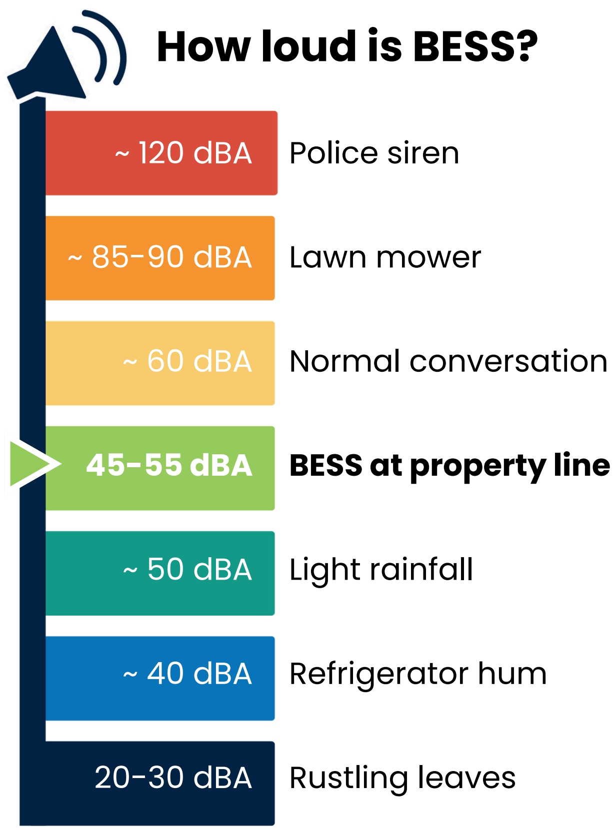
Noise Levels: comparable to a refrigerator running

The aesthetics and peace of a neighborhood and community are important factors in quality of life.

Battery energy storage systems are enclosed in an exterior container, similar in appearance of a shipping container and produce a steady, low-level sound primarily from cooling equipment.

At the property line, noise levels are typically similar to light rainfall or a home refrigerator. Increased setbacks and robust vegetative screening can further buffer neighbors from the sound.

A noise study is conducted to ensure minimal disturbance to the neighboring parcels.



Visual Impact

The height of these containers range from 8’ to 10’ tall. We will offer a landscape plan, in compliance with local ordinances, to provide vegetative screening to mitigate visual impact.

OPERATIONS & MAINTENANCE PLAYERS

Owner:
Financially liable for the activities of the BESS and the costs it incurs and revenues it earns

Operator:
- Makes day-to-day decisions around charging and discharging the BESS
- Registers with the market
- Ensures it meets all obligations as required, e.g. as a capacity asset

Offtaker:
BESS may directly sell capacity and/or storage as a service to one or more off takers

O&M contract:
- Original Integrator may maintain an O&M contract
- Obligated to maintain and test, per their own written procedures, but often also tied into performance guarantees with the utility/off-taker
- May have roles such as: Emergency Contact, NFPA 855 implementation, and continuous monitoring

DECOMMISSIONING

De-energize: Control and cut off any sources of energy to the equipment and work zone.

Disconnect: Disconnect all electrical and mechanical interfaces to prepare for removal of equipment.

Rig and Remove: Remove, handle, and transport facility infrastructure.

Disposition: Transfer equipment to the final off taker (recycle, reuse, repurpose).

RESOURCES

U.S. Department of Energy

A high-level overview of grid-scale energy storage technologies, including how BESS supports reliability, safety, and future grid demand.

New York State Energy Research and Development Authority: BESS Factsheet

A clear, public-facing explainer focused on how BESS improves grid reliability, reduces costs, and supports energy integration.

National Renewable Energy Laboratory: Behind-the-Meter BESS Report

A technical explanation of BESS as an electrochemical system that stores and dispatches energy for grid and distributed applications.

Lightsource bp – BESS 101

A simple, easy-to-understand primer explaining how utility-scale batteries store electricity and release it when it's most needed.

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