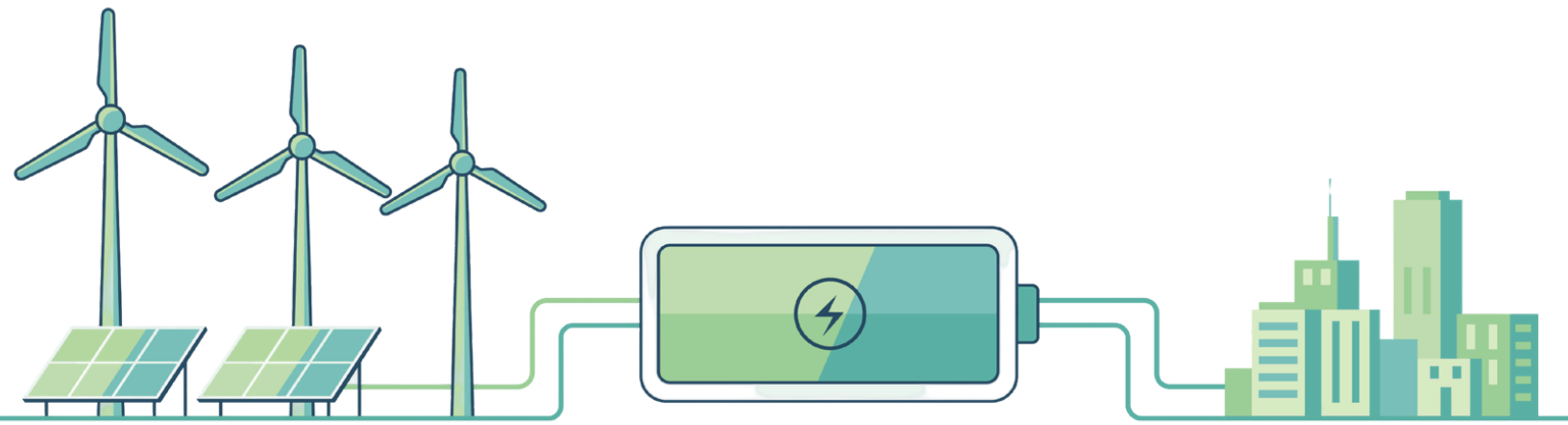
RENEWABLE NORTHWEST

BESS Technology and Evolution

What is BESS?

Battery energy storage systems, often referred to as BESS, store electricity for later use. When electricity generation exceeds demand, electricity from all energy sources, including wind, solar, hydropower, geothermal, and natural gas, can be stored in batteries and discharged when additional power is needed.





From Emerging Technology to Grid Infrastructure

Batteries are not new. They have been used for decades in homes, businesses, vehicles, and consumer electronics. What has changed is the scale, sophistication, and role of battery energy storage on the electric grid.

Over the past 15 years, advances in manufacturing, system design, monitoring technology, fire protection, and safety standards have transformed how BESS facilities are built and operated. Early projects helped the industry learn important lessons. Those lessons are now reflected in **stronger codes, improved equipment, better site design, and more robust emergency planning.**

Today, BESS is increasingly being used as a standard tool for planning, operating, and modernizing the electric grid. It is no longer just a demonstration technology. It is becoming part of the infrastructure utilities and grid operators use to manage demand, improve reliability, and make better use of existing energy resources.

Deployment has Grown Rapidly

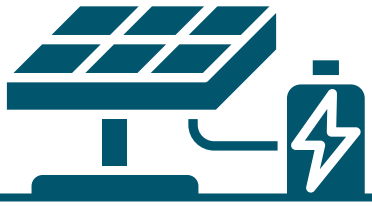
As costs have declined and performance has improved, BESS has become one of the fastest-growing energy technologies in the country. Utilities and grid operators are using BESS to help **respond to peak demand, improve flexibility, support reliability, and integrate a changing mix of energy resources.**

This growth is also beginning to take shape in the Pacific Northwest. Utilities, public power providers, rural electric cooperatives, and grid operators across the region are evaluating and deploying BESS as one of several tools to help meet future energy needs while maintaining reliable and affordable electric service**.** As more projects move from planning to operation, **BESS is becoming part of real-world grid planning and infrastructure investment across the region.**

Modern Systems are More Capable

Early BESS projects were often limited in how long they could deliver electricity. Today's systems can **store more energy, respond quickly to grid needs, and provide power for longer durations.**

Many utilities are now deploying four-hour battery systems, while researchers and manufacturers continue developing longer-duration storage technologies designed for different grid needs. A “four-hour” system means the battery can discharge at its rated power level for approximately four hours before it needs to recharge. For example, a 100-megawatt, four-hour system can deliver 100 megawatts of power for four hours.



Common Types of Energy Storage

BESS is one type of energy storage, but it is not the only one. Different technologies are designed for different uses, durations, costs, site conditions, and grid needs.

Lithium-ion Batteries	Lithium-ion batteries are the most common technology used in many utility-scale BESS projects today. They can respond quickly, fit within a relatively compact footprint, and are often used for shorter-duration applications such as managing peak demand, shifting energy from one part of the day to another, and supporting grid reliability.
Flow Batteries	Flow batteries store energy in liquid electrolytes held in tanks. They are often discussed for longer-duration storage because storage capacity can be expanded by increasing tank size, although they are less common than lithium-ion systems today.
Sodium-ion, Zinc, and Other Battery Technologies	Sodium-ion, zinc, and other battery technologies are being developed to improve performance, reduce costs, diversify supply chains, and provide additional options for different grid needs. Some are beginning to move toward commercial deployment, while others remain earlier in development.
Other Forms of Energy Storage	Other forms of energy storage include pumped hydropower, compressed air, thermal storage, hydrogen storage, and other mechanical or chemical systems. These can be important in broader energy planning, but they are different from the battery energy storage systems most local governments are likely to encounter in near-term land-use and permitting decisions.



These technologies are being developed to improve performance, reduce costs, increase storage duration, strengthen supply chains, and provide utilities and grid operators with more options for different grid needs.

Modern BESS facilities are more capable, more flexible, and better suited to utility-scale grid needs than many earlier systems.

Safety Has Evolved With Technology

Some of the most widely discussed BESS incidents involved earlier systems, older designs, or projects built before today's safety practices were widely adopted. Those incidents were serious, and they helped shape the standards, testing, and design improvements used today.

For example, the 2019 McMicken battery incident in Surprise, Arizona, underscored the importance of emergency response planning, system monitoring, ventilation, gas management, and clear safety standards for utility-scale battery facilities.



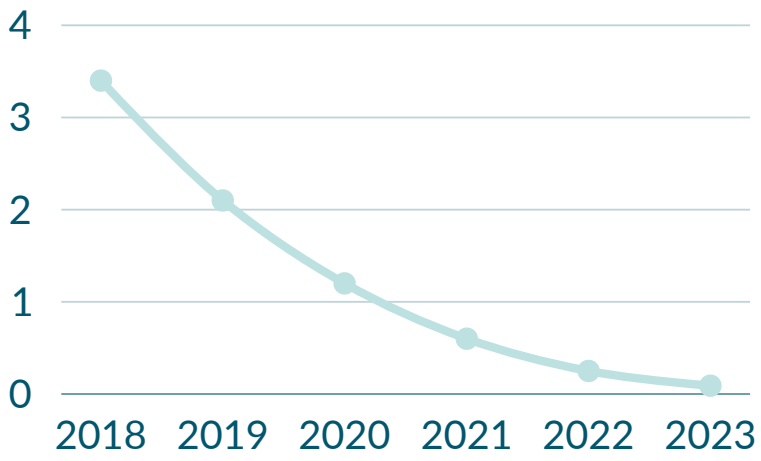
- Modern facilities are designed with multiple layers of protection, including real-time monitoring, thermal controls, fire detection, ventilation, emergency shutdown systems, equipment spacing, and emergency response planning.
- They are also subject to national standards and testing protocols, including NFPA 855, UL 9540, UL 9540A, International Fire Code requirements, and state and local permitting requirements.
- These standards address how systems are designed, installed, tested, operated, monitored, and coordinated with first responders.
- Standards continue to evolve as regulators, manufacturers, utilities, and emergency response experts learn from real-world operating experience. Modern BESS facilities are subject to more comprehensive safety standards, better monitoring, and stronger design expectations than many projects built a decade ago.

The Electric Power Research Institute's (EPRI) BESS Failure Incident Database tracks publicly reported BESS failure incidents and compares those incidents against the rapid growth of deployed battery storage capacity. The data shows an important trend: while incidents continue to occur, the rate of failure has declined sharply as deployment has increased.

EPRI also notes that incident datasets have limitations. The database relies on public reporting and other available information, and it may not capture every relevant incident. That context is important, but the overall trend remains meaningful: **as BESS deployment has grown, BESS failure rate per gigawatt-hour of deployed capacity has declined by 97%**.

BESS Incident Rates Have Declined 97% Since 2018

Reported fire and thermal-runway incidents per GWh of deployed battery energy storage capacity



Source: EPRI Battery Energy Storage System Failure Incident Database

Key drivers in the decline of safety incidents:

- Stronger safety standards and fire-code requirements
- Large scale testing, such as UL 9540A and broader use of NFPA 855
- Improvements in battery management systems, enclosure design, and thermal controls
- Lessons learned from earlier projects incorportated into newer designs and operations

Growth in the Pacific Northwest

BESS deployment is also increasing across the Pacific Northwest as utilities and grid operators plan for growing electricity demand, aging infrastructure, changing weather patterns, and the need to maintain reliable and affordable electric service.

While the pace of deployment varies by state and utility system, BESS is increasingly being evaluated as part of long-term planning across Oregon, Washington, Idaho, and Montana. Projects in the region may serve different purposes, including managing peak demand, supporting local reliability, making better use of existing infrastructure, integrating energy resources, and helping avoid or defer certain grid investments, depending on the project's purpose and how it is integrated into utility planning.

This regional growth reflects a broader shift: BESS is moving from an emerging technology discussion to a practical infrastructure tool that utilities, public power providers, rural electric cooperatives, and grid operators are considering as part of future grid planning.

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