Battery Energy Storage System (BESS)
Best Practices Guide

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BC Hydro
Power smart

1. Executive Summary

This **Battery Energy Storage System (BESS) Best Practices Guide** helps customers work with qualified contractors to identify the best battery solution for their needs. It does **not** endorse specific manufacturers or installers. Recommendations are general best practices and should be adapted to each project's unique conditions. It is for informational purposes only and assumes no liability for any actions taken based on its content; users are responsible for ensuring compliance with all applicable codes, standards, and regulations based on their BESS project.

Specifically, the guide provides procedures for installation and long-term operation of BESS that will be installed for behind-the-meter operation. Behind-the-meter refers to energy storage systems that are connected on the /business owner's side of the electrical meter. A business owner could use a BESS to shift electrical load, improve power quality, or better manage peak loads as a part of the several BC Hydro program offerings explored in the guide. This guide applies to commercial and light industrial buildings across British Columbia, including mixed-use properties, and is intended for property owners, contractors, and installers to support safe implementation and optimized system performance.

For BC Hydro's Energy Storage Incentive please refer to Energy storage incentive and review the ESS application process, ESI Customer Manual and Incentive application workbook. For the full-length version, please refer to Battery Energy Storage System Best Practices Guide.

1.1 Scope

- Applies to systems under **5 MWh** capacity.
- Excludes UPS units and building types not listed.
- Focuses on **behind-the-meter** installations (systems connected on the customer's side of the meter).

1.2 Key Topics

- **Safety & Compliance:** Ventilation, fire suppression, emergency disconnects, and adherence to UL, CSA, NFPA standards.
- **Installation & Integration:** Selecting qualified contractors, choosing appropriate systems, and integrating BESS for optimal performance.
- **Operations & Maintenance:** Regular monitoring, preventive maintenance, and corrective actions to extend system life.
- **Economic & Environmental Benefits:** BC Hydro incentives, energy resiliency, cost savings, renewable integration, and backup power.
- **End-of-Life Management:** Proper disposal and recycling of BESS units.

2. Key Terms and Definitions

Term	Definition
Active Power	Actual power transferred to the load.
Battery Energy Storage System (BESS)	Electrochemical device delivering or absorbing energy at its DC bus.
Battery Module	Assembly of rechargeable cells with protection.
Behind the Meter	Components on customer premises, distinct from grid infrastructure.

Degradation	Permanent reduction in energy storage or power delivery.
Depth of Discharge (DOD)	Ratio of discharged energy to max capacity.
Direct Current (DC)	Electric current flowing in one direction.
End of Life (EOL)	Remaining capacity at which BESS becomes non-functional.
Energy Management System (EMS)	Top-level controller for power flow and distribution.
Energy Storage System (ESS)	Components storing and supplying electrical energy.
Lithium-ion Battery (LiB)	Rechargeable battery using lithium ions.
Lithium Iron Phosphate (LFP)	LiB type using lithium iron phosphate cathode.
Operations and Maintenance (O&M)	Managing physical assets and infrastructure.
Power Conversion System (PCS)	Interface between battery system and AC grid.
Power Factor Correction (PFC)	Technique to improve AC circuit power factor.
Reactive Power	Power absorbed and returned due to reactive properties.
Round Trip Efficiency (RTE)	Ratio of energy supplied vs. retrieved.
SCADA	Supervisory system for component communication.
State of Charge (SOC)	Ratio of current capacity to max capacity (%).
State of Health (SOH)	Current condition vs. original specification.
Thermal Runaway	Self-sustaining reaction causing overheating and potential fire/explosion.
Usable Capacity	Capacity after accounting for max Depth of Discharge.

3. Energy Storage System Basics

Energy Storage Systems (ESS) store energy for later use. Common types include:

- **Mechanical:** Pumped hydro
- **Thermal:** Molten salt
- **Electrochemical:** Batteries

Recent advances in battery technology have made ESS more affordable and practical for commercial buildings.

3.1 Battery Energy Storage System (BESS)

A **BESS** stores electricity as chemical energy and releases it when needed. It can charge from the grid or renewable sources (solar, wind). Some key definitions for ratings that should be understood for BESSs are:

- **Power Capacity (kW/MW)**: The maximum power that a battery can deliver at any given moment. Common units of measurement include kilowatts (kW) or megawatts (MW). Charging and discharging power capacity may differ.
- **Energy Capacity (kWh/MWh)**: The total amount of energy that a battery can store.
- **Storage Duration**: The duration for which the battery can supply electricity at its rated power. This is also the ratio of the energy capacity to the power capacity.
- **State of Charge (SOC)**: The percentage of battery capacity that is charged and available to be converted to electricity.

A BESS can supply electricity for a longer period at a lower power rating. For example, a 1 kW/4 kWh system can supply 1 kW for 4 hrs or 0.5 kW for 8 hrs, or 0.25 kW for 16 hrs.

Figure 1: Rain Barrel Model Describing Stored Energy and Power of a BESS

A Battery Energy Storage System can generally be divided into the following component categories:

- Core electrochemical battery components.
- Battery auxiliary system components.
- Power electronics components.
- Fire Safety Systems.

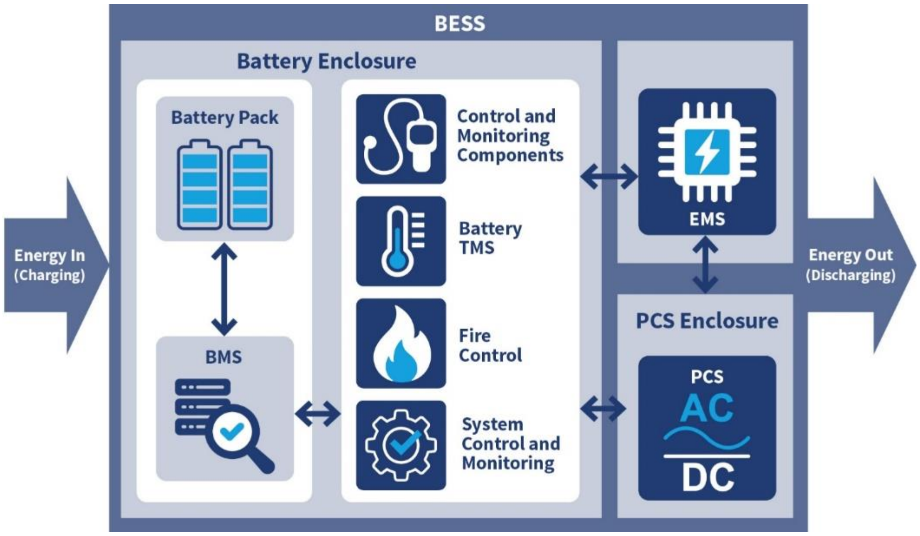

Figure 2: Components of a BESS

4. BESS Use Cases

Battery Energy Storage Systems (BESS) help businesses manage energy costs, improve reliability, and support sustainability goals. They store electricity for later use, making them ideal for facilities adopting electric vehicles, heat pumps, and other smart technologies. Some key benefits are included below:

Benefits	Details
Resiliency & Reliability	Backup Power: Keep critical equipment running during outages. Power Quality: Stabilize voltage and frequency to protect sensitive equipment. Power Factor Correction: Avoid utility penalties by improving power efficiency.
Demand Management	Peak Shaving: Discharge stored energy during high-demand periods to lower costs. Load Shaping: Shift energy use to off-peak hours for savings. Billing Management: Combine with solar to store excess energy and reduce grid reliance.
Supporting Electrification	Replace or optimize diesel generators for cleaner backup power. Reduce greenhouse gas emissions and maintenance costs.

5. Selecting a Contractor for BESS Installation

Choosing the right contractor is critical for a successful Battery Energy Storage System (BESS) project. A qualified contractor ensures proper design, installation, and compliance with regulations.

5.1 What a Good Contractor Does

- Conducts a **feasibility study** to identify cost-saving opportunities.
- Designs and installs the system.
- Optimizes system size based on your energy profile.
- Secures permits and meets building codes.
- Assists with **utility incentive programs**.
- Provides cost estimates, payback analysis, and warranties.

5.2 How to Choose the Right Contractor

- **Certifications**: Ensure they are certified for your battery type.
- **Manufacturer Listing**: Check if they're listed on the battery manufacturer's site.
- **Alliance of Energy Professionals**: BC Hydro can refer you to trusted contractors.
- **Licensed Electrical Contractor**: Must employ Professional Engineers and Red Seal Electricians.
- **Memberships**: CANREA or BC Sustainable Energy Directory (optional but recommended).
- **Insurance & Safety**: Confirm coverage and WorkSafeBC compliance.
- **Reputation**: Review testimonials and past projects.

5.3 What Should Be in the Quote

- **Feasibility Study:** Scope of work, cost to perform study, timeline, financing options, example report of what the customer will receive at the completion of the study
- **Installation Quote:** Equipment specifications; Scope of work; Write-up on the electrical system proposed; Engineering design costs for any civil, electrical, mechanical work and production of drawings; Land survey costs; Preliminary schedule to complete the work; Equipment costs; Installation and construction labour costs; Financing options for the battery; A product warranty; Performance warranty; And a workmanship warranty.

6. Selecting a Battery

6.1 Meeting Use Cases

When selecting a BESS, start by hiring a contractor to conduct a review of the site where you may be installing a battery. This study reviews load patterns and electricity costs to identify opportunities for savings and reliability. It also helps define expected use cases such as backup power, peak shaving, and power quality. Discuss findings with the contractor to set clear expectations and configure the system to meet your needs. Sizing of your battery will be assessed based on this review.

6.2 Sizing

The next step is sizing the BESS for your use case. Battery capacity is measured in kilowatt-hours (kWh) or megawatt-hours (MWh), but focus on usable energy, which accounts for depth of discharge (DoD). For example, a 10 kWh battery with 80% DoD provides 8 kWh of usable energy. Lithium-ion systems typically allow 80% or more.

The contractor also considers lifespan, annual degradation, and load profiles to ensure the system meets performance needs over time. Below table shows some key sizing considerations by use case:

Key Sizing Considerations by Use Case	
Backup Power	Determine average consumption of critical loads and outage duration. Calculate total energy required and select a system that meets this demand.
Power Quality	Requires a power system study to model grid events and BESS response. Discharge duration is short, but PCS must handle real and reactive power for voltage regulation.
Power Factor Correction	Relies on PCS sizing to supply reactive power and operate across a range of power factors.

Peak Shaving	Analyze annual peak demand and duration. Size the BESS to discharge during peak periods and recharge off-peak. BC Hydro demand charges: Medium General Service: $6.03 per kW Large General Service: $13.75 per kW
Load Shaping	Size for 4-hour discharge (per BC Hydro incentive programs) plus extra capacity for degradation. Include contingency factors.

6.3 Chemistry

When choosing a battery supplier, prioritize systems with strong safety, high energy density, and long life. Lead-acid batteries were once common but have low energy density, high self-discharge, and require large space for scaling.

Today, Lithium Iron Phosphate (LFP) is the leading option for stationary storage. It offers competitive energy density, good durability, lower cost per unit of electricity, and minimal use of cobalt and nickel. Using iron instead of expensive materials improves affordability and safety. LFP also has a higher thermal runaway threshold, making it safer than other lithium-ion chemistries.

6.4 Energy Management System

Each BESS should include an approved Energy Management System (EMS) and Battery Management System (BMS). These systems monitor operating conditions and keep voltages, currents, and temperatures within specifications. According to NFPA 855, the EMS must isolate the BESS or place it in a safe state if hazardous conditions arise and alert the owner. Contractors should demonstrate this safety feature during installation and stay up to date on these requirements. Typically, the EMS and BMS are supplied by the same vendor as the battery system.

6.5 Enclosure

NFPA 855 requires BESS enclosures to be made of non-combustible materials and rated for the environmental conditions of the installation site. The contractor must ensure the enclosure meets these requirements for the chosen location.

6.6 Codes & Standards

- **UL Certifications**: UL 1741, UL 9540, UL 9540A, UL 1973, UL 1642.
- **CSA**: CSA C22.2 No 107.1.
- Comply with BC Electrical, Fire, Building Codes, NFPA standards.
- Use fully certified systems to avoid legal and safety risks.

6.7 Suppliers for small commercial sites/ customers

A list of commonly used commercially available off the shelf BESS products for small commercial applications can be found at [Energy storage battery list (bchydro.com)](bchydro.com).

6.8 Permitting

- May require: Electrical, Building, Development, Environmental permits.
- Start permitting early to avoid delays.

6.9 Location & Land Survey

- Large BESS (MWh scale) needs significant space and structural checks.
- Survey for boundaries, utilities, easements; consider geotechnical/hydrology studies.

6.10 Site Panel & DERMS

The BESS connects to the building's electrical panel behind the meter for charging and auxiliary loads. The contractor must confirm the panel has enough space and capacity; if not, an upgrade to higher service is required. Owners may also consider adding systems like solar panels, heat pumps, and electric heating to further electrify the building.

To participate in BC Hydro demand response programs, the BESS must connect to BC Hydro's Distributed Energy Resource Management System (DERMS) for event control. This connection must be highly reliable and support IEEE 2030.5/CSIP, SCADA, an existing API, or another BC Hydro-approved method. Confirm with your installer that the system meets DERMS requirements and review the BC Hydro ESI customer Manual and connectivity guide at Energy Storage Incentive.

7. BESS Integration by Housing Type (BC Guide)

7.1 Scope

- Applies to **Commercial & Light Industrial (C&I)** buildings in BC.
- Focus: Battery Energy Storage Systems (BESS) ≤ **5 MWh** (larger systems are utility-scale).
- **BC Hydro approval required** before installation, even if not exporting to the grid.

7.2 Site Selection

- Assess space for hazards, accessibility, and lifting equipment clearance.
- Show proposed locations to contractor and installers for approval.
- Maintain **60–150 m** setback from high-voltage lines or substations (distance depends on voltage level).
- Avoid flood-prone, high-humidity, dusty areas; ensure ventilation and temperature compliance (-20°C to 50°C).

7.3 Design Requirements

Non-Dedicated/Outdoor	Max unit: 50 kWh; aggregate: 600 kWh. Spacing: ≥3 ft between units and walls.
Exterior Wall	Max unit: 20 kWh; aggregate: 600 kWh.
Walk-in Units	Max size: 53 ft × 85 ft × 9.5 ft.
Hazard Mitigation Analysis (HMA)	Required for: Units >50 kWh or aggregate >600 kWh. New tech or mixed ESS types.

7.4 Safety Measures

- **Emergency Disconnect**: Clearly labeled, within 10 ft; marked "ENERGY STORAGE SYSTEM DISCONNECT."
- **Signage**: ANSI Z535; include hazards, UL certifications, emergency contacts.

- **Security**: Locked cabinets (indoor); fences/barriers (outdoor); bollards for vehicle protection.
- **Ventilation**: Ensure airflow; avoid dust buildup.
- **Fire Detection & Suppression**: NFPA 72 compliant; radiant-energy sensing.
- **Sprinklers**: ≥0.3 GPM/ft² for ≤50 kWh units; larger units based on fire testing.
- **Egress**: Emergency lighting and panic hardware.

7.5 Thermal Management

- **Air-Cooled Systems**: Ventilation, forced air, AC; avoid dust; heaters for cold climates.
- **Liquid-Cooled Systems**: For larger units; efficient but higher maintenance.

7.6 Installation Types

Indoor	• Dedicated-Use Building:
	  ○ Only for energy storage (or storage + generation).
	  ○ Access limited to qualified personnel.
	  ○ No other occupancy types.
	• Non-Dedicated Building:
	  ○ Max height: 23 m (75.5 ft) above grade; no below-grade installs.
	  ○ Secure BESS in locked, non-combustible enclosure or separate equipment room.
	  ○ Must be accessible to emergency responders without passing through electrical rooms.
	  ○ Label doors with manufacturer, model, electrical rating, and hazard info.

Outdoor	• Units must be outdoor-rated; secure with barriers/fencing.
	• NFPA 855 clearances:
	  ○ 10 ft from lot lines, public ways, buildings, combustibles, hazardous materials.
	  ○ Can reduce to 3 ft with fire-rated barriers or UL9540A-tested systems.
	• Keep 10 ft from egress paths; clear vegetation within 10 ft radius.

Special Outdoor Cases	• Exterior Wall: Non-combustible wall, 2-hour fire rating, no openings.
	• Rooftop:
	  ○ Max height: 23 m; non-combustible/Class A roofing.
	  ○ ≥5 ft from roof edge; ≥10 ft from fire access point.
	  ○ Additional requirements for units >20 kWh (e.g., stairway access, standpipe outlet, radiant-energy fire detection).
	• Open Parking Garage:
	  ○ ≥50 ft from HVAC inlets; ≥25 ft from exits; ≥10 ft from egress.
	  ○ Fence to keep public ≥5 ft away.

7.7 Required Documents for Customer/ Business Owner

- Product specs, installation guide, O&M manual, warranty.
- Commissioning plan & report.
- Emergency Response Plan.
- Decommissioning plan.

7.8 Installation Process

1. Review of site → Contractor selection.
2. Site survey & permits.
3. Design & procure equipment (longest lead time: batteries).

4. Prepare site (pads, barriers, vegetation removal).
5. Install BESS & electrical components.
6. Commissioning:
7. Mechanical & safety checks.
8. Cold & hot commissioning.
9. Final performance test.
10. Submit commissioning report; obtain AHJ approval.
11. Provide training & documentation.

8. System Costs

The battery is the largest cost component in a BESS installation, typically accounting for 60–70% of the total cost. Most systems use lithium-ion or lead-acid batteries, and while prices have dropped significantly over the past decade, installation remains a major investment.

Lead-acid batteries have lower upfront costs but only allow about 50% depth of discharge, meaning you need roughly twice as many to match the usable capacity of lithium-ion batteries. Lithium-ion batteries, though more expensive initially, offer up to 98% depth of discharge and last three to four years longer.

Commercial installation costs generally range from $700 to $1,600 per kWh, with larger systems benefiting from economies of scale. Because BESS units are modular, businesses can install multiple units to meet higher energy needs. BC Hydro offers incentive programs to help offset costs. Some providers also offer leasing or payment plans, always confirm the total cost before committing.

After installation, it is strongly recommended to purchase a maintenance plan to keep the system safe and efficient. Discuss ongoing maintenance options and costs with your contractor.

9. Distributed Energy Resource Management System (DERMS)

DERMS is a platform that manages distributed energy resources like generators, solar panels, and battery storage. It enables real-time communication and control, helping utilities balance supply and demand through methods such as Virtual Power Plants and microgrids.

BC Hydro uses DERMS for the Energy Storage Incentive (ESI) program. The ESI program requires the business to sign a 10-year contract allowing BC Hydro to use part of their battery capacity for up to four hours during peak demand events. The battery powers the facility's load, not the grid.

To participate, the BESS must connect to BC Hydro's DERMS using an approved, reliable method (e.g., IEEE 2030.5/CSIP, SCADA, API). Manual control is not allowed, and the customer must maintain connectivity for the contract term.

10. Current BC Hydro Program Offerings

For the most current details, please refer to official program websites, as information may change over time.

10.1 Feasibility Study

- **What it is:** An in-depth study by an energy expert to evaluate energy solutions and provide cost/benefit analysis. For details, See Feasibility Study.

- **Potential Funding:**
    - **100%** for projects >200,000 kWh/year or >100 kW demand impact
    - **50%** for projects 25,000–200,000 kWh/year or 25–100 kW demand impact
- **Eligibility:**
    - Industrial and large commercial customers
    - Large commercial: ≥2 GWh annual electricity use
    - Minimum energy opportunity: 25,000 kWh/year or 25 kW demand impact
- **How to apply:** Through your Key Account Manager or Regional Energy Manager.

10.2 BESS Incentive Programs

BC Hydro offers incentives for businesses installing new behind-the-meter battery systems that provide demand flexibility. Owners agree to a 10-year contract allowing BC Hydro to dispatch the battery during grid events (up to 4 hours per event, twice daily).

- **Incentive**: The lesser of $10,000 × kW nominated, $10,000 × (kWh ÷ 4), or 80% of eligible costs (equipment, installation, permits, DERMS connection).
- **Eligibility**: Must be on a general service or irrigation rate, install a new battery that meets a minimum nominated capacity requirement of 25 kW, have a smart meter, and integrate with BC Hydro's DERMS via approved protocols. Systems must be non-exporting and meet all safety and code standards (UL, CSA, NFPA, CEC).
- **Requirements**: 10-year warranty, ≥80% efficiency, fire safety systems, permanent installation, and compliance with all codes.

For full details, see Energy storage incentive.

10.3 Demand Response for Business

Purpose

Businesses can earn rewards by reducing electricity use during peak demand events, which last up to four hours. Shifting the typical usage before or after an event qualifies for a reward. Participants may join both the Energy Storage Incentive and Demand Response programs. For details, see Demand response for business.

How it works

- **Alert**: Notification a day before event
- **Shift**: **No minimum** reduction is required. Participation in **at least 50%** of events is required to be eligible for rewards.
- **Reward**: Incentive based on demand reduction; paid at season end.
- **Program Details**

Incentive	$50 per kW-season × average demand reduction
Duration	Max 4 hours per event
Eligibility	BC Hydro SGS/MGS/LGS rate; dedicated staff contact

10.4 Self-Generation

The self-generation program enables owners of independent generators, such as rooftop solar PV systems, to send excess electricity back to the grid in exchange for credits toward future electricity use. Energy may be stored in a Battery Energy Storage System (BESS), but when generation exceeds demand and storage is full, the excess is sent to the grid. A bi-directional smart meter tracks consumption and exports. Credits appear on the next bill, and any remaining at the anniversary date are paid at market price. Because this setup combines generation, storage, and grid connection, it requires careful design with proper sizing and protection. For full eligibility and details, see BC Hydro's Self-Generation program.

11. BESS Operations & Maintenance (O&M)

A Battery Energy Storage System (BESS) must be operated according to the manufacturer's instructions and maintained to ensure safety, performance, and longevity. A strong O&M plan helps manage costs, maximize uptime, and extend equipment life.

11.1 Key Elements of O&M

- **Service Agreements:** Consider a Long-Term Service Agreement (LTSA) with the contractor or supplier. These typically last 10–15 years and can include full coverage (24/7 monitoring) or partial services.
- **Owner Training:** After installation, owners receive training on system operation, including modes and adjustable settings for programs like time-of-use.
- **Monitoring:** Most systems offer apps for real-time tracking of capacity, power flow, and alerts. Ensure Wi-Fi connectivity and check the portal monthly.

11.2 Maintenance

- **Preventive Maintenance**: Performed every 6–12 months by certified personnel. Tasks include cleaning, visual inspections, checking harnesses and cooling systems, verifying battery connections, testing fire protection systems, updating software, and reviewing temperature logs.
- **Corrective Maintenance**: Addresses unexpected issues such as overheating, voltage imbalance, or communication failures. Contracts should specify response times and include root-cause analysis after repairs.
- **Spare Parts**: Keep common parts onsite to reduce downtime, but ensure proper storage conditions.
- **Annual Testing**: A qualified technician should perform a full system check once a year and provide a performance report.

11.3 Documentation

Keep detailed records of startup and shutdown procedures, alarm and control testing, maintenance logs, and any system changes. Include safety systems such as the Battery Management System (BMS), fire protection, and ventilation.

11.4 Costs

Annual O&M costs range from $4.56 to $12.61 per kW-year. For example, a 4-hour, 1 MW system costs about $7,880 per year, excluding LTSA and travel expenses.

11.5 Safety Essentials

Main hazards include fire, explosion, electric shock, and chemical leaks. Mitigation strategies:

- Use certified components and follow codes.

- Install BMS, fire detection/suppression, and ventilation.
- Train personnel and maintain hazard signage.
- Ensure PPE requirements are clear.

11.6 Emergency Response Plan

Every facility should have an Emergency Response Plan that outlines shutdown and isolation steps, alarm response procedures, fire and evacuation protocols, emergency contacts, and drill schedules. Update the plan whenever system changes occur.

12. Warranty and Long-Term Service Agreements

12.1 Product and Installation Warranties

Every BESS should include a product warranty covering defects for a specified term and an energy capacity retention guarantee. This guarantee ensures the battery retains a minimum percentage of its original capacity over time or energy throughput. For example, a 12 kWh system with an 80% retention guarantee for 10 years must maintain at least 9.6 kWh capacity during that period. If capacity falls below this threshold under normal use, the supplier must repair or replace the system. Always review warranty terms carefully, misuse or non-compliance can void coverage.

Contractors should also provide an installation warranty, covering defects caused by installation errors or workmanship for a defined period.

12.2 Long-Term Service Agreements (LTSA)

Owners can opt for an LTSA with the supplier for ongoing operations and maintenance. These agreements often include extended warranties and performance guarantees for metrics such as State of Health (SOH), Round Trip Efficiency (RTE), and system availability (e.g., minimum 97%). LTSA terms typically require annual payments and compliance with conditions. Service tiers range from full coverage with 24/7 monitoring and multiple guarantees to scaled-down options at lower cost.

13. Insurance

Installing a BESS can impact your insurance coverage because this technology is still relatively new. Most policies can be adapted, but you must notify your provider before installation, failure to do so may void coverage.

13.1 Key Coverage Areas to Consider

- **Equipment Breakdown**: Covers failures in batteries, inverters, and controllers beyond standard warranties.
- **Fire Hazards**: Lithium-ion batteries carry thermal runaway risks; ensure adequate fire coverage.
- **Natural Disasters**: Outdoor installations may need protection against weather-related damage.
- **Third-Party Liability**: Covers injury or property damage caused by system failure.
- **Cybersecurity Risks**: BESS relies on cloud-based monitoring; consider coverage for cyberattacks.

13.2 Insurance Process

Discuss coverage needs with your installer and insurer before installation. Research providers experienced with BESS, gather equipment and installer details, highlight safety features for potential discounts, and request a quote. Expect higher premiums due to limited industry data.

13.3 Information Insurers May Request

Details on battery manufacturer, contractor qualifications, fire detection and suppression systems, system protection measures, heating/cooling systems, monitoring capabilities, emergency response plans, installation design, and site security (fencing, CCTV, alarms, cybersecurity).

14. Lifetimes and Degradation

14.1 Battery Lifespan

Most BESS units last about 10 to 15 years, depending on how often they are charged and discharged.

14.2 Degradation Over Time

Battery capacity decreases gradually, reducing energy storage, power output, and efficiency. The first year usually sees the largest drop of about two to three percent, followed by roughly one percent per year. Actual rates vary by supplier and usage. To slow degradation, follow manufacturer guidelines and work with your contractor on best practices. Monitor performance through the supplier’s app or online platform. Some providers offer analytics to detect sudden drops. If performance falls below warranty limits, you may qualify for repair or replacement. Always review warranty terms before making a claim. Schedule an annual system check by a qualified technician.

14.3 Moving BESS Units

Relocating a BESS is possible but complex and costly. It requires professional disconnection, transport, and reinstallation according to manufacturer instructions. Installation may be restricted by updated standards or site limitations. Always confirm feasibility with your installer and manufacturer before planning a move.

15. Proper Disposal at End of Life

A BESS reaches end of life when it is no longer cost-effective to operate or when battery cells become unsafe. At this stage, warranties and performance guarantees usually expire, and risks such as overheating or fire increase. Decommissioning should follow manufacturer guidelines and be performed by qualified professionals.

15.1 Key Steps

- Schedule annual assessments and discuss remaining life with your installer.
- If warranties apply, review options before removal.
- Only trained personnel should discharge, disconnect, and remove the system.
- Batteries are hazardous waste and must be recycled by approved facilities. Ask your supplier about recycling programs when purchasing the system.

15.2 Decommissioning Plan

A written plan should outline roles, methods, safety measures, and documentation requirements. Permits are typically required. After removal, a decommissioning report should summarize the process and be kept on file.

15.3 Replacement vs Full Removal

Large commercial systems often allow module replacement instead of full unit removal, which is faster and less costly. Confirm compatibility with your supplier before deciding.

15.4 Cost Considerations

Disposal costs include labor, transport, and recycling. For example, recycling costs average about $3.82 per kWh. A 4-hour, 1 MW system (4 MWh) would cost roughly $15,260 to recycle. Costs vary by location and should be updated periodically. Owners should budget for decommissioning and consider negotiating updates to the plan three years before project end.