



POWIN

Powin Battery Lab

BATTERIES THAT GO BEYOND



The success of your energy storage project depends largely on your system performance. We understand this, and so as part of our commitment to offering the best possible energy storage experience, we established the Powin Battery Lab in 2020.

This is a world-class battery test facility that's located in Powin's Engineering headquarters in Tualatin, Oregon. Our Lab enables us to characterize and validate all batteries from cell to system. Equipped with the latest testing facilities, equipment, and specialists, the Lab plays a central role in establishing better performance guarantees, warranties, control processes, and strategies for each of our products.

Accelerating the Growth of Energy Storage

As demand for reliable, safe, and cost-effective energy storage solutions grows, so does the need for rigorous testing. That's why, since Powin Battery Lab's inception, we have continued to upgrade it to expand cell, module, and system testing capabilities.

This adds an important layer of transparency to understanding battery cell performance in an industry that typically relies on vendor self-reporting. As part of Powin's process, we assist in selecting qualified cell vendors through on-site visits, reporting, and continuous, in-depth conversations and evaluations of existing technologies.

Diversifying battery cell vendors

We work with a variety of carefully vetted cell vendors to bypass much of the supply chain challenges while ensuring optimal performance and longevity of our systems. By controlling all stages of manufacturing and integrating our hardware with our own software, we ensure the highest level of system safety, quality, longevity, and performance. Our vertical integration and diversification of cell suppliers empower us to mitigate cost fluctuations and ensure a steady supply of batteries.

Data-Driven Expertise

The Powin Battery Lab team has half a century of combined experience in testing batteries in the US and around the world. The Powin Battery Lab has logged hundreds of thousands of channel hours in performance testing, as well as cell and module-level safety testing. Every day we measure and monitor over 3 million battery cells that are in the field.

TOTAL TESTING HOURS

1M+ | 60,000
Cell | Stack

300,000 | 15,000
Last 6 month

42%
increase YoY

POWIN
battery lab

Powin Batteries Cells: Innovation You Can Trust

We've created a world-class battery data repository, so you know you're integrating technology with reliable, long-lasting battery cells. As part of this data library, our Battery Lab performs technical evaluations of our battery cell vendors. These evaluations include factory audits, manufacturing capacity analysis, and cell and system performance testing.

We create this battery data repository by:

- ✓ **Assessing and selecting cell vendors** based on best-in-class performance and competitive ROI
- ✓ **Conducting various technical and performance evaluations** on cells used in existing products as well as candidate cells for future products
- ✓ **Managing data** provided by vendors, generated internally, and collected externally
- ✓ **Collecting large amounts of field data**, including voltage, temperature, and current, from virtually every battery cell in the storage system that Powin installed and monitors to build our models.

Next-Level Performance & Safety

Our vetting process is an integral part of what we do. All battery cells are evaluated in stages: bankability evaluation, commercial analysis, technical analysis, quality inspection, and performance testing. The goal of this process is to ensure that cells from new vendors meet our technical and engineering standards and are suitable for integration into our products.

Our ongoing battery cell evaluations also allow us to switch between cell capacities and even different cell chemistries. The Battery Lab continuously monitors advancements in cell manufacturing and design. This means we're prepared to assess new cells, bringing greater safety and performance to Powin systems. We work closely with all of our cell vendors to drive innovation and bring the highest level of performance and safety to the market.

Unparalleled Visibility

Battery Management from Cell to System

As battery performance and system safety is highly dependent on key cell parameters like voltage, current, and temperature, Powin closely monitors and manages them with our proprietary battery management system (BMS) to ensure the longevity and reliability of BESSs. Due to our vertical integration with our BMS paired directly with the system-level Energy Management System (EMS) and Thermal Management System (TMS), you will gain visibility into the performance of your energy storage projects, down to the cell level.

We are able to provide:



Advanced cell-level controls and monitoring



More precise real-time battery SoC and SoH measurements



Increased power availability



Optimized battery and system performance



Enhanced system optimization



Increased system safety



Deeper cycling and longer life of the system

Evaluations:

Quality and Performance are Priorities

We go above and beyond to ensure you get the best quality energy storage solutions. That's why we do everything to ensure we have the most accurate and comprehensive data collection and analysis processes. We've handpicked subject matter experts to lead the way, who bring their expertise and know-how to the table.

This commitment to quality benefits not just us but also our cell vendors, industry stakeholders, and, most importantly, you. In addition, we're constantly working with cell testing professionals to identify cutting-edge cell characterization techniques to bring to the Powin Battery Lab.



To ensure the best results, our testing methodology evaluates key cell characteristics:



Vendor data validation

Ensures cell vendors provide reliable, repeatable data supporting their warranty.



Cycle/Calendar/Design life

Shows how a battery will degrade with more use and through time to help operators plan future augmentations and use cases of a battery system that could last up to 20 years.



DC internal resistance

Indicates the efficiency of the cell since high internal resistance will result in more losses and heat generation.



Round trip efficiency (RTE)

Helps characterize operating costs since a high-efficiency system requires less energy to charge for the same discharge capacity.



Thermal performance

Shows how easily that cell expels heat as Battery cell performance and safety are highly susceptible to temperature.



Predictive performance diagnostics

Enable predictive and preventive maintenance in the field to increase system safety and performance over time.



Incremental Capacity Analyses (ICA)

Tracks the State of Health and State of Charge in cells. The testing models built in the Powin Battery Lab support implementation of real-time analytics engines in the field with constant monitoring of Powin cells.



Electrochemical Impedance Spectroscopy (EIS)

Assesses the internal composition and quality of a cell without disassembling to track differences between cells from various manufacturers as well as State of Health internal changes associated with aging mechanisms to build more accurate models.



State of Charge (SOC)/State of Health (SOH) curves

Help tune the Powin BMS and analytics engines to support projects in the field from installation through life.



Cell-level fire safety

Informs about how cells will behave pushed to thermal runaway to ensure Powin systems are safe.

Designed with Safety in Mind:

Relentless Prevention, Detection & Mitigation

Your safety is our key priority. And it drives everything we do at Powin.

We test every cell, module, and stack product against UL 9540A and NFPA standards and put each of our platforms through Large-Scale Burn tests to simulate a worst-case environment. Over time, lithium iron phosphate cells have demonstrated an advanced safety profile attributed to a higher thermal runaway temperature compared to NMC, NCA, and LMO technologies.

To ensure the highest safety standards, we work with accredited third-party labs to run cell safety tests according to industry standards. Test protocols provide standard methods for evaluating safety performance and are critical for guiding site-level safety measures such as equipment spacing.

During testing, we exceed industry standards by putting our battery systems under the highest level of stress and assessing the response. Safety is our top priority, and our successful test results prove that our thermal and insulation barriers prevent propagation from one battery unit to the next.

The safety standards that Powin tests against are:

- UL9540
- UL9540A
- NFPA855
- NFPA69
- UL1973
- Large-Scale Burn



Unwavering Commitment to Performance

As part of our commitment to battery cell quality and performance, we do vigorous testing. This includes testing against vendor claims as well as the performance of compatible cells on the market. We use this analysis to produce our Cell Vendor Reports, which characterize new cells against Powin's standard, ensuring the safe and reliable integration of a diverse cell supply.

We use a combination of scientific approaches to battery cell testing and modeling, deep scientific knowledge of battery cell physics and chemistry, and data we obtain in the Lab and in the field to ensure that our products meet and exceed expectations.

In addition to these tests, we also offer performance and lifespan guarantees for our systems that are backed by data from our battery laboratory tests, cell vendor warranties, and performance guarantees. Many of these guarantees are specifically arranged by Powin to ensure our customers receive the optimal balance of longevity, efficiency, and value.

The Battery Lab also collaborates with our in-house analytics and engineering teams on development. The Lab is involved in efforts to provide industry-leading opportunities for Powin's systems to address service, predictive and preventive maintenance, and capacity augmentation or maintenance.

Want the peace of mind that comes with having complete visibility into your energy storage project?

We can help. Reach out to us at contact@powin.com

To learn more, please visit www.powin.com