American Recovery and Reinvestment Act (ARRA)

Sodium-Ion Batteries for Grid-Level Applications

Demonstrating low-cost, grid-scale, ambient temperature sodium-ion batteries

U.S. DEPARTMENT OF ENERGY | Electricity Delivery & Energy Reliability

Energy Storage Program

Aquion Energy, Inc.

In June 2012, Aquion Energy, Inc. completed the testing and demonstration requirements for the U.S. Department of Energy's program with its low-cost, grid-scale, ambient temperature Aqueous Hybrid Ion (AHI) energy storage device.

During the three-year project, Aquion manufactured hundreds of batteries and assemble them into high-voltage, grid-scale systems. This project helped them move their aqueous electrochemical energy storage device from bench-scale testing to pilot-scale manufacturing.

The testing successfully demonstrated a grid-connected, high voltage (>1,000 V), 13.5 kWh system with a 4-hour discharge. Additionally, testing characterized the energy storage capacity of the units, the response to various signals, compliance with utility interconnection standards, battery and power conversion system efficiency, and effectiveness under various cycles typical of the applications being validated. Advanced system modeling will demonstrate application-level testing and the functionality of the unit with respect to its ability to respond to external control signals and properly interact with the electric grid when carrying out relevant sequences.

Project Benefits

- Enables integration of renewable energy technologies, such as solar and wind
- Enhances grid stability
- Improves grid asset utilization by storing energy during off-peak periods for use during local load peaks

Advantages of Aquion Energy Systems

- Long cycle life
- Less environmental impact
- Safe, nonvolatile components
- Low levelized cost of electricity

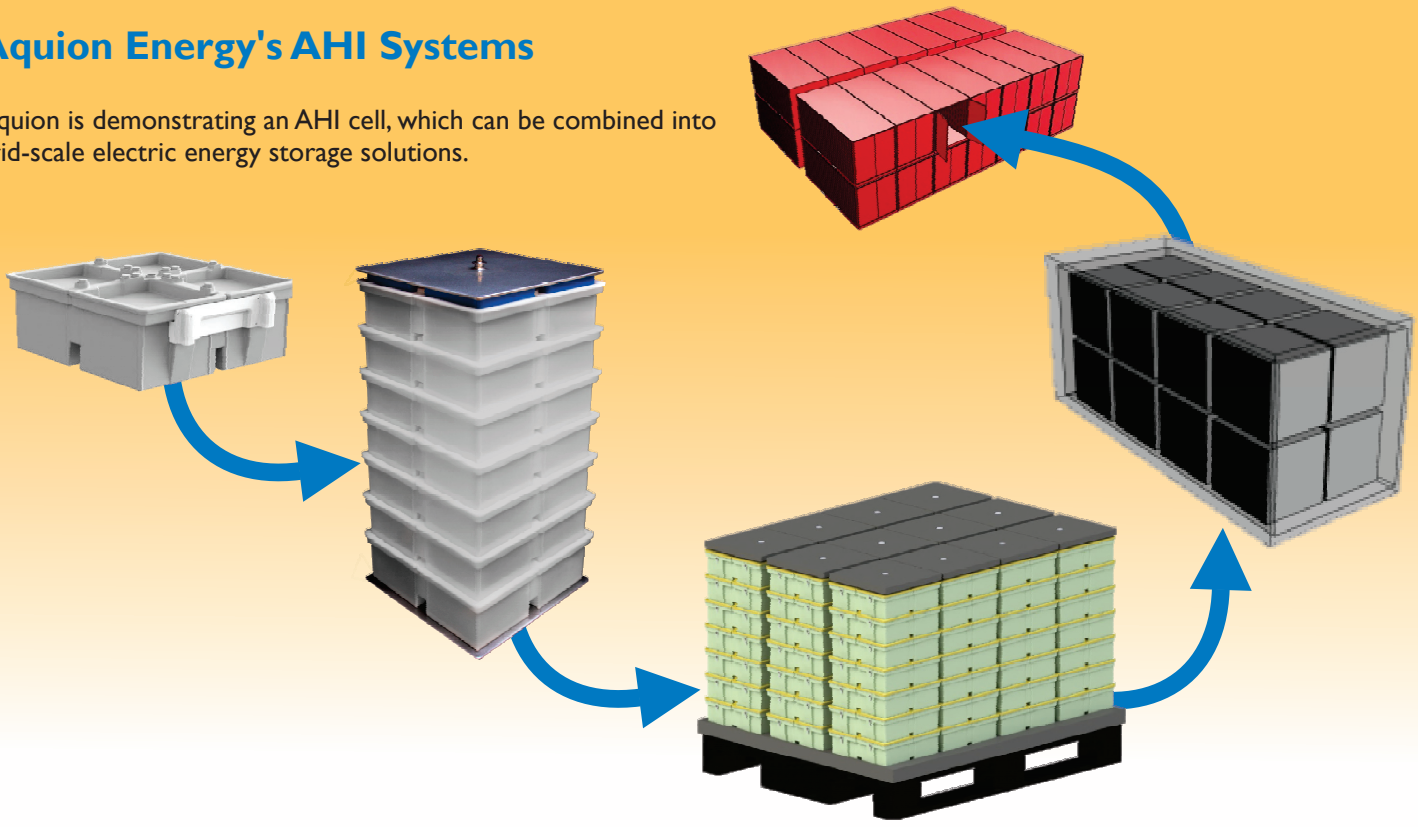
Budget

Total Project Value:
$10,359,827

DOE/Non-DOE Share:
$5,179,000/$5,180,827

Aquion Energy's AHI Systems

Aquion is demonstrating an AHI cell, which can be combined into grid-scale electric energy storage solutions.



Timeline

August 2010:
Advanced cell concept specified

February 2011:
Cell design qualified

April 2011:
Advanced battery design qualified

May 2011:
Cell format decision

July 2011:
Full pilot production qualified

September 2011:
Testing and evaluation plan developed

June 2012:
Prototype battery demonstrated

Goals

- Achieve the following technical targets:
  - Projected capital cost of less than $250/kWh at pack level
  - Deep discharge cycle life of greater than 10,000 cycles
  - Volumetric energy density of greater than 20 kWh per cubic meter
  - Lifetime of over 10 years
- Demonstrate a high voltage test system >10 kWh

Project Partners

- Aquion Energy, Inc.
  http://www.aquionenergy.com
- Carnegie Mellon University
  http://www.cmu.edu

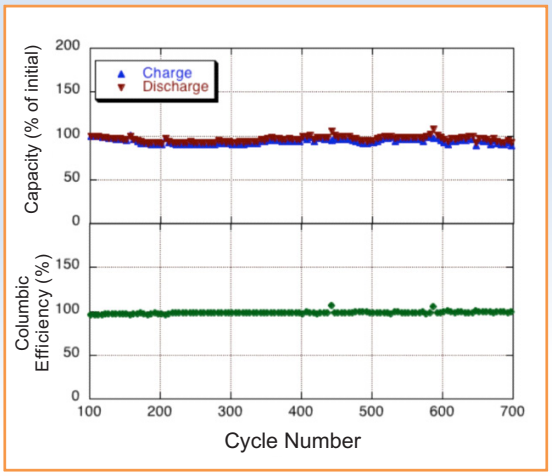
Technology Enhancements

After more than a year of testing, Aquion battery tests showed near perfect charge-discharge efficiency, indicating very little degradation (right).

The energy storage chemistry in the Aquion AHI battery uses an electrochemical couple that combines a high-capacity carbon anode with a sodium intercalation cathode capable of thousands of deep discharge cycles over extended periods of time.

The AHI technology includes the use of thicker electrodes, less expensive separator and current collector materials, and benign materials for electrodes and electrolyte salts.

Aquion has earned a 2012 Cleantech 100 Award for its battery technology.



For More Information

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Related Reading

Sandia National Laboratories, "Energy Storage Systems Program (ESS)," http://www.sandia.gov/ess/.

Ted Wiley, "Aquion Energy 2012 Progress Report," presentation at the 2012 DOE Energy Storage Program Peer Review, http://www.sandia.gov/ess/docs/pr_conferences/2012/papers/Wednesday/Session2/04_Wiley_Aquion_PeerReviewPresentation.pdf.

Importance of Energy Storage

Large-scale, low-cost energy storage is needed to improve the reliability, resiliency, and efficiency of next-generation power grids. Energy storage can reduce power fluctuations, enhance system flexibility, and enable the storage and dispatch of electricity generated by variable renewable energy sources such as wind, solar, and water power. The Office of Electricity Delivery and Energy Reliability Energy Storage Program funds applied research, device development, bench and field testing, and analysis to help improve the performance and reduce the cost of energy storage technologies.

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