

ESA '08: Predictable Power in a CleanTech World

Meeting highlights storage's critical role in electrical infrastructure

The 2008 Electricity Storage Association Meeting (ESA08) in Anaheim, California was extremely well attended and provided attendees with a concise update of both business and technical aspects of the accelerating electricity storage industry. Day 1 defined the sizeable investments being made by battery companies, electric utilities, public programs, industry organizations, and venture firms. Dinner at the Bower Art Museum provided yet another perfect opportunity for attendees to network. Day 2 then focused on the broad commercial deployment of electricity storage systems in diverse applications around the world.

The overwhelming conclusion of ESA08 was the critical role electricity storage must play in an efficient electrical infrastructure of the future. Electricity Storage offers a paradigm shift to the electricity infrastructure by decoupling supply and demand. This will have near term and pervasive effects throughout the energy industry from central generation, to smart grids, to off-grid. Significant penetration of renewable generation will also be greatly enhanced by the ability to buffer supply from demand

through electricity storage capacity.

The current instantaneous approach for generating and delivering electricity to customers is ill-equipped to handle step-

changing loads combined with unpredictable, dispersed generation sources. The ability to decouple generation from "on-demand" consumption mitigates extreme transient mismatch between supply and demand. This reduces price spikes at the local level, currently born by the electric utility and the rate payer.

Day 1: Investment in Electricity Storage

Electric Utility Programs

The proliferation of viable electricity storage technologies, amplified by current world energy demands, has triggered unprecedented levels of investment in electricity storage. This investment is absolutely necessary to yield the highly optimized, rugged, and powerful storage systems required to enable the incorporation of advanced generation technologies into a globally competitive energy infrastructure.

The electric utility industry was strongly represented at ESA08 by six of the world's largest utilities. Jim Kelly, Senior VP of T&D for SCE gave the opening keynote address with a hallmark presentation recognizing that electricity storage is key to deep penetration of renewables, and must be an integral component of an efficient energy infrastructure. This was followed by a presentation from Ali Nourai of AEP with an outline of AEP's plan to expand on their highly successful multi-MW deployment of NaS batteries from NGK. Seth Zimring made the scale of the opportunity clear: "A 6-MW system is a small system for PG&E." He then went on to delineate PG&E's bulk-storage ►

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applications, detailed in the company's current RFI:

- ▶ substation islanding
- ▶ load leveling
- ▶ frequency regulation
- ▶ ramping and peak shaving
- ▶ time-shifting and arbitrage

Eva Gardow discussed FirstEnergy's requirement for energy storage in the context of the SmartGrid, as well as various integrated storage systems currently under evaluation.

The future for bulk storage was then put into perspective by Ed Cazalet of MegaWatt Storage Farms in his presentation "Energy Storage Roadmap for California." The utility session was rounded out by Dan Rastler of EPRI, presenting energy storage systems as key assets in the clean energy value chain in a the partnership between utilities and end-use customers.

The Utility Programs session made clear that electric utilities are keenly interested in the operational flexibility offered by electricity storage capacity. Utilities are pushing industry, through funded initiatives and industry-wide collaboration, to build megawatt-scale products. While such systems have already been frequently demonstrated, costs and limited production are hindering rapid market acceptance. Utilities are working diligently to determine the best way to apply available technologies for maximum benefit.

Public Programs

Fully-integrated and cost-effective electricity storage systems have emerged in recent years due to the persistent efforts of the Department of Energy in collaboration with Sandia National Laboratories. Under the leadership of Dr. Imre Gyuk, the DOE Energy Storage Program has facilitated and supported partnerships between States, utilities, and industry to seed numerous successful US companies. Products from these companies are among the tools required to maintain productivity while overcoming power fluctuations and outages, to remain globally competitive. Information was provided on

increased funding, new directions, and future plans of the DOE Storage Program as well as other offices within DOE.

The states of California and New York are prominent in their support of energy storage and their collaboration with industry. Both Pramod Kulkarni of the CEC and Joe Sayer of NYSERDA addressed the pivotal role of electricity storage to energy and environmental challenges. In this vein, NYSERDA has released Program Opportunity Notice, PON-1200, providing up to \$1.5 million in matching funds for grid-connected energy storage demonstration projects sited in New York State.

International Programs

With greater penetration of renewables in Europe, electricity storage capacity has immediate application. Jillis Raadschelders of KEMA provided an understanding of energy storage opportunities, including the issue of fluctuations in wind energy generation due to high penetration levels and anticipated rapid growth. Melanie Chamberland of the Canadian CANMET Energy Technology Center reviewed market restructuring and environmental drivers providing some very interesting market opportunities for distributed generation and energy storage. Jim Baker of EA Technologies provided a concise portrait of energy storage enabling the UK's carbon mitigation strategy, which in practice relies on expanding renewable energy production for 5% to 35-40% in just 12 years.

Venture Capital Session

The venture capital session included brief presentations from each of four top-tier venture firms with strong backgrounds in energy storage investments. This was followed by a discussion of the rapidly expanding field of Energy Storage, stimulated by the tremendous global pressure for green & clean technologies due to soaring oil prices. Participants included John Rockwell, Element Partners; Andrew Chung, Lightspeed Venture Partners; David Wells, Kleiner Perkins Caulfield and Byers; and Zeb Rice, Angeleno Group. The common consensus among the group was that the energy storage field offered tremendous opportunities for investment due to relatively small entry price coupled with a potentially huge return from the game-changing benefits that would ▶

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accrue from a truly commercially viable energy storage technology. The session chair, Dr. Imre Gyuk, managed over an hour of questions, reflecting the high level of interest from the audience in commercialization paths.

Day 2: Deployment

The present availability of fully-integrated, commercial electricity storage systems was evident at the meeting. Thousands of MWh of storage capacity are already installed throughout the world, ranging from household systems storing a few kWh, to industrial systems capable of instantaneously delivering tens of Megawatts to support critical infrastructure.

Deploying Storage Systems

The Deployment session began with Bob Hemphill, president and CEO of AES Solar, describing his company's goal to develop a global platform of utility-scale solar photovoltaic (PV) projects with an available \$1B in funding. With equatorial application sites around the world, cost-effective and field-ready energy storage is seen as a key enabling component of this plan.

Daniel Wolf of the Fraunhofer Institute UMSICHT then gave a succinct analysis of existing global bulk-storage installations around the world. This set the stage for the remainder of ESA08, looking at specific installations.

Mature Storage >20 MW Deployed

This session highlighted existing bulk-storage products. Brad Roberts described the highly integrated lead-acid system from S&C Electric, deployed in 2MWAC modules; Tomio Tamakoshi reviewed NGK's Sodium-Sulfur technology with over 260 MW and 1.5 GWh (!) installed capacity; and Jim McDowall gave an update on GVEA's Ni-Cad battery in Alaska – the World's Most Powerful Energy Storage Battery at 27 MW, used to support generation and transmission related outages.

Flow Cells: A New Industry

An exciting development in recent years has been the emergence of flow-cells as a viable option for bulk energy

storage. With the ability to decouple power and energy ratings within the system design, volume-produced flow cell systems can be tailored to support site-specific requirements without altering the core system design. Common performance features among flow cells is extremely high cycle life and short charge times without extended charge balancing requirements.

Deeya Energy's "micro" flow cell product, the ESP-6000™, was presented by Rick Winter. The system is purpose-built for critical infrastructure support in low availability service areas. Its unique value proposition is the lack of cooling requirement for applications at high ambient temperatures.

Brian Beck of VRB Power Systems then presented explanation of vanadium redox flow battery technology, ▶

Third Annual Phil Symons Award Presented to Jim McDowall

One of the highlights of the 18th annual ESA meeting was the presentation of the Phil Symons Electricity Storage Award to Jim McDowall of Saft Batteries. Jim was honored in recognition of his efforts and accomplishments in the field of battery energy storage and his commitment to the success of the ESA. Jim has been an active member of the ESA Board for several years and is the Past Chairman of the ESA.



Jim McDowall, center, receives the 2008 Phil Symons Award from past recipients, Bill Hassenzahl, left, and Ali Nourai.

The Phil Symons Award is presented each year to an individual who has made significant contribution to the advancement of electricity storage. The award is given in recognition of Phil's dedication to the electricity storage industry and his tireless service to building the ESA. The Award recipient is selected each year by the Chairperson of the ESA Board based on recommendations from ESA members. ◀

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and an update on the availability of commercial VRB energy storage systems. Kevin Dennis of ZBB Energy discussed their Zinc-Bromine technology and plans for implementation in China. Initial deployment will be at the Future House USA, the United States Entry on the Olympic stage in Beijing to be displayed during the Olympic Games and for several years following.

The final flow cell presentation was from Dr. David Hodgson of Plurion, with strong collaboration in Scotland targeting renewables, as well as energy and power arbitrage.

Emerging Technologies

Two very well funded and dynamic technologies were presented as relative new-comers to the bulk storage field: Hydrogen and Lithium-ion. Bill Leighty of the Leighty Foundation introduced the term “Hydricity” in the context of hydrogen transmission and storage strategies, to provide transmission and affordable, annual-scale, firming of diverse, large-scale, stranded, renewable energy resources. Jim McDowall of SAFT America then provided a succinct review of the various Lithium-ion technologies that are now starting to be deployed in a wide range of stationary applications, including electricity storage.

Luncheon Keynote

Ed Kjaer, Director of SCE’s Electric Transportation Division, gave an inspired presentation on the future of Plug-in Hybrid Electric Vehicles and their impact on the future electric grid. He outlined how SCE plans to roll-out a smart grid distribution system to integrate this new addition to the electric power system.

Integrated Storage with Renewables

Gerry Braun of the California Energy Commission initiated the next few sessions with a discussion of the vital partnership that must develop between renewable energy and energy storage. It is clear that the potentially dominant role of intermittent renewable energy sources in California creates a near term need to pilot appropriate mixes of renewable sources, efficiency measures and storage, while taking advantage of smart grid capabilities as they are deployed.

Georgianne Peek of Sandia National Labs then focused on the development of technologies for increasing the penetration of distributed photovoltaic (PV) generation into the utility grid; while maintaining or improving power quality and grid reliability. She made the case that integration of electrical energy storage systems with residential and small commercial (≤ 100 kW) PV generation will be a key factor in achieving the financial, operational, economic, and environmental benefits of distributed energy within the U.S.

Storage Economics with Renewables

Storage Economics with Renewables was the focus of the final session of the conference. Jillis Raadschelders of KEMA in the Netherlands reiterated the discussion of the increased risk to stability of supply and power quality due to increased fluctuations in generation from wind energy in the context of the GROW-DERS project. He then described the ITM project to manage power at the local level through instantaneous control of electric vehicle batteries and electric heat pumps.

Rahul Walawalkar of Customized Energy Solutions presented a paper on the Economics of Energy Storage in the NYISO & PJM Markets. His work focused on providing regulation services in these two markets, finding a strong case for the use of flywheel systems to support the real-time balance of supply and demand. He also found that emerging energy storage technologies can play a very important role in scenarios with greater share of intermittent renewables in the electric grid.

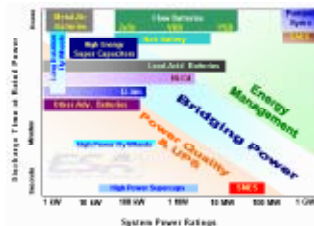
Rick Fioravanti of KEMA gave the final formal presentation of the meeting discussing the use of dynamic simulation tools to analyze how storage technologies can assist in the Integration of large renewables with RTO/ISO markets and operations.

DAY 3: SCE Lab Tour

The meeting concluded with an in-depth tour of the SCE Electric Transportation Lab in Pajoma, CA. The lab is one of the most complete facilities in the nation dedicated to testing battery powered cars and light trucks. ESA members got a close-up look at all types of hybrid electric vehicles and a glimpse of the “garage of the future.” ◀

NEWS BRIEFS

Updating Technology Comparison Charts on the ESA Web Site



Several charts such as this are being updated and redesigned for the ESA's Web site.

In early 2008, ESA contracted Energy Insights to develop a questionnaire and collect the required new information on different energy storage technologies in order to be able to update ESA technology comparison charts.

The data collection and review for accuracy was completed in

July. Currently, new comparative graphs are being designed to depict the relative strengths and feasibility of different energy storage technologies for various applications. ESA will try to preserve the simplicity and utility that has been the hallmark of our current charts while improving on the accuracy of these charts. We expect the charts to be on our Web site by mid-October.

AICHE Issues White Paper on Massive Energy Storage

In June the American Institute of Chemical Engineers (AIChE) issued a white paper titled "Massive Electricity Storage". The paper outlines the Institute's assessment of Massive Electricity Storage (MES) is the critical technology needed to make the use of renewable energy on a very broad scale. The paper makes the case for large battery storage systems located near the load centers to optimize the use of renewable power sources. A copy of the AIChE White Paper will be made available on the ESA Web site.

ESA Chairman Named to New DOE Electricity Advisory Committee

In April, the U.S. Department of Energy (DOE) announced the members of its newly-established Electricity Advisory Committee. The thirty inaugural members include some of the nation's top public and private sector leaders in electricity policy, planning, and operations,

including Brad Roberts, Chairman of the ESA Board of Directors. Mr. Roberts also serves as the Chairman of the Energy Storage Subcommittee for the group as well.

The Committee was established to provide counsel to the DOE on long-range planning and priorities for the modernization of the U.S. electricity delivery infrastructure. The group's responsibilities will include advising on deployment of smart grid technologies, research and development of energy storage technologies, renewable energy resource system integration, and new transmission infrastructure to ensure the efficient delivery of electricity. The Committee will provide senior-level counsel to DOE's Office of Electricity Delivery and Energy Reliability in meeting requirements of the Energy Policy Act of 2005 and the Energy Independence and Security Act of 2007.

Joining this high-level committee is clearly a tribute to the recognized expertise of both Brad and ESA. In addition to his duties as ESA Chairman, Mr. Roberts is Director of Power Quality Systems for S&C Electric Company.

ESA Honors Ben Norris

Ben Norris was one of the original members of the Utility Battery Group (UBG), the ESA's predecessor organization, and as such he participated in several studies of electricity storage. Ben has worked diligently to advance the programs of the UBG and the ESA and until the 2008 meeting, he held the record for attending all the UBG and ESA meetings. The ESA honored Ben in August for his dedicated efforts and exceptional performance as an ESA board member and as a promoter of electricity storage throughout the world. Ben served as ESA's Treasurer for the past three years and he hopes to continue his technical activities in the electricity storage arena. ◀



Ben Norris, center, receives an award from ESA Board members Bill Hazenzahl, left, and Rick Winter.

Future Events

DOE Peer Review Meeting

September 29-30, 2008, Washington, DC. The Peer Review Agenda will include the latest DOE/ESS research program developments in energy storage technologies & applications for industry and government; economic benefits of energy storage advanced batteries, flywheels, electrochemical capacitors, power electronics research & development, updates on DOE joint efforts with California & New York State and more. For more information, visit <http://www.sandia.gov/ess>.

ESA 2009 Annual Meeting

May 2009, Washington, DC. Details to be announced during the DOE Peer Review meeting on September 29, 2008.

EESAT 2009

October 4-7, 2009, Seattle, Washington. ESA, DOE and Sandia National Laboratories will again host this biennial, international Electrical Energy Storage Applications & Technologies Conference (EESAT), to be held at the Renaissance Seattle Hotel. International experts gather every two years to present technical and economic papers that focus on the full range of electrical energy storage technologies and power applications, including: conventional & advanced battery energy storage, power electronics, SMES, flywheels, CAES, electrochemical capacitors, pumped hydro and more. For more information, visit the EESAT web site (<http://www.sandia.gov/eesat>) or e-mail eesatinfo@sandia.gov.

Related Meetings

“Electricity Storage in Europe” Summit, October 8, 2008, Amsterdam, The Netherlands, sponsored by Delta Energy and Environment.

Third International Renewable Energy Storage Conference (IRES 2008), November 24-25, 2008, Berlin, Germany.

“Advanced Energy Storage: An Enabling Technology for Renewable Energy” Conference, December 2-4, 2008, Lajolla, CA sponsored by Montreux Energy.

“Power Storage Event - Renewable Generation, Regulatory Requirements and Advanced Methods in Technology” Conference, January 15-16, 2009, Las Vegas, NV, sponsored by Platts.

“Grid-Scale Energy Storage – The Time is Now” Conference, January 26-28, 2009, San Diego, CA, sponsored by InfoCast.

About the ESA

Our Mission

To promote the development and commercialization of competitive and reliable energy storage delivery systems for use by electricity suppliers and their customers, thereby bringing financial and technical benefits for energy storage operators.

Membership Benefits

- ▶ Gain early knowledge of the latest developments in energy storage technology and field/customer applications of new/innovative storage technologies, and information on how these can be used for member's business advantage
- ▶ Early notification of upcoming business leads in U.S. and abroad
- ▶ Enhanced exposure to potential customers for energy storage products and services
- ▶ Ability to network with users, manufacturers, and researchers in the energy storage field
- ▶ Access to ESA contact list of more than 800 names of industry leaders interested in energy storage
- ▶ Ability to actively interface with key representative from government and industry to receive insights into energy storage markets and strategic directions of key industrial firms

Join Now

General Membership is \$795 per year which includes attendance at meetings, conference proceedings, special tours, and social events.

Join the ESA between now and December 31 and receive full ESA 2008 member benefits at no additional cost.

To join the ESA, complete our on-line membership form. You will be asked to provide credit card information over our secure transaction server.

For questions about membership in the ESA, contact Gerard Thijssen in the Netherlands at +31 26 3 56 26 03 or e-mail membership@electricitystorage.org.