

7TH ANNUAL

# NEXT-GENERATION 2017 ENERGY STORAGE

February 14-16, 2017

San Francisco, CA

## What's next for energy storage?

### Cambridge EnerTech's 7th Annual Next-Generation Energy Storage 2017

convenes leading experts in the fields of battery materials, systems design and integration, and manufacturing and commercial applications, along with utility planners, electrical, transmission, distribution, modeling, and protection engineers who

**ADDRESS EMERGING ISSUES DRIVING THIS  
PIVOTAL TIME IN ENERGY STORAGE.**



## 2017 CONFERENCE PROGRAMS

FEBRUARY 14-15, 2017

### Stationary Energy Storage



FEBRUARY 16, 2017

### Flow Batteries



FEBRUARY 16, 2017

### Fuel Cells for Stationary





**Banking on batteries?** With demands for electrical power continually rising, utilities and project developers are focusing on how to stabilize intermittent electrical energy production and demand with storage. The combination of high-energy density and low costs found in advanced battery design can potentially provide storage services to the grid, utilities and downstream customers by improving power quality, conversion, capacity and reliability.

## TUESDAY, FEBRUARY 14

### 8:00 am Workshop Registration

### 8:30-11:30 Pre-Conference Workshops\*

**W1:** Battery Safety Tutorial

**W2:** Stationary Battery Market Trends and Forecast

**W3:** BESS Grid Integration 101: Electric Power System Considerations, Existing Applications, and Future Opportunities for Battery Energy Storage Systems

\* Separate registration required. See page 6 for details.

### 12:00 pm Main Conference Registration

## What Is Needed for Stationary Energy Storage? Market, Policy, and Economics

### 1:15 Organizer's Opening Remarks

*Mary Ann Brown, Executive Director, Conferences, Knowledge Foundation, a Part of Cambridge EnerTech*

### 1:20 Chairperson's Opening Remarks

*Reyad Fezzani, Chairman & CEO, Regenerate Power*

### 1:30 KEYNOTE PRESENTATION

*Craig Miller, Senior Program Manager, National Rural Electric Cooperative Association, Inc. (NRECA)*

### 2:15 Energy Storage Project Development

*Elliot Hinds, J.D., Partner, Energy, Crowell & Moring LLP*

### 2:45 Estimating Revenue from Energy Storage in Market Areas

*Raymond Byrne, Ph.D., Distinguished Member, Technical Staff, Data Analysis and Exploitation Department, Sandia National Laboratories*

Estimating potential revenue from energy storage is the first step in evaluating the feasibility of an energy storage project. In market areas, it is possible to use historical market data, combined with an optimization algorithm, to estimate the maximum potential revenue from energy storage. The presentation focuses on arbitrage as well as arbitrage plus frequency regulation, with results from CAISO, ERCOT, PJM, ISO NE, and Singapore.

### 3:15 Sponsored Presentation (Opportunity Available)

### 3:30 Refreshment Break

### 4:00 Utility Storage Needs – An Evolving Market

*Thomas A. Lovas, Senior Program Manager & Consultant, Cooperative Research Network/Business & Technology, National Rural Electric Cooperative Association, Inc. (NRECA)*

The dynamics of today's energy storage market are characterized by both technological innovation and the expanding interest in enhancing electric system performance through storage. Electric cooperatives are rapidly embracing storage and are considering a variety of applications. The development of use cases and case studies are underway to support effective storage implementation within a diverse community of electric systems.

### 4:30 Sizing and Costing Energy Storage for the Grid

*Vincent Battaglia, Ph.D., Head, Energy Storage, Energy Storage and Distributed Resources, Lawrence Berkeley National Laboratory*

### 5:00 PANEL DISCUSSION: BESSs: Lessons Learned and Future Solutions

Flexibility is a key aspect of integrating renewables into the grid. Batteries provide advantages for storing and managing intermittent power sources and for usage fluctuations. This panel gathers experts in energy strategy, policy, market development and regulations to discuss the benefits and challenges of implementing stationary energy storage.

*Moderator: Reyad Fezzani, Chairman & CEO, Regenerate Power*

*Panelists:*

*Vincent Battaglia, Lawrence Berkeley National Laboratory*

*Raymond Byrne, Sandia National Laboratories*

*Thomas A. Lovas, NRECA*

*Elliot Hinds, J.D., Crowell & Moring LLP*

*Craig Miller, NRECA*

### 6:00 Welcome Reception in the Exhibit Hall with Poster Viewing

### 7:00 Close of Day

## WEDNESDAY, FEBRUARY 15

### 7:30 am Java and Jive Breakfast Breakout Discussion Groups

Grab coffee and breakfast and join a discussion group. These are moderated discussions with brainstorming and interactive problem solving, allowing conference participants from diverse backgrounds to exchange ideas and experiences and develop future collaborations around a focused topic.

## What Is Needed for Stationary Energy Storage? Integration Data Acquisition & Analytics

### 8:30 Chairperson's Remarks

*Juan Gomez, Ph.D., PE, Director, University of Texas at San Antonio - Texas Sustainable Energy Research Institute*

### 8:35 A Technical Perspective in Developing an Energy Storage Project – What to Do, Know, and Watch Out For

*Daniel Borneo, PE, Engineering Program/Project Lead, Sandia National Laboratories*

As more Energy Storage (ES) projects are being implemented, it is important to understand how best to design the power and energy requirements of an ES system so that it is most cost effective. This talk discusses lessons learned from the portfolio of projects that Sandia is involved with. In addition, we discuss other aspects of developing a successful ES project, including commissioning, testing, data acquisition, applications and operations.

### 9:05 Unlocking the Potential of Energy Storage Using Big Data

*Tal Shoklapper, Ph.D., CEO and Co-Founder, Voltaiq, Inc.*

The deployment of energy storage in conjunction with renewable solar energy opens up new use cases and revenue streams, including resilient microgrids, grid balancing and demand response. Unfortunately, today's batteries are poorly understood in these applications, leading to restrictive operating conditions that limit financial viability and expose organizations to excessive liability. We highlight how data collected from across the battery lifecycle can be harnessed using machine learning algorithms to unlock the potential of energy storage.

### 9:35 Managing Supply Voltages and Power Flows in a Distribution Grid with Residential Battery Storage Co-Located with Solar PV

*Elizabeth Ratnam, Ph.D., Postdoctoral Scholar, The Berkeley Energy and Climate Institute, University of California, Berkeley*

We propose an optimization-based algorithm for coordinating residential battery storage to manage bi-directional power flows in a distribution grid. Our objectives are twofold: (1) to reduce peak loads approaching a network capacity, and (2) to improve voltages delivered to residential customers with solar PV. To assess the distributor benefit, the algorithm is applied to a GridLAB-D distribution model. Our results confirm that the algorithm improves supply voltages and reduces peak load.

**10:05 Sponsored Presentation** (*Opportunity Available*)

**10:20 Coffee Break in the Exhibit Hall with Poster Viewing**

### What Is Needed for Stationary Energy Storage? Power Partnerships

**11:00 Evaluation of Flow Battery Performance for a Variety of Applications**

*Juan Gomez, Ph.D., PE, Interim Director and Research Director, Texas Sustainable Energy Research Institute, The University of Texas at San Antonio*  
Co-Presenters to be Announced

Two flow battery chemistries at two different capacities are tested. The objective of the industry-university collaborative effort is to evaluate the ability and viability of the flow batteries for providing a variety of services ranging from demand-response, peak shaving and load shifting to frequency regulation and ancillary services. The presentation highlights results from both the performance and functional testing phases.

**11:45 Unlocking System Value with Battery Gas Turbine Hybrid Applications**

*Joseph Heinzmann, Senior Account Manager, GE Energy Storage, General Electric*  
Co-Presenter to be Announced

The LM6000 Hybrid EGT product integrates a 10 MW battery energy storage system from Current, powered by GE, and an existing GE LM6000 aeroderivative gas turbine with control system upgrades. It will allow the turbine to operate in standby mode without using fuel and enable immediate response to changing energy dispatch needs. By eliminating the need to run the turbines at minimum loads, the product will save fuel, reduce maintenance costs and cut down on greenhouse gas emissions.

**12:30 pm Luncheon Presentation** (*Sponsorship Opportunity Available*)  
or Enjoy Lunch on Your Own

**1:00 Session Break**

### What Is Needed for Stationary Energy Storage? Banking on Batteries

**2:00 Chairperson's Remarks**

*Brad Fiebig, Energy Storage Product Manager, Lockheed Martin* (invited)

**2:05 Battery System Development: Addressing Key Topics in Terms of Safety, Reliability, Efficiency and Cost Reduction on a System Level**

*Neil Maguire, CEO, Adara Power Inc.*

Lithium-ion batteries have great advantages versus traditional chemistries such as

lead-acid and nickel-based batteries. The engineering challenge is to ensure these advantages are delivered safely. Adara Power's founder and CEO, who is an expert in safety analysis and engineering, discusses how having experience with advanced electronics from silicon chips to full systems based on automotive requirements is imperative to designing and manufacturing safe, reliable energy storage systems.

**2:35 Caterpillar's Micro-Grid System - Present Energy Storage and Future Needs**

*John Votoupal, Research Specialist, Energy & Transportation Technology, Caterpillar, Inc.*

Caterpillar's micro-grid presently consists of traditional diesel gensets, wind turbines, photovoltaic panels, and energy storage, with the energy storage elements presently consisting of traditional and advanced energy storage systems. Some applications and future needs will be reviewed.

**3:05 System Hybridization to Minimize Life Cycle Costs**

*R. Shaw Lynds, MS, Systems Research Manager, Systems Research, Maxwell Technologies*

We present an overview of Maxwell's grid energy storage demonstrations, and technical approaches for system hybridization of ultracapacitors and batteries.

**3:35 Refreshment Break in the Exhibit Hall with Poster Viewing**

**4:00 Improving Energy Storage Project Economics through Optimized Energy Storage System Design**

*Brad Fiebig, Energy Storage Product Manager, Lockheed Martin*

As the energy storage industry matures and begins to serve a much broader range of applications, it will become increasingly important for the industry to transition from custom, individually engineered systems to pre-designed and certified energy storage systems enabling rapid, scalable, reliable, and cost-effective deployment. What are the key system-level design considerations for productized, pre-engineered energy storage solutions?

**4:30 Addressing Peak Energy Demand with the Tesla Powerpack**

*Archan Padmanabhan, Lead, Energy Products & Analytics, Tesla*

Tesla's Powerpack systems offer a modular and versatile storage solution for C&I customer and utilities alike. With over a 100MWh of installed systems, Tesla has successfully deployed software for one of the key value propositions with storage, peak demand management. This presentation provides an overview of Tesla's integrated Powerpack system and optimization capabilities.

**5:00 Close of Conference**

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## Flow Batteries

Energizing  
REDOX Reactions

Flow batteries hold the potential as a versatile and attractive solution to store and deliver energy over the kW/kWh to MW/MWh range – well suited for large- to mid-scale grid energy storage applications. However, despite decades of research, their widespread implementation for grid electrical storage has not yet materialized. R&D continues to focus on both improved performance and cost reduction, making available to utilities their pursuit for efficiency improvements.

THURSDAY, FEBRUARY 16

**8:00 am Registration and Morning Coffee**

### Engineering Higher-Energy Density: Advances in Electro-Chemistries

**8:45 Organizer's Opening Remarks**

*Mary Ann Brown, Executive Director, Conferences, Knowledge Foundation, a Part of Cambridge EnerTech*

**8:50 Chairperson's Opening Remarks**

*GJ Ia O', Ph.D., Director, Electrochemical Engineering, Primus Power*

» **9:00 FEATURED PRESENTATION: ORGANIC AQUEOUS FLOW BATTERIES FOR MASSIVE ELECTRICAL ENERGY STORAGE**

*Michael J. Aziz, Ph.D., Gene and Tracy Sykes Professor of Materials and Energy Technologies, John A. Paulson School of Engineering and Applied Sciences, Harvard University*

We have developed an approach to flow battery electrolytes using the aqueous redox chemistry of small, highly soluble, inexpensive organic molecules such as quinones and aza-aromatics. This new approach may enable massive electrical energy storage at greatly reduced cost.

**9:40 Advancing Long Duration Flow Battery Capabilities with Coordination Chemistry**

*Thomas D. Jarvi, Ph.D., General Manager, Energy Storage, Lockheed Martin Energy*  
Flow battery system architecture separates system power and energy capabilities.

## FLOW BATTERIES (CONT.)

This separation can enable low cost and reasonable system performance if the active materials are properly designed. However, the chemistries used most commonly do not adequately take advantage of this architecture. The flow battery under development at Lockheed Martin Energy and how it overcomes several traditional flow battery shortcomings will be described.

### 10:10 Low-Cost and Safe Aqueous Redox Flow Batteries

*Bin Li, Ph.D., Staff Scientist, Energy & Environmental Directorate, Pacific Northwest National Laboratory (PNNL)*

Redox flow batteries have attracted wide attention for long-duration, large-scale energy storage applications. We focus on current and future directions to address two of the most significant challenges in energy storage: cost and safety. A high priority is aqueous systems with low-cost and highly soluble redox chemistries. In particular, we introduce the development of aqueous inorganic and organic redox flow batteries at PNNL in the recent years.

### 10:40 Coffee Break in the Exhibit Hall with Poster Viewing

#### Engineering Higher-Energy Density: Novel Formats

### 11:15 Flow Batteries Based on Redox Targeting Reactions for High-Density Large-Scale Energy Storage

*Qing Wang, Ph.D., Associate Professor, Department of Materials Science & Engineering, National University of Singapore*

In conventional batteries, active materials are coated on current collectors to form electrode sheets. On the basis of redox targeting reactions between battery materials and redox mediators, the above electrode configuration could be converted into a decoupled structure with the active materials stored in separate tanks while their charging/discharging are carried out by the redox mediators. This leads to a disruptively novel energy storage device - Redox Targeting Flow Battery.

### 11:45 Duration without Degradation: Delivering Multi-Hours over Multi-Decades

*GJ Ia O', Ph.D., Director, Electrochemical Engineering, Primus Power*  
Primus Power's proprietary EnergyPod® flow battery system employs only one tank of electrolyte solution and one pump (vs. two for others), a patented bromine electrode and zinc electrode and no separator (which typically need to be replaced in 5-10 years for other flow batteries) – together these lower footprint, increase lifetime and reduce cost. An overview of this innovative zinc-bromide flow battery platform will be presented.

### 12:15 pm Sponsored Presentation (Opportunity Available)

### 12:30 Luncheon Presentation (Sponsorship Opportunity Available) or Enjoy Lunch on Your Own

### 1:00 Session Break

#### Engineering Higher-Energy Density: Materials

### 1:30 Chairperson's Remarks

*Bin Li, Ph.D., Staff Scientist, Energy & Environmental Directorate, Pacific Northwest National Laboratory (PNNL)*

### » 1:35 FEATURED PRESENTATION: COMPOSITE STRUCTURES FOR VANADIUM REDOX FLOW BATTERIES (VRFB)

*Dai Gil Lee, Ph.D., Director and Professor, EWS and Mechanical Engineering, Korea Advanced Institute of Science and Technology (KAIST)*

Although vanadium redox flow batteries (VRFB) have been considered future energy conveniences, they have not been widely employed. To meet requirements of high electrical conductivity under strong acid environments per U.S. Department of Energy target values, their structures consist of brittle graphite, weak polymers or ceramic coated stainless steel. To circumvent the weak characteristics and manufacturing difficulty, carbon composite bipolar

plates, hybrid composite endplates made of carbon and glass composites and glass composite flow frames have been developed.

### 2:05 Safety Advances in Flow Batteries for Enhanced Safety and Reliability

*Paul Sibley, Vice President, Product Management, Engineering, ViZn Energy Systems, Inc.*

Using advanced flow batteries provides an even greater mix of capacity, power, and long life to maximize significant cost savings. The added life benefit of flow batteries with the ability to support deep discharges multiple times per day, while simultaneously seeing 100s or 1,000s of rapid, short duration charge/discharge cycles at partial states of charge, increases the cost savings and substantial return on investment.

### 2:35 High-Energy Density Multiple Redox Semi-Solid Liquid Flow Battery: Redox Processes and Design Strategies

*Yi-Chun Lu, Ph.D., Assistant Professor, Electrochemical Energy and Interfaces Laboratory, Department of Mechanical and Automation Engineering, The Chinese University of Hong Kong*

We discuss design strategies to increase the energy density of redox flow batteries by going beyond the solubility limit and involving multiple active-redox, forming multiple redox semi-solid liquid flow batteries. This concept takes advantage of both highly soluble active materials in the liquid phase and high-capacity active materials in the solid phase. Using LiI electrolyte and solid S/C composite as an example, we discuss the electrochemical characteristics and the synergistic interactions of the biphasic high-energy density redox flow battery.

### 3:05 Refreshment Break in the Exhibit Hall with Poster Viewing

#### Stationary Applications

### 3:30 The Solar Flow Battery – Opportunities for Base-Load Solar Electricity

*James R. McKone, Ph.D., Assistant Professor, Chemical Engineering, Department of Chemical and Petroleum Engineering, Swanson School of Engineering, University of Pittsburgh*

Redox flow batteries and photovoltaics are a natural combination for providing flexible renewable power, but both suffer from high capital costs. We are using the tools of photo-electrochemistry to develop the new approach "solar flow battery" (SFB), which converts and stores solar energy in one monolithic device. Ongoing work using technologically relevant semiconductors and aqueous electrolytes has demonstrated its feasibility and indicated that high roundtrip energy conversion efficiencies can be obtained from remarkably simple device architectures.

### 4:00 Optimizing Flow Batteries and PV for Managing Building Loads

*Paul Brooker, Ph.D., Assistant Research Professor, Florida Solar Energy Center, University of Central Florida*

Due to its variable nature, solar energy requires energy storage in order to maximize its utilization, particularly at high penetration levels. Flow batteries represent an ideal technology to meet these needs due to their excellent cycle lifetimes and tolerance to deep discharges. Optimizing the capacity and power of flow batteries with the amount of PV installed at the site requires balancing the building load profile with the electricity grid's needs.

### » 4:30 FEATURED PRESENTATION: A RISING TIDE LIFTING ALL FLOW BATTERIES! IMPROVING POWER DENSITY BY UNDERSTANDING HOW TO IMPROVE MATERIALS

*Thomas Zawodzinski, Ph.D., Governor's Chair, Electrical Energy Storage, Department of Chemical and Biomolecular Engineering, University of Tennessee; Governor's Chair, Physical Chemistry of Materials Group, Materials Science & Technology Division, Oak Ridge National Laboratory*

### 5:00 Close of Symposium

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This eighteenth meeting continues Cambridge EnerTech's event series on the advancement of fuel cell technology. This symposium targets end users, developers and manufacturers of stationary fuel cell systems across fuel types, system architectures, and power ranges. This year's Fuel Cells for Stationary symposium focuses on fuel cell systems development for stationary applications and the technical advancements, strategies for commercialization and regulatory updates from the government, academic and industry stakeholders. Don't miss this opportunity to hear the latest developments from these key players within the industry on how they are achieving success.

THURSDAY, FEBRUARY 16

8:00 am Registration and Morning Coffee

## Fuel Cells Applications & Market

8:45 Organizer's Opening Remarks

*Craig Wohlers, Executive Director, Conferences, Knowledge Foundation, a Part of Cambridge EnerTech*

8:50 Chairperson's Opening Remarks

*James M. Fenton, Ph.D., Secretary of The Electrochemical Society; Director, Florida Solar Energy Center, Professor, Materials Science and Engineering, University of Central Florida*

» 9:00 FEATURED PRESENTATION: FUEL CELLS – A CRITICAL CHAPTER IN THE ENERGY TRANSITION 'BOOK'

*John McGuinness, Strategic Marketing Leader, General Electric Fuel Cells, LLC*

The energy transition 'book' has generated a great amount of interest among policy makers, regulators, business and investors, but it is a book that is still being written. There is a general consensus on how it should end, and the first several chapters – which focused primarily on wind and solar – have been written, read and are now being acted upon. While the remaining chapter titles may be known, and elements of the plot are being exposed, we don't know precisely what will be written. Therefore, this presentation will reveal the fuel cell chapter and discuss how fuel cells are a critical component to the energy transition.

## Advanced Materials Design & Integration

9:40 Preparation of Metallic Nanocatalysts/Nafion Film by a Drying Process

*Jae-Young Lee, Ph.D., Professor, Woosuk University; Vice President, Hydrogen Fuel Cell RIC, South Korea*

A new simple drying process was developed in order to prepare a Pt/Nafion film for self-humidifying membrane in a proton-exchange membrane fuel cell (PEMFC).

10:10 High-Performance Electrocatalyst for Hydrogen Evolution Reaction

*Ram Gupta, Ph.D., Assistant Professor, Chemistry, Pittsburg State University*

With the ever-increasing demands on energy and environmental protection, there is an urgent need to develop multifunctional, high-performance and durable materials for energy production. Hydrogen generated from water splitting is an alternative and renewable energy source, and presently, platinum is one of the most effective catalysts for its generation. However, its wide application is limited due to its high cost and it is essential to develop low-cost and earth-abundant materials to replace precious-platinum based catalysts.

10:40 Coffee Break in the Exhibit Hall with Poster Viewing

## Power-to-Gas

11:15 Power-to-Gas (P2G) for Enabling High Renewable Power Use

*Jack Brouwer, Ph.D., Associate Professor, Mechanical and Aerospace Engineering; Associate Director, National Fuel Cell Research Center and Advanced Power and Energy Program, University of California, Irvine*

P2G has the desirable features of enabling separate sizing of the energy capacity and power capacity of the system, production of a zero emissions transportation or stationary power fuel, and ready storage of the product in existing infrastructure (e.g., natural gas system) or resources (e.g., salt cavern). These features cannot be engendered by traditional energy storage technologies like batteries. Analysis of the P2G concept will be presented and discussed.

## Hybrid Applications

11:45 Hybrid Power Source Combining Lithium-Ion Batteries with PEM Fuel Cell Powered by Reformed Bioethanol

*Paolo Fracas, Ph.D., CEO, Management, Genport srl, Italy*

We would like to introduce a novel off-grid auxiliary clean power system designed to extend runtime of primary renewable energy sources (RES). Our G7000 HPS is tightly integrated with a lithium battery pack (GENIOL Series) delivering additional power or extending runtime when the battery and the primary energy source is off. GenScada is a remote IoT-based SW that provides supervisory, diagnostic and predictive control to smoothly adapt the dispatching strategies.

12:15 pm Sponsored Presentation (Opportunity Available)

12:30 Luncheon Presentation (Sponsorship Opportunity Available) or Enjoy Lunch on Your Own

1:00 Session Break

## The Hydrogen Ecosystem

1:30 Chairperson's Remarks

*Keith Wipke, Fuel Cell & Hydrogen Technologies Program Manager, National Renewable Energy Laboratory*

1:35 Fuel Cells for Community Hydrogen

*James M. Fenton, Ph.D., Secretary, The Electrochemical Society; Director, Florida Solar Energy Center; Professor, Materials Science and Engineering, University of Central Florida*

Future energy landscapes will be shaped by the increased adoption of electric vehicles and solar production. To meet new demands (EV charging) and address old issues (solar variability), hydrogen may be employed as an energy source (fuel cells) or energy sink (electrolysis). Both the production and consumption of hydrogen may occur at community levels to support EV charging as well as meet local energy demands.

2:05 H2@Scale: Deeply Decarbonizing the Energy System

*Keith Wipke, Fuel Cell & Hydrogen Technologies Program Manager, National Renewable Energy Laboratory*

This talk will focus on the role of hydrogen at the grid scale and the efforts of a large, national lab team assembled to evaluate the potential of hydrogen to play a critical role in our energy future. Facts about hydrogen, along with the vision of how it will fit into our future energy system and the R&D needs to enable this future, will be discussed.

2:35 Renewable Hydrogen – Benefits and Barriers

*Stephen Jones, Managing Director, ITM Power*

We discuss how ITM and electrolysis fit into a renewable fuel supply chain and how they could be used most effectively to manage the incentives for California renewable energy.

3:05 Refreshment Break in the Exhibit Hall with Poster Viewing

3:30 Ultra-Clean Power, Heat and Hydrogen Generation with Direct Fuel Cells

*Pere Margalef, Ph.D., Director, Advanced Technology Development, FuelCell Energy, Inc.*

FuelCell Energy designs, manufactures, sells, installs, operates and maintains ultra-clean, highly efficient stationary fuel cell power plants for distributed power generation. Our power plants provide megawatt-class scalable on-site power and utility grid support, helping customers solve their energy, environmental and business challenges.

**4:00 Near-Term Business Case Assessment for Power-to-Hydrogen in California**

*Josh Eichman, Ph.D., Research Analyst, National Renewable Energy Laboratory*  
 Hydrogen production from electrolysis offers a unique opportunity to integrate multiple energy sectors, contributing to greater flexibility, and potentially more clean and efficient operation of each energy sector. This talk explores the near-term business cases for electrolysis equipment in California. Four main scenarios and a variety of sensitivities are examined. Each sheds light on the important factors that affect economic competitiveness of electrolyzers and more generally, flexible demand response devices.

**Alternatives in Energy Storage**

**4:30 Life-Cycle Energy Analysis of Technology Alternatives for Energy Storage: Comparing Hydrogen and Batteries**

*Matthew A. Pellow, Ph.D., Postdoctoral Researcher, Global Climate and Energy Project, Stanford University*

We evaluate the life-cycle energy costs of storing grid power in hydrogen using a regenerative hydrogen fuel cell (RHFC). The analysis finds that a hydrogen system stores more energy than batteries for the same manufacturing energy input. We estimate the energy return on investment of intermittent renewable generation firmed with storage, using these device-level energy return ratios.

**5:00 Close of Symposium**

**NEXT-GENERATION ENERGY STORAGE 2017**

**Pre-Conference Workshops \***

**TUESDAY, FEBRUARY 14 | 8:30-11:30 AM**

**W1 Battery Safety Tutorial**  
 Batteries become daily use components for many applications. More than that, we can say that without batteries our life will change dramatically. In the race for energy density, we sometimes forget the safety. Unfortunately, we face daily safety events with injuries and severe damage. This training program focuses on stationary battery safety along battery cycle life (acceptance, testing, assembly, use, transportation and disposal). The training incorporates Shmuel De-Leon's and other experiences on battery safety for over 25 years of work in the field. The motivation behind the training is to provide attendees with the knowledge needed to safely handle the batteries in their organizations and to support reduction in safety events.

*Instructor: Shmuel De-Leon, CEO, Shmuel De-Leon Energy, Ltd.*

**W2 Stationary Battery Market Trends and Forecast**  
 The global market for lithium-ion batteries continues to grow and is expected to exceed \$25 billion by 2017. It continues to advance as high-power and high-capacity cells increase penetration into large-format applications and compete with established energy storage technologies such as lead-acid. In recent years, lead-acid batteries have moved beyond usage in traditional automotive applications to other markets, such as uninterruptible power supply systems (UPS) for communication base stations, medical equipment and electric vehicles. Due to market

penetration, product maturity, and low cost, lead-acid remains a dominant battery chemistry. Bringing together leading market analysts, this tutorial will share the latest trends and forecasts for the global Li-ion and lead-acid battery markets.

*Instructor: Vishal Sapru, Energy & Power Systems Research Manager and Growth Consultant, Frost & Sullivan*

*Additional Instructors to be Announced*

**W3 BESS Grid Integration 101: Electric Power System Considerations, Existing Applications, and Future Opportunities for Battery Energy Storage Systems**

The use of energy storage has become increasingly important with the large-scale development of renewable resources, such as wind generators and photovoltaics. Electric power system studies identify system needs and show the potential opportunities for BESS and competing technologies. Attendees learn the electric power system issues, types of electric power system studies that must be conducted, and other considerations that must be addressed to successfully develop Battery Energy Storage Systems.

*Instructor: Michael I. Henderson, Manager, Power Systems Analysis and Training*

*Additional Instructors to be Announced*

*\*Separate registration required.*

**HOTEL & TRAVEL INFORMATION**



**CONFERENCE VENUE & HOTEL:**

**Hotel Kabuki**

1625 Post Street | San Francisco, CA 94115 | Phone: 415-922-3200

**Discounted Room Rate: \$239 s/d**

**Discounted Room Rate Cut-off Date: January 17, 2017**

**RESERVATIONS:** Go to the travel page of [KnowledgeFoundation.com/Next-Generation-Energy-Storage](http://KnowledgeFoundation.com/Next-Generation-Energy-Storage)

# SPONSORSHIP & EXHIBIT OPPORTUNITIES

Knowledge Foundation offers comprehensive packages that can be customized to your budget and objectives.

Sponsorship allows you to achieve your goals before, during, and long after the event. Packages may include presentations, exhibit space and branding, as well as the use of delegate lists. Signing on early will maximize your exposure to qualified decision-makers and drive traffic to your website in the coming months.

## PODIUM PRESENTATIONS

Available within the Main Agenda!

Showcase your solutions to a guaranteed, targeted audience through a 15- or 30-minute presentation during a specific conference program, breakfast, lunch, or separate from the main agenda within a pre-conference workshop. Package includes exhibit space, on-site branding, and access to cooperative marketing efforts by Knowledge Foundation. For the luncheon option, lunches are delivered to attendees who are already seated in the main session room. Presentations will sell out quickly, so sign on early to secure your talk!

## INVITATION-ONLY VIP DINNER/ HOSPITALITY SUITE

Select specific delegates from the pre-registration list to attend a private function at an upscale restaurant or a reception at the hotel. From extending the invitations, to venue suggestions, Knowledge Foundation will deliver your prospects and help you make the most of this invaluable opportunity.

## ONE-ON-ONE MEETINGS

Select your top prospects from the pre-conference registration list. We will reach out to your prospects and arrange the meeting for you. A minimum number of meetings will be guaranteed, depending on your marketing objectives and needs. A very limited number of these packages will be sold.

## EXHIBIT

Exhibitors will enjoy facilitated networking opportunities with qualified delegates, making it the perfect platform to launch a new product, collect feedback, and generate new leads. Exhibit space sells out quickly, so reserve yours today!

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are available, including:

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- Padfolios and More...

**FOR MORE INFORMATION,  
PLEASE CONTACT:**

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