“Provided an extremely thorough overview of industry trends and risks, I feel like I came away with new ideas and opportunities to go after in the market.”

Senior Energy Trader, Con Edison Energy
OVERVIEW

Battery storage is a technology whose time has finally arrived in many markets across the globe. Implementations are increasing, with storage addressing multiple problems and opportunities across the power grid, and use cases are abounding – both for utility-scale and behind-the-meter applications.

In recent applications, storage has been used:
- As a peaking resource
- To firm up renewable projects
- To support electric vehicle charging
- To help end-use customers minimize exposure to costs

As costs continue their decline, a dramatic upsurge in storage deployments will transform various aspects of the electric power industry.

This course will give an in-depth overview of battery storage, including definitions, technologies, applications and business models. In addition, it will address important relationship between battery storage and its interaction with other resources on the grid as the power grid evolves. Content will also include the pricing and regulatory issues that impact how storage is deployed. It will look at how battery storage is providing services into wholesale power markets, how it is being used as a tool for utility system management, and how it is being utilized by end use customers. Attendees will learn about the application of battery storage across the globe, with a focus on U.S. markets and some emphasis on the western states. The program will address state-of-the art concepts, and challenges for the energy industry to successfully utilize and optimize battery and energy storage as part of their energy portfolio and resource mix.

LEARNING OUTCOMES

- Review the history of the electric utility industry’s engagement with energy storage to date
- Identify the various storage technologies, and the performance and cost issues related to each battery storage medium
- Review methods of storage deployment to date, including managing peak demand, frequency regulation, demand response, demand management, renewables firming, hybrid generation, arbitrage, and infrastructure support
- Review statistics on energy storage in today's market and future projections
- Discuss the issues related to dominant lithium ion technologies, including cost curves, supply chain efficiencies, and potentially constraining limitations on cobalt
- Discuss the role of regulators at federal and state levels in promoting energy storage
- Examine best methods for implementing battery storage as a useful resource in utility portfolio planning, with specific reference to various utility projects
- Highlight competitive market issues related to each storage technology and prospects for future growth with an emphasis on batteries, particularly as they relate to western markets
- Discuss emerging use cases, with an emphasis on deployments in western states
- Review platforms used to help aggregate and integrate battery storage into the grid

“Peter’s breadth of knowledge on the topics and industry was quite impressive.”
Director Trading, Con Edison Energy

“Appreciated the level of thought, content and detail into the battery storage market. Level of attendees was excellent for information sharing and networking. Will attended other educational courses in the future.”
Director of Business Development, Fibrebond
AGENDA

MONDAY, DECEMBER 9, 2019

8:00 – 8:30 am    Registration and Continental Breakfast

8:30 am – 5:00 pm    Course Timing

12:00 – 1:00 pm    Group Luncheon

The Big Picture: Energy Storage to Date, Applications, and Its Growing Role on the Grid Today
- History of storage as a grid management tool
- The evolution of the power grid and the growing need for energy storage
  - Growth in wind and wind production profiles
  - Growth in solar and solar production profile
- Storage processes, technologies, and applications across the energy industry
- Types of energy storage
  - Pumped storage
  - Compressed air
  - Elevated rail
  - Flywheels
  - Liquid air
  - Thermal
  - Advanced lead acid
  - Flow batteries
  - Lithium ion batteries (multiple chemistries)
- Trends and shifts in today’s electricity markets – drivers of change
- Benefits of energy storage and the concept of value stacking
  - Grid reliability – frequency regulation
  - Infrastructure enhancement
  - Peak management
  - Renewables firming and enhancement
  - Hybrid fossil generation (batteries combined with aeroderivative engines)
  - Self-storage
  - Demand response
  - Demand charge management
  - Managed EV charging

Battery Storage Technologies: Cost and Performance
- Technical fundamentals – how each chemical storage technology works
- Understanding their potentials, limitations, and promising applications
- Charging speeds, depth of discharge limitations, cycle lives
- Costs and performance – current status and projections for key technologies
  - Lithium ion supply chain dynamics
    - Impact of EVs
    - Battery manufacturing volumes
    - Cost curves
    - Criticality of cobalt and possible solutions
  - Balance of system costs
  - The importance and role of storage-related software
- Market dynamics and competitive positioning – why lithium ion is winning
**AGENDA**

**MONDAY, DECEMBER 9, 2019 (CONTINUED)**

**Valuing Storage as a Resource in Utility Portfolio Planning**
- Determining optimal levels and values for storage applications as the grid evolves
- Discussing how the grid will evolve – especially renewables – and why the need for storage will increase
- Power system planning requirements for achieving successful integration of energy storage
- Megawatt hours (MWh) vs megawatts (MW) – optimal energy to capacity ratios
- Battery energy storage as compared to end-use customer demand-side management
- Best planning practices for grid operations and utilities to accommodate storage into the grid

**TUESDAY, DECEMBER 10, 2019**

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<th>8:00 – 8:30 am</th>
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**Regulatory Framework: Policy and Rate Structures**
- Understanding the policy landscape relevant to storage at the Federal level
  - Investment tax credit (ITC) tied to solar projects
  - FERC Order 841 and integration of storage into wholesale energy markets
- State and local policy drivers
  - Storage-specific initiatives: Nevada S.B. 204 PUC study and storage goals, and 10/18 rules for DERs
  - California AB 2514
  - MA mandate
  - NY mandate
  - NV storage goals
  - Broad measures
  - Utility grid modernization proceedings
  - NYREV

**Battery Storage and the Evolving Grid**
- Use cases
  - Renewable and distributed energy market projects - Utah Virtual Power Project, California residential and commercial projects
  - Utility-scale renewables and solar – Arizona and California
  - Storage as a grid flexibility resource - California
  - Storage and management of distributed energy resources (DER) - California
  - Storage and microgrids
  - The role of storage in the era of the smart grid

**End-of-Life Disposition**
- Charging lifecycles for main lithium battery chemistries
- Re-purposing used EV batteries in secondary applications
- Recycling of spent batteries (existing and future models; value of waste streams)

**Battery Storage: Chemistries & Applications: Where the Future Is Going**
- Future technological development
- Ongoing energy market disruptions and projections for future storage deployments
- Optimizing storage as a resource in the short- and long-term
- Opportunities and risks – how to move forward
COURSE INSTRUCTOR

Peter Kelly-Detwiler
Principal, NorthBridge Partners

Peter Kelly-Detwiler currently advises technology companies and customers concerning the integration of energy-consuming and producing assets into the power grid. He has 25 years of experience in the electric energy industry, with 15 years as an executive in competitive retail markets, since their inception in 1997. He served in various functions within the industry, including as Director of Customer Care (East Coast) for NewEnergy Ventures. Prior to NorthBridge, he was Sr. Vice President of Constellation Energy’s Load Response group. In this function, he created this unit and oversaw its growth to become a business with approximately $80 million in revenue, capable of dispatching 1700 MW of customer load. At Constellation, Mr. Kelly-Detwiler was the go-to person to teach new hires the Energy 101 class, explaining restructured markets and the employees’ role within that context.

“Excellent introduction into market dynamics of energy storage and the technologies.”

Senior Engineer, MEPPI

“A great breakdown of the energy markets with solid predictions gleaned from careful consideration of trends.”

Design Technician II, BHI Energy

“Peter was excellent! Very knowledgeable, patient and engaging! He knew his material, it was up-to-date and yet he wasn’t professorial.”

Principal, WGRA

“This course provided a snapshot of the future of energy and the future of energy is battery storage.”

General Superintendent, Northline Utilities

“The course is very informative on the latest battery storage technologies in the market. It provides the latest cost and performance, opportunities and risks of battery storage.”

Cost Estimator, TC Energy

“Peter is our ‘Bill Nye’ – the science guy! Super job!”

Ontario Operations Manager, Stantec

“I walked away with a much better grasp on battery storage and its future.”

Public Utilities Specialist, WAPA
POST-COURSE WORKSHOP
The Economic Potential of Energy Storage
TUESDAY, DECEMBER 10, 2019

12:30 – 1:00 pm       Workshop Registration
1:00 – 4:30 pm        Workshop Timing

OVERVIEW
Energy storage is a favorite technology of the future for good reasons. Many people see affordable storage as the missing link between intermittent renewable power, such as solar and wind, and 24/7 reliability. Utilities are intrigued by the potential for storage to meet other needs such as relieving congestion and smoothing out the variations in power that occur independent of renewable-energy generation. As technological advancements and gains in efficiencies and power densities for storage platforms continue to reach the market, many of these applications will continue to show more viability for actual investment.

Identifying the most economical projects and highest-potential customers for storage is a top priority for a diverse set of companies including power providers, grid operators, battery manufacturers, energy-storage integrators, and more. This workshop will discuss emerging legal and regulatory issues as well as specific methodologies to model in order to assess the economic value of storage in different applications. The workshop will demonstrate how to build a comprehensive cost-benefit analysis and illustrate these techniques through in-depth case studies.

LEARNING OUTCOMES
• Discuss emerging legal and regulatory issues for energy storage
• Discuss the regulatory framework and state issues
• Explain how to build a comprehensive cost-benefit analysis
• Evaluate technical and economic modeling as well as the components for storage projects
• Evaluate how to properly size batteries for a project
• Discuss several utility case studies
WORKSHOP AGENDA

TUESDAY, DECEMBER 10, 2019

- Emerging legal and regulatory issues
  - The State/Federal jurisdictional breakdown as applied to storage
- Distribution/retail vs. transmission/wholesale and where does generation fit in
  - Federal regulatory framework for storage
    - Order No. 841 and the regional compliance picture
    - Storage classification as transmission
  - Selected state issues
    - Inclusion in rate base
    - State procurement efforts
- Commercial contracting issues
  - Build-Transfer Agreements
  - PPAs and product definition
  - Handling “stacked” services
  - Ownership arrangements
- Project modeling
  - Financial model
  - Technical to economic modeling
- Project components
  - Timeline and resource specific
  - Capital cost breakdown
  - Operating cost breakdown
  - Other drivers of cash flow
- Battery sizing
  - Objectives and approach
  - Properly sizing a battery system
  - Technology selection
  - Filling in specifics for batteries
- Case study examples
  - Arizona Public Service
- Final considerations
- Future opportunities and next steps

WORKSHOP INSTRUCTORS

Donald Chung
Energy Innovation Consultant, Arizona Public Service

Donald Chung brings over 20 years of technical and commercial experience to his role at APS, where he is focused on developing innovative solutions meeting customers’ clean energy and resilience needs. His expertise in renewable and distributed energy was built through prior roles at the National Renewable Energy Laboratory – where he managed energy technology analysis projects, as well as project development consulting efforts – and at an international solar technology company where he held various leadership positions with responsibility for North American sales, marketing, procurement, and operations.

Donald holds a B.S. from Duke University, an M.S. from U.C. Berkeley, and an M.B.A. from the University of Michigan.
WORKSHOP INSTRUCTORS

Cliff Sikora  
**Partner, Troutman Sanders**

Cliff Sikora has practiced electricity law in Washington, D.C. for 30-years. He has had the honor to advise the firm’s electric sector clients on regulatory and transactional matters since 1996, after starting his legal career in public service with FERC and the U.S. Senate Committee on Energy & Natural Resources. His practice is focused on providing strategic and transactional advisory services for a wide variety of industry interests including utilities, IPPs, EPC contractors, banks, and infrastructure funds. Mr. Sikora also advises clients in matters before FERC, federal courts, and state PSCs, and defends companies facing financial audits, enforcement actions, and reliability audits. He conducts compliance training on standards of conduct, codes of conduct and best practices, and has designed corporate compliance programs for companies in the electric industry. Cliff has particular expertise in working with clients on business plans for grid scale batteries, transmission project development, RTO market rules, and legal issues associated with power system engineering, planning and reliability.

John Fernandes  
**Senior Consultant – Emerging Technologies, Customized Energy Solutions (CES)**

A recognized thought leader in energy storage policy and market development, John brings over a decade of broad experience in the energy industry with time spent at a public utility, the Federal Energy Regulatory Commission, and some of the country’s leading energy storage development companies. John has operated in every US wholesale energy market and has offered expertise in international markets, including Canada, the UK, Mexico, and Australia. He has helped shaped policy for numerous states as well as the US Department of Energy. John has an MBA from the University of Delaware, a Master’s in Public Health from Johns Hopkins University, and is a guest lecturer for the University of Colorado at Denver Global Energy Management Program.

Joe Fox  
**Market Director – Power, Ulteig**

Joe’s career spans various engineering, technical sales, and market development leadership positions with diversified technology providers and renewable EPC / development firms. His technical experience includes network planning and analysis, grid modelling, and dynamic simulation of various alternative energy solutions including energy storage, power electronics, renewable energy, FACTS, and microgrids. Specific to energy storage, Joe has conducted numerous technical and commercial studies demonstrating energy storage use cases, including comprehensive studies for a large IOU in Texas and a large IOU in the Southeast U.S. that has led to multiple grid connected energy storage projects. Joe holds a B.S. in Electrical Engineering from the University of Wisconsin-Madison.
IACET CREDITS

EUCI has been accredited as an Authorized Provider by the International Association for Continuing Education and Training (IACET). In obtaining this accreditation, EUCI has demonstrated that it complies with the AN-SI/IACET Standard which is recognized internationally as a standard of good practice. As a result of their Authorized Provider status, EUCI is authorized to offer IACET CEUs for its programs that qualify under the AN-SI/IACET Standard.

EUCI is authorized by IACET to offer 1.1 CEUs for the course and 0.4 CEUs for the workshop.

REQUIREMENTS FOR SUCCESSFUL COMPLETION

Participants must sign in/out each day and be in attendance for the entirety of the course to be eligible for continuing education credit.

INSTRUCTIONAL METHODS

Case studies and PowerPoint presentations will be used in this program.

EVENT LOCATION

A room block has been reserved at the Hilton Lake Las Vegas Resort & Spa, 1610 Lake Las Vegas Pkwy, Henderson, NV 89011, for the nights of December 8-9, 2019. Room rates are US $109.00, plus applicable tax. To reserve your room, please call 1-702-567-4700 or visit the website and to reference the EUCI Meeting Group to get the group rate. The cutoff date to receive the group rate is November 15, 2019 but as there are a limited number of rooms available at this rate, the room block may close sooner. Please make your reservations early.

REGISTER 3, SEND THE 4TH FREE

Any organization wishing to send multiple attendees to this course may send 1 FREE for every 3 delegates registered. Please note that all registrations must be made at the same time to qualify.
A room block has been reserved at the Hilton Lake Las Vegas Resort & Spa, 1610 Lake Las Vegas Pkwy, Henderson, NV 89011, for the nights of December 8-9, 2019. Room rates are US $109.00, plus applicable tax. To reserve your room, please call 1-702-567-4700 or visit the website and to reference the EUCI Meeting Group to get the group rate. The cutoff date to receive the group rate is November 15, 2019 but as there are a limited number of rooms available at this rate, the room block may close sooner. Please make your reservations early.

SPECIAL BUNDLE PRICE  FUNDAMENTALS OF BATTERY STORAGE
AND POST-COURSE WORKSHOP: DECEMBER 9-10, 2019: US $1795 
EARLY BIRD on or before NOVEMBER 22, 2019: US $1595

FUNDAMENTALS OF BATTERY STORAGE COURSE ONLY
DECEMBER 9-10, 2019: US $1395
EARLY BIRD on or before NOVEMBER 22, 2019: US $1195

EARLY BIRD on or before NOVEMBER 22, 2019: US $495

Substitutions & Cancellations
Your registration may be transferred to a member of your organization up to 24 hours in advance of the event. Cancellations must be received on or before November 8, 2019 in order to be refunded and will be subject to a US $195.00 processing fee per registrant. No refunds will be made after this date. Cancellations received after this date will create a credit of the tuition (less processing fee) good toward any other EUCI event. This credit will be good for six months from the cancellation date. In the event of non-attendance, all registration fees will be forfeited. In case of course cancellation, EUCI’s liability is limited to refund of the event registration fee only. For more information regarding administrative policies, such as complaints and refunds, please contact our offices at 303-770-8800. EUCI reserves the right to alter this program without prior notice.

How did you hear about this event? (direct e-mail, colleague, speaker(s), etc.)

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Company

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Exp. Date  Security Code (last 3 digits on the back of Visa and MC or 4 digits on front of AmEx)  Billing Zip Code/Postal Code

OR Enclosed is a check for $ to cover registrations.

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