

UTILITY SCALE PV PLANT ASSET OPTIMIZATION

*Component Performance, Obsolescence,
Replacement & Re-Powering*

December 3-4, 2018
Millennium Knickerbocker Hotel
Chicago, IL

POST-SYMPOSIUM WORKSHOP

**A Fundamental Approach to
Re-Powering: Optimizing Revenue
and Energy Production While
Reducing Costs and Risk**

TUESDAY DECEMBER 4, 2018



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symposium and 0.4 CEUs for
the workshop

OVERVIEW

In the utility-scale solar industry, asset owners and managers are paying increasing attention to life-cycle obsolescence, component replacement and re-powering issues. This asset optimization perspective starts with the replacement of modules, inverters, racking/tracking installations and related balance-of-system (BoS) components in already-operating plants, of course.

Now that these solar power plant assets are also actively in an acquisition and disposition mode — with utilities increasingly assuming long-term ownership positions — the asset optimization emphasis is extending to O&M, maintaining a competitive levelized cost of electricity (LCOE) margin and fine-tuning a plant's overall health and condition to maximize financial performance in a market context.

This course has been developed at the request of electric utilities, investors, project developers, engineering procurement construction firms and other solar industry asset management organizations as a forum to provide guidance and tools for properly evaluating and assigning financial value and consequences to the conditions and metrics that accompany the full range of life-cycle obsolescence, component performance and replacement, and re-powering decisions — regardless of the stage at which the utility-scale project upgrade is under consideration. The program instructors have been specifically selected for their expertise in applying best practices their industry counterparts can understand, remember and apply.

LEARNING OUTCOMES

- Identify trends driving utility-scale life-cycle obsolescence, component performance and re-powering decisions
- Define key technical and financial considerations related to solar power plant life-cycle obsolescence, component performance and re-powering options
- Examine key tax and project finance concerns as well as qualification opportunities for solar power plant performance and re-powering decisions
- Assess key legal considerations, construction contract provisions, and insurance issues associated with power plant component performance replacement and re-powering decisions
- Evaluate the economics of building in storage to a power plant or project at origination and retrofit stages
- Discuss how asset owners and managers should implement life-cycle obsolescence, replacement and re-powering analytical and decision-making processes

WHO SHOULD ATTEND

- Utilities
- IPP generators
- Project developers
- Investors
- EPCs

AGENDA

MONDAY, DECEMBER 3, 2018

- 8:00 – 8:30 am** **Registration and Continental Breakfast**
- 8:30 – 8:45 am** **Overview and Introductions**
- 8:45 – 10:30 am** **I. Introduction to PV Plant Life-cycle Obsolescence, Component Performance, Replacement and Re-powering Asset Optimization Decision-making**
- A. Stakeholder value proposition (risk management) related to specific asset management entities
 - 1. Utilities
 - 2. Project owners
 - 3. Developers
 - 4. Investors and insurers
 - 5. EPCs
 - 6. O&M support and organizations
 - 7. Commercial/Industrial (C&I), institutional and/or other load serving entity (LSE)
 - B. Impact of asset management considerations regarding:
 - 1. Anticipated “life” of PV system
 - 2. O&M
 - 3. Plant viability
 - 4. Revenue
 - 5. Ownership/operations analysis and decisions
 - 6. Time-based ownership options
- 10:30 – 10:45 am** **Morning Break**
- 10:45 am – 12:00 pm** **II. PV Plant Asset Management Decision Road Map and Triggers**
- A. Knowing why to act
 - B. Knowing when to act
 - C. Knowing who needs to act
 - D. Knowing how to act
 - E. Data collection and analysis
 - F. Tools
- Panel Discussion***
- 12:00 – 1:00 pm** **Group Luncheon**
- 1:00 – 3:00 pm** **III. PV Plant Asset Optimization Options for Inverters, Modules, Racking/Trackers and Balance of System (BoS)**
- 1. Condition and site assessment
 - 2. Value assessment and replacement economics
 - 3. Comparing specifications and performance metrics of existing component(s) w/replacement component(s)
 - 4. Warranties
 - 5. Performance guarantees
 - 6. Disposition of replaced components
- 3:00 – 3:15 pm** **Afternoon Break**

AGENDA

MONDAY, DECEMBER 3, 2018 (CONTINUED)

3:15 – 5:00 pm

IV. PV Plant Asset Optimization Economics and Finance

- A. Plant health and condition > availability + performance = revenue
- B. Re-powering preparation and planning and its value for funding and insurance
- C. Where the costs are shifted and reduced
- D. Reviewing the fiscal variability graphics based on different scenarios
- E. Implications for asset ownership
 - 1. Value of the increased production relative to the cost of the retrofit
 - a. Additional energy that can be sold as part of the existing power purchase agreement
 - b. Additional incentives that can be created, such as additional renewable energy credits revenue
 - 2. Tax-related considerations
 - a. Federal, state and local incentives
 - b. Deductions and other offsets
 - c. Depreciation

Panel Discussion

5:00 pm

Course Adjournment for the Day

TUESDAY, DECEMBER 4, 2018

7:45 – 8:15 am

Continental Breakfast

8:15 – 9:45 am

V. The Relationship of Life-cycle Obsolescence, Component Performance and Replacement, and Re-powering to LCOE (Levelized Cost of Energy)

- A. What is LCOE and its trendlines?
- B. Is LCOE the perfect and/or only relevant valuation metric?
- C. LCOE components, their values and weighting
- D. LCOE throughout plant lifetime
- E. How is LCOE affected by life-cycle, component replacement and re-powering considerations
- F. Reducing LCOE
 - 1. The application of reliability
 - 2. RAMS and SMART concepts
 - 3. Impact of new industry standards

Panel Discussion

9:45 – 10:00 am

Morning Break

AGENDA

TUESDAY, DECEMBER 4, 2018 (CONTINUED)

10:00 – 11:45 am

VI. PV Power Plant and Energy Storage Integration as an Asset Optimization Strategy

- A. Configuration requirements
 - 1. The value of flexibility
 - 2. “What if” scenarios
 - 3. Technologies and selection
 - 4. Impact on PV design, layout and sizing
 - 5. Cost issues
- B. Requirements for energy storage availability
 - 1. Plant health and condition
 - 2. At what point does plant over-build evaporate?
 - 3. Does an effective storage strategy improve inverter component life?
- C. Limitations and end-of-life attributes
 - 1. Condition assessment (time, temperature DOD and charge cycles)
 - 2. Value assessment and replacement economics
 - 3. Operations and maintenance (O&M)
 - 4. Disposition

11:45 am

Symposium Adjourns

POST-SYMPOSIUM WORKSHOP

A FUNDAMENTAL APPROACH TO RE-POWERING

Optimizing Revenue and Energy Production While Reducing Costs and Risk

TUESDAY DECEMBER 4, 2018

12:30 – 1:00 pm **Workshop Registration**

1:00 – 5:00 pm **Workshop Timing**

OVERVIEW/AGENDA

A term that is now being applied to the holistic concept of long-term PV plant performance and viability is re-powering. The industry has advanced well beyond just considering how to deal with conditions as the plant ages and components come due for replacement. The re-powering concept, as historically applied by utilities, incorporates in-service dimensions of reliability, availability, maintainability, safety and performance.

Re-powering's applicability encompasses projects in the following PV plant life-cycle stages:

- Plants at concept
- Existing plants with unanswered questions and hidden issues
- Distressed plants
- Plant acquisition/disposition
- De-commissioning

This workshop will consider the fundamentals of performance optimization and re-powering, their powerful operational and financial impact throughout the life of a solar plant and how to implement a coherent asset optimization process that the C-suite can embrace.

LEARNING OUTCOMES

- Identify opportunities and decision-making points to control future risks and costs, whether buying a plant or using a PPA
- Assess the elements that positively and negatively impact plant health, condition and performance
- Evaluate those economic choices that will result from rapid changes in technology, loss of manufacturer and/or warranty coverage, and system re-configuration issues over time
- Define critical specification questions that lower LCOE while improving performance and output
- Review the successful steps that have historically provided the utility industry flexibility to consistently deliver plant reliable, available, maintainable and safe plants
- Analyze the cost and service impacts that assist familiarizing and building upper management interest and support in short, medium and long-term decision making
- Compare advantages and disadvantages regarding the planning and execution of specific steps and changes that need to be made, and when, for best plant performance and re-powering results

AGENDA

TUESDAY, DECEMBER 4, 2018

12:30 – 1:00 pm

Workshop Registration

1:00 – 1:45 pm

I. PV Plant Re-Powering Fundamentals

- A. What is PV re-powering?
- B. Why re-power PV plants?
- C. Definitions and types of re-powering
 - 1. The value and need for a lifecycle concept
 - 2. Deal with rapid changes in technology and availability
 - 3. Existing plants — addressing unanswered and hidden issues
 - 4. Distressed plants
 - 5. Plant acquisition/disposition

1:45 – 3:00 pm

II. PAM – An Integrated Systems Delivery Process

- A. The PAM (Preemptive Analytical Maintenance) Process
 - 1. Determining the correct and necessary data as found in historic utility plant operations
 - 2. Application of technologies
 - 3. What are the elements and metrics what is the impact
- B. Starting today with technologies for tomorrow
- C. Initiating a PV systems process into a new project
- D. Introducing/overlaying a PV systems process into on-going plant operations

3:00 – 3:15 pm

Afternoon Break

3:15 – 4:15 pm

III. The Pillars of PV Plant Re-powering: PAM, RAMS, SMART

- A. Delivering reliable PV Systems with an engineering systems process
- B. RAMS (reliability, availability, maintainability [testability] and safety)
- C. SMART (specific, measurable, attainable, realizable and time-bound/traceable) engineering

4:15 – 5:00 pm

IV. Experts Panel: Adopting a Re-powering Approach for All Solar Projects?

- A. Assessing the practicality of adopting a comprehensive re-powering approach that can supplant a least-cost approach in the beginning and throughout the life-cycle of a project
- B. Will the C-suite consider a re-powering approach that could yield more immediate and long-term value than a least-cost approach?
- C. Are the two approaches mutually exclusive?
- D. What is involved in quantifying the financial and economic benefits as well as the downsides of an integrated re-powering process?

SYMPOSIUM INSTRUCTORS



Bryan Banke

Director – Asset Management, Enerparc

Bryan Banke is Director of Asset Management at Enerparc, a privately-held company based in Hamburg, Germany that provides solar EPC services across 19 countries and owns 1GW as a solar IPP. He is responsible for the performance — both operational and financial — of the entire portfolio of operating projects in the US. He was an early creator of standardized operating policies and procedures in the management of solar-asset portfolios. Prior to joining the Enerparc, Mr. Banke managed NRG Energy's distributed-generation portfolios, before assuming control of the solar and wind operations for Renewable Energy Trust Capital.



John Balfour

President, High Performance PV

John Balfour is President and CTO for High Performance PV. He brings 4 decades of PV experience in organizing, training & managing large and small multi-discipline working groups in PV, energy planning, R&D, and technology transfer. He has been active as a PV technology and System provider / integrator in EPC and O&M. As a PV author he has published 6 educational texts and 2 other PV books, hundreds of newspaper and magazine articles, white papers including work with Sandia National Laboratories and SEPA. His work has been with a broad range of technology and process developers, VC companies, financiers and insurance organizations, universities, international laboratories, standards agencies, volunteer mentoring groups. For decades, Dr. Balfour has worked closely with PV stakeholders including system owners, asset managers, O&M professionals, architectural and engineering professionals, EPCs, PV system integrators, manufacturers, system financiers and insurers, bonding companies, legal firms, VCs, electrical and water utilities among others. He supports the areas of pre-design, pre-installation consulting, design, plans review, systems and financial analysis, QA, Project management trouble shooting and post installation services including testing, monitoring, commissioning and O&M.



Randy Corey

COO, sPower

Randy Corey, Chief Operating Officer at sPower, possesses 35+ years of experience in solar industry and operation construction, electrical, mechanical, engineering management, project management, manufacturing, customer service and supply chain management. He was appointed COO after successfully delivering more than 650MW of operating projects over the course of 30 months as the SVP of Operations. Mr. Corey joined sPower after its acquisition of Tioga Energy.



Eric Daniels

CEO and Founder, Field Energy Ops

Eric Daniels is CEO and Founder of Field Energy Ops, which specializes in maximizing energy production and the financial optimization of solar assets over the life of the investment, as well as offering complete field diagnostic, repair and renovation services. Prior to that, he served as the regional president for Robert Bosch LLC's North American solar division where he introduced structured financing, loan and lease programs and led all OEM supply for module contracts, customer service, marketing, sales and operations. Before his tenure at Bosch, Mr. Daniels served as the Chief Technology Officer for BP Solar, where he developed advanced module technologies and 6 Sigma quality programs. He and team earned 5 top BP awards for innovation, environment and commercialization and filed numerous patents addressing improved solar module reliability. Mr. Daniels also served as the global vice president of sales for BP Solar, and held senior roles with Siemens Solar and IPC Westinghouse, leading sales, marketing, customer service and product development.

SYMPOSIUM INSTRUCTORS



Jeremy Garcia

Leader – Solar O&M, Arizona Public Service (APS) invited

Jeremy Garcia manages Solar O&M department for Arizona Public Service Co (APS). During his 15 years with the utility, he has worked in generation engineering, customer construction and solar O&M. His current role within the solar O&M department is to oversee the operations and maintenance activities of some 200 APS-owned solar sites. Mr. Garcia also spent 4 years in the United States Navy and has earned a bachelor's degree in Business Management.



Russ Morris

President, Morris Ram Consulting

Russ Morris provides RAM/SE engineering consulting services across a broad spectrum of technical fields, including solar and wind power. His expertise extends to electronics, electrical, avionics, hydraulics, pneumatics, flight control, guidance, and signal processing systems, reflecting more than 35 years' experience in reliability and maintainability of military and commercial aerospace and medical systems, as well as 13 years of design experience in medical diagnostic ultrasound and broadcast television equipment. He was a Boeing International trainer, mentor and coach in RAM topics for Boeing US, Boeing Australia and Boeing India, and a number of national and international companies. He is a 20-year contributor to the Boeing Ed Wells program of technical excellence and has three patents in medical electronics and aerospace unmanned systems. Mr. Morris is currently supporting the development of IEC 63019 solar power availability standard and is working on an ad hoc committee to begin development of reliability standards for solar and wind power.

INSTRUCTIONAL METHODS

This program will use PowerPoint Presentations, group discussions, as well as active participation.

REQUIREMENTS FOR SUCCESSFUL COMPLETION

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

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 ANSI/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 ANSI/IACET Standard.

EUCI is authorized by IACET to offer 1.0 CEUs for the symposium and 0.4 CEUs for the workshop.

REGISTER 3, SEND THE 4TH FREE

Any organization wishing to send multiple attendees to this event may send 1 FREE for every 3 delegates registered. Please note that all registrations must be made at the same time to qualify.

EVENT LOCATION

The event is located at The Millennium Knickerbocker, 163 E. Walton, Chicago, IL 60611. A room block has been reserved for the nights of December 2-3, 2018. Room rates are US \$95. Call **1-800-621-8140** for reservations. Mention the EUCI event to get the group rate. The cutoff date to receive the group rate is October 3, 2018 but as there are a limited number of rooms available at this rate, the room block may close sooner. ***Please make your reservations early.***



Please make checks payable to "PMA"

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PLEASE REGISTER

UTILITY SCALE PV PLANT ASSET OPTIMIZATION AND POST-SYMPOSIUM WORKSHOP

DECEMBER 3-4, 2018: US \$1895
Early bird on or before November 16, 2018: US \$1695

UTILITY SCALE PV PLANT ASSET OPTIMIZATION ONLY

DECEMBER 3-4, 2018: US \$1495
Early bird on or before November 16, 2018: US \$1295

POST-SYMPOSIUM WORKSHOP ONLY

TUESDAY, DECEMBER 4, 2018: US \$595
Early bird on or before November 16, 2018: US \$495

I'M SORRY I CANNOT ATTEND, BUT PLEASE EMAIL ME A LINK TO THE SYMPOSIUM PROCEEDINGS FOR US \$395

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

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OR Enclosed is a check for \$ _____ to cover _____ registrations.

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 2, 2018 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 (201) 871-0474