INTRODUCTION TO WHOLESALE ELECTRICITY MARKETS: RTOs AND ISOs

October 2-3, 2019
EUCI Office Building Conference Center
Denver, CO

“Excellent course that is taught by an expert who really takes time to explain concepts and issues.”

Customer Account Executive, Bonneville Power Administration

EUCI is authorized by IACET to offer 1.1 CEUs for the course

EUCI is authorized by CPE to offer 12 credits for the course
OVERVIEW

This course is designed to introduce basics of wholesale electricity markets operating in the U.S., Canada and Mexico. The purpose is enhancing attendees' understanding of types of wholesale electricity markets and the platforms that offer such markets. The focus will be on the functions of RTOs / ISOs and their role in providing platforms for real-time and day-ahead energy markets, ancillary service markets and in some cases capacity markets. Participants will also gain a high-level understanding of current issues affecting electricity markets and will receive detailed explanation of how the electricity markets operate.

Major topics covered in this course include:
Basics of Electric Power Systems
- Fundamentals of electricity, definitions and measuring units
- Generation, transmission, distribution, and loads
- Types of generation resources including intermittent resources, costs, and capabilities
- Load duration curves, system load factors, load growth and customer classes
- Ancillary services
- Power system losses
- Power system load flow simulation

Regulatory Oversight – Role of FERC and State Regulatory Agencies

Regional Transmission Organizations (RTOs) and Independent System Operators (ISOs)
- RTOs/ISOs in U.S. and Canada
- Regulatory structure of RTOs/ISOs
- RTO functions and characteristics
- Advantages and disadvantages of RTO participation
- Role of FERC, state regulatory agencies, and market monitor

Regional Wholesale Electricity Markets Fundamentals – Part 1
- Wholesale electricity prices trend and volatility
- Locational marginal price (LMP) and its components
- Review of supply and demand relationship, spot versus bilateral electricity markets
- Economic merit order selection and unit commitment including responsibilities and obligations
- Security constrained economic dispatch and scheduling
- Two settlement system: day ahead and real-time settlement
- Cost of transmission congestion
- Financial transmission rights (FTRs) for hedging against transmission congestion
- Wholesale demand response
- Capacity market
- Ancillary services market
- Virtual trading
- Comparison of energy, capacity, and ancillary service markets offered by RTOs/ISOs in the U.S.
- LMP simulation

Regional Wholesale Electricity Markets Fundamentals – Part 2
- Forward pricing curve
- Generator bidding strategies and constraints
  - Variable cost and its components, marginal cost, incremental cost
  - Cost-based vs. market-based rate
- Scarcity pricing and load pockets
- Energy price forecasting overview
- Brief overview of risk management
- RTO/ISO financial settlement

“Great introduction for those new to power markets and the power industry.”
Resource Management Consultant, APS
LEARNING OUTCOMES

Participants with little or no prior electric utility industry background or experience will be able to benefit from this course. At the adjournment of the course participants will be able to:

- Describe major components of a power system and types of wholesale electricity markets
- Describe platforms for real-time and forward wholesale electricity markets
- Explain locational marginal price (LMP) and its components
- Describe, at high level, types of risks inherent in the wholesale energy markets and financial tools to manage such risks
- Describe the role of generators, transmission, and load in a power system
- Define and provide examples of ancillary services
- State the role of FERC and state regulatory agencies
- Describe ISO/RTO functions
- Describe role of transmission in the regional wholesale electricity markets
- Explain bilateral and real-time energy markets
- Discuss RTO/ISO financial settlement and credit issues

WHO SHOULD ATTEND

- Employees new to the industry or with limited industry experience
- Energy attorneys and regulatory personnel new to the industry
- Energy traders and power marketers new to their job
- Customer service representatives
- Support staff of electric utilities and RTOs/ISOs - accounting, IT personnel, and support personnel
- Power generator and transmission project owners/developers
- Energy finance professionals

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

This course will use slide presentation, group discussions, as well as active participation. Attendees will have ample opportunities to actively participate in review questions/answers sessions, group breakout sessions, and simulations/demonstrations offered as part of this course.

“Raj was able to break down a new and somewhat complex topic and explain it to non-technically trained audience.”

Financial Reporting Manager, Midland Cogeneration Venture

“This course did an excellent job of introducing me to the basic concepts of the energy markets and should give a good understanding moving forward so I can learn about these concepts further and how they could affect me moving forward.”

Civil Engineer, SWPA

REGISTER TODAY! CALL 303-770-8800 OR VISIT WWW.EUCI.COM
### AGENDA

**WEDNESDAY, OCTOBER 2, 2019**

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
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<tbody>
<tr>
<td>7:30 – 8:00 am</td>
<td>Registration and Continental Breakfast</td>
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<tr>
<td>8:00 – 10:30 am</td>
<td><strong>Power System Basics, Types of Generation Resources and Loads, and Regulatory Oversight</strong></td>
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<tr>
<td></td>
<td>- Fundamentals of electricity, definitions, and units</td>
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<td></td>
<td>- Overview of source to socket components - generation, transmission, distribution, and loads</td>
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<td>- Power flow demonstration</td>
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<td>- Types of generation resources, heat rate, capacity factor, and installation costs</td>
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<td>- Load characteristics - load duration curves, load factor, and customer classes</td>
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<td>- Demand response</td>
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<td>- Power system losses</td>
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<td>- Regulatory oversight – role of FERC, State regulatory agencies, and market monitor</td>
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<td>- Review questions</td>
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<td>10:30 – 10:45 am</td>
<td>Morning Break</td>
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<td>10:45 am – 12:00 pm</td>
<td><strong>Types of Energy Markets, Regional Transmission Organizations (RTOs) and Independent System Operators (ISOs)</strong></td>
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<td></td>
<td>- Wholesale electricity prices and volatility</td>
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<td>- Review of supply and demand relationship</td>
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<td>- Types of electricity markets – real-time (spot) versus bilateral markets</td>
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<td>- RTOs/ISOs in U.S. and Canada</td>
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<td>- RTO functions and characteristics</td>
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<td>- RTO drivers</td>
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<td>- Advantages and disadvantages of RTO /ISO participation</td>
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<td>- Regulatory framework and role of FERC and state regulatory agencies</td>
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<td>- RTO stakeholders</td>
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<td>- Review questions</td>
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<td>12:00 – 1:00 pm</td>
<td>Group Luncheon</td>
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<td>1:00 – 3:00 pm</td>
<td><strong>Locational Marginal Price (LMP)</strong></td>
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<td>- LMP concept</td>
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<td>- Components of LMP and examples</td>
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<td>- Nodal, Hub, and Zonal LMP</td>
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<td>- LMP demonstration, review questions, and class exercise</td>
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<td>3:00 – 3:15 pm</td>
<td>Afternoon Break</td>
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<td>3:15 – 5:00 pm</td>
<td><strong>RTO/ISO Wholesale Electricity Markets</strong></td>
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<td>- Economic merit order and unit commitment</td>
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<td>- Security constrained economic dispatch</td>
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<td>- Cost of transmission congestion and losses</td>
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<td>- Financial transmission rights (FTRs) for transmission congestion hedging</td>
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<td>- Day ahead and real-time market, scheduling and dispatch</td>
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<td>- Capacity market</td>
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<td>- Ancillary services – whose responsibilities?</td>
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<td>- Comparison of markets offered by RTOs/ISOs in the U.S.</td>
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<td>- Review questions</td>
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AGENDA

THURSDAY, OCTOBER 3, 2019

7:30 – 8:00 am  Continental Breakfast

8:00 – 8:15 am  Review of Previous Day; Opportunities for Questions and Discussion on Previous Day's Material

8:15 – 10:00 am  Regional Wholesale Electricity Market Basics - Continued
  • Overview of generator/load offer/bidding considerations, bid and offer curves, three-part bid
  • Generator capacity dispatch range, variable cost components, start-up cost, no load cost, ramp rate concepts
  • Overview of RTO/ISO financial settlement
  • Review questions

10:00 – 10:15 am  Morning Break

10:15 – 11:45 am  Risk Management and Credit Requirements
  • Potential risks
  • Overview of risk hedging tools for real-time and bilateral markets: FTRs, virtual trading, options, futures, and SWAPs
  • Credit requirements
  • Review questions

INSTRUCTOR

Raj Rana, PE, MBA, CEM, PMP
President, Rana Energy Consulting

While serving as the director of RTO Policy and NERC Compliance at American Electrical Power, Raj was responsible for coordination of energy, transmission, market structure, finance, and governance related RTO policy issues among the AEP business units, development of corporate positions/policies, and advocacy of such positions at regulatory agencies, at stakeholder forums in PJM, SPP, and ERCOT RTOs. He was also responsible for the development and coordination of strategic direction of AEP’s power system reliability compliance program among all business units, as well as coordination and facilitation of compliance plans, policies and procedures within the company to ensure timely and successful compliance of NERC, and regional reliability standards.

Previously, Mr. Rana worked in AEP’s System Planning department in various positions. His experience at AEP includes planning and operation of the bulk transmission network, generation interconnections, tariff and regulatory/legislative issues, system integration, asset management, mergers and acquisitions, as well as planning and engineering studies for international transmission and generation projects.

Mr. Rana holds a BSEE degree from M. S. University (India), an MSEE degree from West Virginia University, and an MBA degree from University of Dayton. Mr. Rana also completed the AEP Management Development Program at the Fisher Business College of the Ohio State University. He is a life-senior member of IEEE and holds the Ohio State PE license. Mr. Rana is also a certified energy manager and project management professional.
EVENT LOCATION

EUCI Conference Center
4601 DTC Blvd., B-100
Denver, CO 80237

NEARBY HOTELS

<table>
<thead>
<tr>
<th>Hotel Name</th>
<th>Address</th>
<th>Phone</th>
<th>Distance Away</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hyatt Regency Denver Tech Center</td>
<td>7800 E. Tufts Ave</td>
<td>303-779-1234</td>
<td>0.3 miles</td>
</tr>
<tr>
<td>Hilton Garden Inn Denver Tech Center</td>
<td>7675 E. Union Ave</td>
<td>303-770-4200</td>
<td>0.6 miles</td>
</tr>
<tr>
<td>Denver Marriott Tech Center</td>
<td>4900 S. Syracuse St</td>
<td>303-779-1100</td>
<td>0.7 miles</td>
</tr>
<tr>
<td>Hyatt Place Denver Tech Center</td>
<td>8300 E. Crescent Parkway</td>
<td>888-492-8847</td>
<td>0.9 miles</td>
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Program Level 1: Intermediate, Delivery Method: Group-Live, Advanced Preparation: None

REGISTER 3, SEND THE 4TH FREE

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OR, scan and email to: conferences@euci.com

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October 2-3, 2019: US $1395
Early bird on or before September 13, 2019: US $1195

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Print Name
Job Title

Company

What name do you prefer on your name badge?

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City State/Province Zip/Postal Code Country

Phone Email

List any dietary or accessibility needs here

CREDIT CARD INFORMATION

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Account Number

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.

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 August 30, 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.
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