



**Course length:** Two days

**Prerequisites:** None, though a basic understanding of the electric business such as that presented in Electric Industry Overview (online course) or Understanding Today's Electricity Business (book) is helpful.

**CPE credits:** 16

### An in-depth study of the challenges and opportunities presented by increasing penetrations of distributed energy resources (DER) and microgrids

As distributed energy resources (DER) including load management, generation, storage, and microgrids grow rapidly, utilities are struggling to develop sustainable strategies that integrate them into their physical operations and business models. This seminar explores the characteristics of these technologies and the associated challenges and opportunities. Participants will learn technical, economic, and regulatory details and discover strategies that energy companies and state regulators are taking to optimize use of DER.



### WHO WILL BENEFIT FROM THIS SEMINAR?

- Electric and gas utility managers and strategic planners
- Analysts and financial professionals involved in electric utilities, generation, and/or DER services
- Regulatory staff and commissioners
- Professionals in the legal, regulatory, and PR fields involved in the electric business
- Utility distribution engineers and transmission system operators

### WHAT PARTICIPANTS WILL LEARN

- The basics of how the key distributed energy resources (DER) work
- Operational characteristics, costs, and value of the key DER
- What microgrids are and their characteristics, costs, and value
- Challenges of integrating DER and microgrids into the electric grid
- What utilities and regulators are doing to optimize use of DER and microgrids
- How DER and microgrids may force changes to the utility business model

### COURSE AGENDA

#### Introduction

- The 20th century grid and why it is changing
- The 21st century grid
- What the new technologies are
- Challenges to the utility business model

#### Distributed energy resources (DER) – what they are, how they work, technical characteristics, economics

- Overview of DER categories (generation, load management, storage)

- Defining technical characteristics (dispatchability, variability, predictability, ramp rates, distribution system interconnection issues including voltage and power quality)
- Defining costs (fixed, variable, and leveled)
- Defining value (avoided line loss, capacity, energy, ancillary services, deferred transmission and distribution investment, environmental benefits, customer benefits)
- Distributed generation (DG)
  - Photovoltaic (PV) solar
  - Microturbines and reciprocating engines
  - Cogeneration/combined heat and power (CHP)
  - Fuel cells
- Demand Side Management (DSM)
  - Energy efficiency
  - Economic demand response and load shifting
  - Electric vehicles (EV)
- Distributed storage (DS)
  - Thermal storage
  - Batteries
  - Fly-wheels

#### Microgrids

- What is a microgrid?
- How microgrids work (resource technologies and microgrid control systems)
- Technical characteristics of microgrids
- Costs and value of microgrids
- Case studies – examples of existing microgrids

#### Physical integration of DER/microgrids into the grid

- Overview of bulk power system (generation and transmission) planning and operations
- Challenges and strategies for bulk grid planning and operations when integrating DER





- How DER affects bulk power system planning and operations
- Capacity planning
- Transmission design
- Day-ahead scheduling
- Real-time operations
- Tools for successful integration of DER
  - Integration of DER into markets
  - Enhanced forecasting and communication with resources
  - Enhanced flexibility in the overall system
  - Interconnection requirements
  - Distribution system planning
  - Distribution upgrades
  - Smart inverters
  - Flexibility from DER
- The role of microgrids
- Costs of integrating DER
- Measuring the value of adding DER to the system (including value-of-solar)
- A future transactive marketplace?

### **Business and regulatory challenges associated with DER and microgrids**

The regulatory paradigm and how utilities set rates and make money

- The impact of DER on load growth
- Revenue and rate impacts of DER
- The issue of how to charge for grid access and how to pay for value (net energy metering, cost shifting, integration costs, system value)
- Regulatory issues associated with microgrids
- Are utilities destined for a death spiral?
- Tools for addressing business and regulatory challenges
  - Rate structures (fixed fees, minimum charges, time-of-use)
  - Payment for DER energy (net metering, avoided cost, feed-in tariffs, time-of-use, market-based and locational prices)

- Payment for other value
- Distribution resource plans
- Resource auctions
- Utility ownership of DER

### **Transition to a new world: DER, microgrids, and future business models**

- The traditional utility-based electricity value chain
- A possible new customer-centric electricity value chain
- The fight to win the customer (utilities vs. other service providers such as Google, AT&T, Comcast, Ford, Tesla, Apple)
- Competing utility futures
  - Evolved traditional monopoly
  - Energy services utility
  - Distribution network operator (distribution system platform provider, distribution system operator)
  - Energy services integrator
- New utility business models
- The future of the energy consumer (different roles from traditional to active prosumer)
- Examples to watch (California, New York, Hawaii, Minnesota)
- Developing a vision for energy markets in the 2020s

