Current Energy Issues

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EEI-AGA Accounting Leadership Conference
June 12, 2018
Minneapolis, MN
Our Industry Vision Is Customer-Driven

Value-Focused
More Dynamic, More Secure Energy Grid
Cleaner Energy
Innovative Energy Solutions

Source: Edison Electric Institute (EEI)
In the last 10 years, electric companies have invested $881 billion to build smarter energy infrastructure and transition to even cleaner generating sources.

Source: Edison Electric Institute (EEI)
Utility functions will evolve over time as customer adoption of DER grows and the opportunity to enable the net value is created in this transition.

Stage 1: Grid Modernization
- Cost Mgmt. Services
- Information & Decision Tools
- Grid Modernization
- Aging Infrastructure Refresh

Stage 2: DER Integration
- Customer Onsite Supply & Reliability
- Related Services
- DER Integrator & Optimization
- Dist. Platform Development

Stage 3: Distributed Energy Markets
- Multi-party Transactions
- Market Operations

Source: Paul De Martini
Drivers of Distributed Energy Resource Penetration

- Reliability/Resiliency Issues
- State/Federal Policies Promoting Clean Energy
- State Net Energy Metering Policies
- Federal and State Policies Promoting Grid Modernization
- Falling solar PV Costs
The Electricity Grid is Dynamic and Becoming More Transactive
Industry Goal

Strike a balance among reliability, sustainability, and affordability

- Attain customers’ desired level of electric reliability...
- ...and society’s clean energy policy goals...
- ...at the lowest possible cost to electricity customers.

Reliability  Sustainability  Affordability

Source: Edison Electric Institute (EEI)
A Holistic Approach to Smarter Energy Infrastructure Development is Needed

Source: Edison Electric Institute (EEI)
Smarter Energy Infrastructure

**DRIVERS**

1. Customer Wants & Needs
2. Environmental Goals
3. Growth in Distributed Energy Resources
4. New Technologies

**BENEFITS**

1. Enhanced Reliability
2. Increased Resiliency
3. Reduced Carbon Emissions
4. Empowered Customers
5. Flexible & Responsive Energy Grid Platform

Source: Edison Electric Institute (EEI)
What is “Transactive Energy”? 

“Techniques for managing the generation, consumption or flow of electric power within an electric power system through the use of economic or market based constructs while considering grid reliability constraints.”

Source: GridWide Architecture Council
Drivers of Transactive Energy

- Growing presence of Distributed Energy Resources

- Grid Modernization
  - Evolving Grid Operations (e.g., AMR/AMI, microgrids, advanced communication and control technologies)
  - Increased Customer Engagement (through dynamic pricing tariffs, retail customer choice, and other programs)
  - State (and Federal) Support
Requirements of a TE System

- A TE System **Must** Provide:
  - A method for DER Services to be sold into the Grid
  - A mechanism(s) for Pricing Grid Services
  - A System for Communicating Price and other Information
  - An Efficient means of allocating Electricity and other services
  - A Suitable Set of Incentives and Delegation of Responsibilities to ensure that necessary electricity Service will Continue to be Delivered to all Customers
Transactive Energy
Three Stages of Complexity

Stage 1:
Time-of-Use
or
Real-Time Pricing

Stage 2:
Locational-Based Pricing

Stage 3:
Peer-to-Peer Transactions
Transactive Energy
Critical Issues for Utilities

- The Evolution to a Transactive Energy System presents **Four Key Issues** for Utilities to Address:
  - What will be the role of utilities in the new system
  - How will long-term system planning (capacity additions, T&D additions, etc.) be done?
  - How will distributed energy resources – and the grid itself – be valued and priced?
  - A more decentralized grid, with multiple communication interfaces, creates **increased cybersecurity risk** – how will this be managed?
Customer Solutions
## Evolving Electric Company Business Model Attributes Need a Customer Focus

<table>
<thead>
<tr>
<th>FROM</th>
<th>TO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased usage (sales)</td>
<td>Increased breadth and variety of electricity services (electrification)</td>
</tr>
<tr>
<td>Growth in assets</td>
<td>Growth in services for customers by infrastructure investment in the grid and smart technologies to give customers maximum value, choice, and flexibility</td>
</tr>
<tr>
<td>Customer classes are homogeneous</td>
<td>Customer classes are heterogeneous with an emphasis on customized solutions</td>
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</table>

Source: Edison Electric Institute (EEI)
Individualized Customer Services

Source: The Edison Foundation Institute for Electric Innovation, Thought Leaders Speak Out: Key Trends Driving Change in the Electric Power Industry, December 2015
Electric company investments in charging infrastructure amount to more than $300 million to deploy more than $22,000 EV CHARGING STATIONS.

DID YOU KNOW?

Source: Edison Electric Institute (EEI)
The electric power industry uses 90% of deployed energy storage in the U.S.

DID YOU KNOW?

Source: Edison Electric Institute (EEI)
Energy Storage: Why Now?

Energy storage can be deployed in all parts of the energy grid, and has applications in all parts of the value chain.

Enhance Electric Company Operations
- Alleviate high energy prices through time shifts
- Reduce the need for new generation

Provide Grid Support
- Regulate frequency
- Reduce spinning, non-spinning, and supplemental reserve requirements
- Voltage support
- Black start electricity restoration

Optimize Power System
- Defer transmission and distribution upgrades
- Relieve electricity congestion

Enhance Customer Experience
- Higher power quality and reliability
- Retail electric energy time shift

Source: Adapted from DOE/EPRI Handbook, EEI (graphic)
Microgrids Are Evolving and Electric Company Partnerships Are Emerging

Electric companies are currently leading and/or partnering in 30 percent of all microgrid projects.

Source Data: GTM Research
Potential Elements of a Microgrid Campus
Who Benefits from Microgrids?

- Factories
- Data Centers
- Hospitals
- Remote Sites
- Critical Loads
- Mines
- Military Bases
- Extreme Weather Events / Natural Disasters
- Targeted Facilities

Vulnerable Areas
Utility Involvement in Microgrids Projects is Growing Rapidly

Utility Involvement in U.S. Microgrid Projects

U.S. Microgrid Projects as of 2017 2Q
Legal Issues in Microgrid Development

- Ownership
- Rates and Cost Recovery
- Interconnection, Planning, and Performance
- Interaction of Retail and Wholesale Markets
- Microgrid Pilot Considerations

Source: KenKulak, Morgan Stanley)
There Is Growing Interest in Smart Community Pilots

- Ammon, ID
- Annapolis, MD
- Austin, TX
- Chattanooga, TN
- Chicago, IL
- Columbus, OH
- Greenville, SC
- Kansas City, MO
- Montgomery County, MD
- Nashville, TN
- New York, NY
- Pittsburg, PA
- Portland, OR
- San Diego, CA
- San Francisco, CA
- Washington, D.C.

Source: Edison Electric Institute (EEI)
Smart Communities Powered by Smart Connections

- Street Lighting
- Smart Buildings
- Distributed Energy Resources
- Smart Transportation
- Monitoring & Sensing
Number of EEI Member Companies Engaged in Smart Community Projects

- **Smart Street Lighting**: 27
- **Smart Transportation**: 29
- **Smart Buildings**: 11
- **Distributed Energy Resources**: 28
- **Data Analytics & Intelligent Services**: 11
Rate and Regulatory Reform Is Needed

**CHALLENGES**

1. Rapid Technology Change
2. Changing Customer Expectations
3. Slow & Inflexible Process
4. One Size Does Not Fit All

**WAYS FORWARD**

1. Informal Collaboration
2. Performance-Based Ratemaking
3. Flexible Rate Structures
4. Transparent Pricing for Grid & Energy
Data Analytics Is Important

**EARLY GAINS**

1. Enhanced Visibility Into Energy Grid
2. Predictive Energy Grid Maintenance
3. Rapid Outage Detection & Restoration
4. New Customer Services

**WHAT'S NEXT**

1. Next-Generation Energy Grid Management
2. DERs as Energy Grid Resources
3. Tailored Customer Services
4. Smart Cities

Source: Edison Electric Institute (EEI)
Smarter Energy Infrastructure Initiative

Policy Priorities

- Electric Company Ownership
- Cost Recovery & Regulatory Reform
- Making the Business Case
- Education, Outreach, and Collaboration
- Cyber Security

Source: Edison Electric Institute (EEI)
Physical and Cybersecurity
The Threat Landscape

Source: The Chertoff Group
Approach to Grid Security

Standards
- Physical
- Cyber

Industry-Government Partnership
- Electricity Subsector Coordinating Council (ESCC)
- Electricity Information Sharing & Analysis Center (E-ISAC)
- Partnerships with federal, state, & local governments

Incident Response
- Grid Resiliency
- Mutual Assistance
- Spare Equipment Programs

Source: Edison Electric Institute (EEI)
Cyber & Physical Security

- Securing and protecting our nation’s energy grid assets are top industry priorities.
- Security of the electric industry is regulated – critical energy grid assets are subject to mandatory, enforceable cyber, and physical security standards.
- Industry and government collaboration is essential. Exercises are taking place nationally and regionally to prepare for extraordinary scenarios.
- The industry is making significant investments to protect the most critical assets.

Source: Edison Electric Institute (EEI)
The Ten Biggest Blackouts in U.S. History Have Occurred within the Past 30 Years
... And Half of Them in the Past Decade

Source: Peter Marsters and Trevor Houser “America's Biggest Blackout” The Rhodium Group, October 26, 2017
Cyber Mutual Assistance (CMA)

- Industry initiative to provide cyber assistance to the electric power industry
- CMA participants include:
  - investor-owned electric companies
  - municipal/public power
  - electric cooperatives
  - RTO/ISO
  - PMA
- Participating CMA electric companies serve over 80 percent of all U.S. electricity customers
- CMA is an extension of EEI’s Mutual Assistance program

Source: Edison Electric Institute (EEI)
Generation

- Old and unreliable
- Frequent power plant outages (12 times more often than mainland U.S. averages)
- High dependency on fuel oil and lack of incentives to diversify fuel mix (less than 4% of current supply is renewables and 45% is oil)
- Principal generators located far from load centers with a poorly maintained T&D infrastructure susceptible to significant damage from hurricanes

Source: Transformation Advisory Council (TAC)
Grid Modernization – An Urgent Issues for Puerto Rico Current Challenges

Transmission and Distribution (T&D)

- T&D System is poorly designed and operated
- T&D Infrastructure has not been adequately maintained or upgraded
- Very poor vegetation management and lack of rules and enforcement policies contributing to outages, energy losses, and power quality
- Highly vulnerable to catastrophic events leading to reliability, power quality and resiliency issues

Source: Transformation Advisory Council (TAC)
Grid Modernization – An Urgent Issues for Puerto Rico Current Challenges

Customer Service

- Poor power quality leading to major customer migration
- High level of technical losses and electricity theft (17% of energy lost in FY 2016)
- Inconsistent, unreliable, and outdated IT systems for remote, reliable, and timely collections and service
- Disorganized and ineffective customer service infrastructure

Source: Transformation Advisory Council (TAC)
The TAC was established in December 2017 to provide input to rebuild and transform the Puerto Rico electric system to one that is hardened, smarter, more efficient, cleaner, less dependent on fossil fuels, and more customer focused. Its vision is an electric system that has the following attributes:

- Reliable and Resilient
- Customer – Centric
- Promotes Financial Viability
- Model of Sustainability
- Serves as an Economic Engine for Puerto Rico
Conclusion

- The integrated energy grid is the backbone of our economy. Electric companies are making investments for a modern, reliable grid to meet the growing demands of our digital society.

- Electric companies are empowering customers with more choices and control, while ensuring that our electric supply is safe, reliable, affordable, and increasingly clean.

- Regulation is evolving to ensure a diverse and resilient integrated energy grid, as well as the deployment of new technology and innovation that will benefit ALL customers.

- Grid security is a top industry priority!

Source: Edison Electric Institute (EEI)
David K. Owens is an accomplished executive with extensive experience in public policies surrounding utility operations, strategic planning, technology development, rate making and regulation.

He is recognized as one of the foremost authorities on electric utility issues, industry restructuring and transformation. His experience in the electricity sector includes leading the Edison Electric Institute’s (EEI’s) efforts over a broad set of issues that affect the future structure of the electric industry, and new rules in evolving competitive markets.

He was responsible over the strategic areas of energy supply and finance, environment, energy delivery, energy services, state regulatory issues, and international affairs. He also spearheaded efforts to enhance the public policy climate for investments in America’s electric infrastructure with emphasis on the role of new electrification technologies to address climate change, and to enhance energy efficiency through smart buildings, smart appliances, smart meters, and smart electric grids.

Mr. Owens retired from EEI in June 2017 with four decades of utility experience. He remains an advisor to EEI and serves on the Board of Xcel Energy. He also chairs the Transformation Advisory Council providing insights in the new design of the Puerto Rico electric systems.