Integrated Grid Overview, Opportunities and Challenges

EPRI Seminar: Integrated Grid Concept and Technology Development

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Our Mission…

Advancing safe, reliable, affordable and environmentally responsible electricity for society through global collaboration, thought leadership and science & technology innovation.
Three Key Aspects of EPRI

**Independent & Neutral**
Objective, scientifically based results address reliability, efficiency, affordability, health, safety and the environment

**Nonprofit**
Chartered to serve the public benefit

**Collaborative**
Bring together scientists, engineers, academic researchers, industry experts
Our Members…

- 450+ participants in more than 30 countries

- International funding of nearly 25% of EPRI’s research, development and demonstrations
The Power of Collaboration

Delivering greater value for EPRI members’ investment

- Pool resources
- Share responsibility
- Answer research questions
- Increase efficiency
- Share technical skills and expertise
The Traditional Electric Power System
The Landscape

- Most new generation connecting at grid “edge”
- The “edge” is the distribution system
- Distribution has least amount of utility visibility/control
Challenges for Utilities

- **Accommodate** disruptive innovations
- **Improve** efficiency
- **Incorporate** demand response
- **Increase** resiliency
- The list goes on...

**Distributed Energy Resources (DER)**

- Combined Heat & Power
- Demand Response
- Home Energy Management
- Rooftop Solar
- Energy Storage
- Electric Vehicles
- Large-Scale Solar
The Challenge – A Few Examples

24 by 7 Electricity

Startup Power

Voltage Quality
Interconnected but Not Integrated

Integration Enables Values of all Resources
The Power System – *Looking Forward*

**Generation Becomes More Flexible**

**Consumers Become Energy Producers**

**T & D Becomes More Controllable and Resilient**

**Loads Become More Interactive and Dynamic**

*A More Dynamic End-to-End Power System*
Vision of the Future…

The Integrated Grid

- Grid Modernization
- Communication & Standards
- Integrated Planning & Ops
- Informed Policy & Regulation
EPRI’s Integrated Grid Initiative

At EPRI.com, search for the complete number: 300200xxxx
Integrated Grid Methodology

The Integrated Grid’s benefit-cost framework contains both bulk system and distribution system elements.
Features of the Benefit-Cost Framework

- **Comprehensive**: Can include any quantifiable impacts from distribution to bulk system, with or without externalities

- **Flexible**: Designed to address a variety of economic questions from a variety of perspectives
  - Can adopt
    - a utility-planning perspective for guiding decisions, or
    - a broader societal perspective for policy implications
The economic and technical questions for the framework are not pre-configured.
EPRI’s Integrated Grid Initiative

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Capacity and Energy in the Integrated Grid

Are we becoming capacity-inefficient and capacity-scarce while becoming energy-efficient and energy-abundant?

The Capacity and Energy report describes:

- How individual resources may contribute differently to the system’s capacity to deliver energy
- How changing supply and load characteristics make it necessary to distinctly address both energy and capacity on wholesale and retail levels
- The cost of capacity, based on an assessment of cost structures of several U.S. utilities
- Emerging trends in wholesale markets and retail rate structures to value capacity and energy as distinct elements of those structures
- Key research to enable DER to provide both capacity and energy
A Week in the Life of a Solar-Powered Home

Receiving power *from* the grid

Sending power *to* the grid

Graph showing site demand (kW) with grid capacity for delivering energy to customer and grid capacity for receiving energy from customer.
Utilities have high levels of fixed cost to support capacity to supply/accept energy to/from customers.

Fixed and Variable Cost Composition of Residential Average Bill

Analysis of 10 unique utilities’ cost structures based on FERC Form 1 and EIA data.
Today, Fixed Charges Don’t Reflect Actual Costs

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Fixed Costs about 6% in this Example
Integrated Grid Success

Wide Coordination is Crucial

Standards Organization

Global R&D

Key Stakeholders

EPRI Members
Questions
Together...Shaping the Future of Electricity