Smart Grid System Report Stakeholder Webinar Series

Distributed Energy Resource Technology Webinar

- Three topics:

1. Load Served by Microgrids
2. Grid-Connected Distributed Generation (DG) and Storage
3. Grid-Responsive, Non-Generating Demand-Side Equipment

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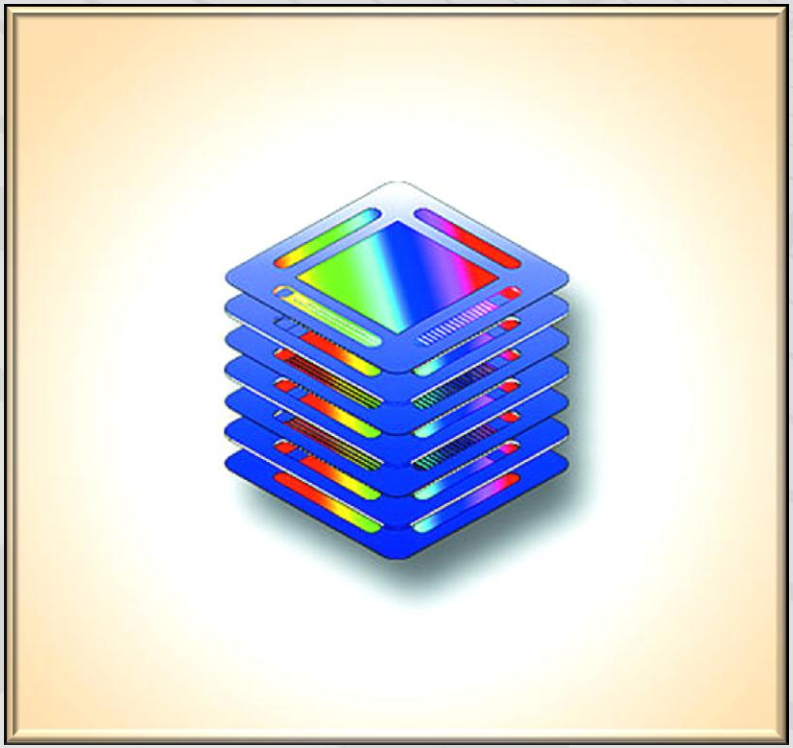
Load Served by Microgrids



Fuel Cells May Power Future Microgrids

Load Served by Microgrids

Description

- Distributed energy resources and storage devices integrated to the grid with interconnected loads
  - Operate connected to the main power grid
  - Capable of operating as an island
- Key distinctions between a microgrid and distributed generation
  - Ability to be islanded with coordinated control
  - Defined as containing more than one generating source
- One of three cornerstones of the future grid
  - Provides accessible, abundant & affordable electric power
    - Local power sources connected to regional grid
    - Manages local energy supply and demand

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Load Served by Microgrids

Description

- Microgrids may add three features to the grid
  - Efficiency
    - May use 85% of heat generated during electricity generation for local heating needs by combining heat and power
    - Central grid loses 60% of energy of thermal plants plus delivery losses (7%)
  - Matches supply and demand: security, quality, reliability
    - May reach 99.999% reliability as compared with 99.9%
  - Appears as a controlled entity on the electric system
- Currently very nascent component of smart grid
  - However, important component of future smart grid
    - Microgrid technologies likely to be pervasive
- Asset for entities with high reliability requirements

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Load Served by Microgrids

Proposed Metrics

- Current metrics
  - *(Metric 6.a) the number of microgrids in operation*
  - *(Metric 6.b) the capacity of microgrids*
  - *(Metric 6.c) the percentage of total grid summer capacity*
    - No continuous data source that matches the metrics

- How many metrics do we need?
  - Potential other metrics
    - Metrics denoting added stability?

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Load Served by Microgrids

Proposed Metrics and Issues

- What metrics are most valuable in providing a sense of progress on the smart grid?
  - Cost of implementing a microgrid
    - Currently requires a significant investment above the price of delivered electricity
- Do we need more than one? How many?
- We have separated microgrids as a sub-category of distributed generation that can be islanded and controlled?
  - Should we?

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Load Served by Microgrids

Data Sources

- Previous report
  - Resource Dynamics Corporation study
  - Navigant Consulting
  - Pike Research, quarterly summary
  - Projections from “Grid 2030,” produced by Dept of Energy
- Next report
  - MIT 2011 Study -- “The Future of the Grid”
    - One-off report
  - Other potential data sources?
  - Could there be a reporting requirement?

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Load Served by Microgrids

Stakeholders

- End users
- Distribution-service providers
- Curtailment-service providers
- Electric-service retailers
- Generation and control products and services suppliers
- Policymakers
- Policy advocates

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Load Served by Microgrids

Regional Aspects

- Regional factors should not create many obstacles
- Favorable in remote places (Alaska, Hawaii)
- Availability varies widely
  - Different designs and sizes
  - Generation options vary depending on region
    - Dependent on economic resources
- Other perspectives?

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Load Served by Microgrids

Challenges

- Technical
  - Interconnection requirements
  - Large-scale microgrids difficult to protect
  - Penetration level
  - Security
  - Power generation types
  - Power Quality
- Business and financial
  - Lost utility revenues
  - Interconnection
  - Costs of firmware and software
- Other perspectives?

Microturbine

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Grid-Connected Distributed Generation (DG) and Storage

SGSR Distributed-Energy-Resource Technology Webinar

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Grid-Connected Distributed Generation and Storage

Description

- Small-scale local power generation (10 MVA or less)
  - ICE driven generators (primarily diesel), solar cells, wind turbines, micro hydro installations, biomass, waste-to-energy, fuel cells …
    - Grid-connected at primary or secondary distribution voltages
- Includes energy storage
  - Batteries, flywheels, thermal storage, pumped hydro
- Ownership atypical compared with large centralized generators
  - Commercial, industrial, and residential
- Partially or completely offsets utility energy sent to customer
  - Sell surplus back to grid
- Actively managed generation, not back-up generation

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Grid-Connected Distributed Generation and Storage

Proposed Metrics

- Current metrics
  - *(Metric7.a) Percentage of actively-managed fossil-fired, hydrogen, and biofuels distributed generation*
    - Both MW and MWh measured as % of DG and total capacity
  - *(Metric7.b) Percentage of actively-managed batteries and flywheels, excluding transportation applications*
    - Both MW and MWh measured as % of DG and total capacity
  - *(Metric7.c) Percentage of non-dispatchable renewable generation*
    - Both MW and MWh measured as % of DG and total capacity
- All metrics exclude DG not actively managed, and backup generation

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Grid-Connected Distributed Generation and Storage

Proposed Metrics (cont'd)

- How many metrics do we need?
  - Do we need more than one? How many?
  - Potential other metrics
    - Percentage of customers supported by storage capacity
    - Percentage of customers with DG connected to the grid
- What metrics are most valuable in providing a sense of progress on the smart grid?
  - Capacity with DG?
  - Number of homes, buildings or facilities supported by DG storage?
- Distributed vs Dispersed needs to addressed?

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Grid-Connected Distributed Generation and Storage

Data Sources

- Previous report
  - DG generation, EIA
    - Electric Power Industry, Capacity of Distributed Generators…
    - Limited to commercial and industrial
  - Storage – nascent category
  - Non-dispatchable renewable energy DG not clearly distinguished
    - Listed as Wind and Other in above report
- Next report
  - Sources of “Thermal Potential” other data sources?
  - Non-dispatchable renewable energy sources??
    - Distributed vs dispersed clarification?

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Grid-Connected Distributed Generation and Storage

Stakeholders

- Distributed-generation and storage-device manufacturers
- Local, state and federal energy policymakers
- Standards organizations and their developers
- Balancing authorities
- Transmission providers
- Distribution-service providers
- End-users

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Grid-Connected Distributed Generation and Storage

Regional Aspects

- Varied regional regulations on production
  - Differing emission standards – Specific vs. Best Available Technology (BAT)
- Value and incentives for DG capacity vary
- Generation varies widely
  - Different designs and sizes
  - Resources for DG are not uniform across regions (e.g. wind, solar, hydro)
- Other perspectives?

Grid-Connected Distributed Generation and Storage

Challenges

- Technical
  - Standardization of the DG system interface with the grid
  - Operation and control of the distributed generation
    - Fault detection may be harder
    - DG tends to be removed from grid first
  - Planning and design
  - Voltage regulation, power quality
    - Some inverters can cause harmonics
    - DG can cause under/over voltage
- Short life-times, low energy density for some battery types
  - Round-trip efficiency affects cost effectiveness
- Material properties for flywheels

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Grid-Connected Distributed Generation and Storage

Challenges (cont'd)

- Business and financial
  - Expensive for utilities
    - Instrumentation and communication requirements
  - Lack of standard interconnection agreements
  - Storage value proposition needs to be made
    - Lower costs needed
    - Requires a large degree of maintenance
  - Cost/kW installed remains higher than grid-supplied base-load supply
    - Fluctuating fuel prices can make DG uneconomic
- Other perspectives?

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Grid-Responsive, Non-Generating Demand-Side Equipment

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Grid-Responsive, Non-Generating Demand-Side Equipment

Description

- Metric measures penetration of demand-side equipment that responds to the dynamic needs of the smart grid
- Includes only original equipment or simple retrofit of existing equipment
  - Doesn't need highly skilled labor
  - Includes communicating thermostats, smart appliances such as washers, dryers, refrigerators, freezers, electric water heaters, controllable wall switches, responsive space conditioning
    - Commercial, Industrial, Residential
  - Excludes advanced meters, communications gateways, equipment that generates or stores electrical energy, and equipment that requires unique engineering for its installation at an endpoint
- Dependent on signals and rates only beginning to be put in place
  - Only 8 percent of U.S. electricity customers have any form of time-based or incentive-based prices

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Grid-Responsive, Non-Generating Demand-Side Equipment

Proposed Metrics

- Current metrics
  - *(Metric 9.a) Total U.S. load capacity in each consumer category (i.e., residential, commercial, and industrial) that is actually or potentially modified by behaviors of smart, grid-responsive equipment (MW)*
  - *(Metric 9.b) Total yearly U.S. retail sales volume for purchases of smart, grid-responsive equipment ($)*

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Grid-Responsive, Non-Generating Demand-Side Equipment

Proposed Metrics

- What metrics are most valuable in providing a sense of progress on responsive appliances?
- Do we need more than one? How many?
- Do we need to separate appliances by type?
- Split devices into residential, commercial, industrial?
- Should frequency responsive devices be added?

Grid-Responsive, Non-Generating Demand-Side Equipment

Data Sources

- Previous report
  - APQC Survey of Utilities
  - Data on programmable communicating thermostats (PCT)
- Next report
  - Continue to use stimulus-funded installation numbers
  - Survey American Home Appliance Manufacturers (AHAM) for production of types and number of devices?
  - Report pilot scale numbers?
  - CleanTech data?
  - MIT 2011 Report has some information
  - Use PCT numbers only?

Grid-Responsive, Non-Generating Demand-Side Equipment

Stakeholders

- End users
- Balancing authorities, reliability coordinators
- Local, state and federal energy policymakers
- Product and service providers
- Aggregators of generation and demand
  - Curtailment Service Providers
- Utilities

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Grid-Responsive, Non-Generating Demand-Side Equipment

Regional Aspects

- Energy and demand programs driven at independent system operators or utility level
  - Energy programs are localized but equipment is manufactured at the national level
- National or international standardization required for manufacturer inclusion in appliances
- California Energy Commission could drive a standard

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Grid-Responsive, Non-Generating Demand-Side Equipment

Challenges

- Technical Challenges
  - Implementing communication interfaces
  - Memory considerations for data storage requirement
  - Software to analyze, develop and communicate price
  - Lack of a universal communication protocol to send price or emergency signals
    - Industry hasn't chosen wireless communications standard
      - Wifi, Zigbee, and Z-Wave

Grid-Responsive, Non-Generating Demand-Side Equipment

Challenges (cont'd)

- Business and Financial Challenges
  - Business case not fully proven partially because of technical challenges
  - Relatively high costs of hardware installation
  - No regulatory support to require capability
  - Lack of product availability at big box retailers