



Electricity Industry

Issues in the Implementation of Distributed Generation

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Overview

- Definition of distributed generation (DG)
- Types of DG
- Potential benefits and realizing them
- Issues in Implementation
 - Technical
 - Economic
 - Infrastructure
 - Environmental
 - Institutional and Regulatory
- Conclusion

Definition of Distributed Generation (DG)

- Modular electric generation or storage located close to the point of use
- Small generation resources interconnected at the distribution level
- “Small” defined as less than 10 MW
 - Typically, much less (25kW - 250kW)
- DG often defined as “installed on customer side of meter” but it can also be installed by distribution utility

Types of DG

Most commonly:

- Diesel generators – commercial, old technology
- Micro-turbines – commercial, new technology
- Fuel cells – limited applications, changing technology

Renewables:

- Photovoltaics – niche applications, expensive
- Wind turbines – commercial, geographic limitations
- Biomass – commercial, often sized larger
- Hydro – commercial, geographic limitations

Potential Benefits of DG

- Enhanced reliability and improved power quality
- Support for demand response
 - Reduced spot prices
 - Mitigation of market power
- Reduced environmental and human health impacts from electricity generation
- Increased fuel diversity and energy security
- Secondary economic benefits

Benefits highly dependent on type and location of DG

Realizing the Potential

- What can DG really do (or not do)?
- What do customers want?
 - And which customers want it?
- What is effect on the distribution system?
 - Can control issues associated with DG adversely affect system operations?
- Will DG deliver its promise?
 - Power quality?
 - Reliability?
 - Reduced costs?
 - Defer other generation/distribution/transmission investment?
 - Environmental benefits?

Issues in Implementation

- Technical
- Economic
- Infrastructure
- Environmental
- Institutional and Regulatory

Technical Issues

- From the customer's (DG owner) perspective
 - Interconnection requirements
 - Dispatch/operations
 - Access to market
 - Power quality
- From the utility system perspective
 - Safety
 - Reliability
 - Power quality
 - Operations

Technical Issues: Customer Perspective

- **Interconnection**
 - Technical requirements
- **Dispatch/operations**
 - Will owner/host control DG operations or will utility and/or ISO?
- **Access to market**
 - If DG owner plans to sell into grid, can it qualify?
- **Power quality (for the host customer)**
 - Effects depend on type of DG installation
 - Some technologies (e.g., fuel cells) may require accompanying use of others (e.g., storage)

Technical Issues: Utility Perspective

- **Safety**
 - Interconnection requirements
- **Reliability**
 - Impact of DG on distribution reliability depends on type, number and location of DG installations
 - May lead to increase in “failure points” requiring monitoring
- **Power quality (for other customers)**
 - Also depends on type, number and location of DG installations
 - Large numbers of DG installations may require additional system monitoring to ensure stable operations
- **Operations**
 - Who controls dispatch? Trade-off of value of DG between owner and utility

Economic Issues

- Customer perspective
 - High cost
 - Investment return requirements
 - Financing
 - Split incentives
- Distribution utility perspective
 - High cost
 - Split incentives
 - Institutional and regulatory factors
- *Also, solutions to technical issues may add to costs affecting economics of DG*

Economic Issues: Customer Perspective

- High costs compared to alternatives
 - Cost-effectiveness may depend on customer demand for power quality, reliability and/or combined heat and power (CHP)
- Higher returns required from non-core business-related investments (e.g., up to 30-40%)
- Financing hurdle
 - Out-of-pocket payment < Project Cost < Financing
- Customer does not capture system (e.g., distribution reliability) and non-monetary (e.g., environmental) benefits (externalities) of DG to offset own (internal) costs

Economic Issues: Utility Perspective

- Costs of DG higher than alternatives:
 - Capacity
 - Reliability
 - Traditional equipment for upgrading and maintaining distribution
- Split incentives: Distribution company does not capture customer and/or non-monetary benefits to offset its own costs

Infrastructure Issues

- Fuel availability
 - Determines what type of DG can be installed and where
 - Affects potential benefits (e.g., environmental) and costs
- Bulk power system and market
 - Intermittent nature of some DG technologies makes them non-dispatchable and may limit their value for system reliability and security
 - Small size (and number) of DG installations may complicate interactions with system/market operator limiting some benefits (DG may be “seen” only as reduced load)
 - Advanced metering may be required to capture some benefits

Environmental Issues

- Environmental impacts depend on DG technology
- Readily available technologies (e.g., diesel generators) have undesirable levels of noise and air emissions
- Clean technologies have limited availability and cost more
- Permitting requirements for clean DG are complicated and discouraging
- Net impacts of many DG installations v. fewer wires or larger plants

Institutional and Regulatory Issues

- **Interconnection standards and procedures**
 - Standardized and well-publicized interconnection requirements
 - Utility point of contact and business practices
 - Matched to complexity of resource from both customer and utility perspective
- **Lack of proper price signals (e.g., LMP) at retail (and wholesale?) level**
- **Rate structure issues**
 - Standby and back-up rates
 - Impacts on other (non-DG) customers
- **Utility distribution system planning practices**
 - Lack of public technical information

Conclusion

- Potential benefits of DG can be significant
- Size of typical DG makes identification of appropriate applications desirable
- Costs may be substantial
- Benefits (and costs) vary with DG type, number and location
- Capturing benefits will require addressing a number of implementation issues
- Effort to get these issues “right” is important to ensure that DG can fulfill its potential