Distributed Generation: Its Role in Virginia's Energy Future
A Briefing Paper for Distribution Resources Workshop, 17 May 2002

Prepared by

Michael Willingham
Manisa Pipattanasomporn

Alexandria Research Institute

Introduction

According to the U.S. Department of Energy (DOE), distributed generation (DG) refers to a variety of small, modular power generating technology or storage systems located at or near an electrical load.[1] From a strategic perspective, distributed generation applies to "relatively small generating units (typically less than 30 MWe) at or near consumer sites to meet specific customer needs, to support economic operation of the existing power distribution grid, or both. Reliability of service and power quality are enhanced by proximity to the customer; and efficiency is improved in on-site applications by using the heat from power generation."[2] Distributed systems include biomass-based generators, combustion turbines, concentrating solar power and photovoltaic systems, fuel cells, wind turbines, microturbines, engine and storage technologies.

Distributed power technologies provide site-specific benefits to both end-user customers and electric utilities. The U.S. Environmental Protection Agency notes that while "central power systems remain critical to the Nation's energy supply, their flexibility to adjust to changing energy needs is limited. Distributed generation, on the other hand, complements central power by: (1) providing a relatively low capital cost response to incremental increases in power demand, (2) avoiding transmission and distribution capacity upgrades by locating power where it is most needed, and (3) providing the flexibility to put surplus power back into the grid at user sites."[3] Since key determinants of the national electric energy future include utility restructuring, technology evolution, and public environmental policy, DG is poised to become an important energy option particularly for Virginia.

Virginia and Distributed Generation

Virginia has in recent years become a preferred location for high-technology firms such as telecommunications and information companies, e-businesses and electronic component manufacturing companies.[4] These technology-based industries, which have become a significant factor in the Commonwealth's growth, require both high-quantity and premium-quality electric power around the clock. Although the U.S. has the most reliable electricity system in the world with 99.9 percent reliability, "that's only good enough if you're running light bulbs and refrigerators," said Mark Wilhelm, vice president of EPRI, a Palo Alto, Calif.-based research and development company working to understand and develop new solutions for the nation's utilities. "Any industry that is computer chip-based needs 99.999999 percent reliability." At 99.9 percent, e-commerce and other IT systems are only assured of 8,751 hours of electricity supply per year out of a possible 8,760, Wilhelm added. "That's not good enough when even an interruption of one-third of a second can cause major problems or equipment damage."[5] The problem, in the words of EPRI vice president Karl Stahlkopf, is that "(t)he power system that we have today was not designed for the measures of reliability that would support a silicon-based society."[6] In the view of some market analysts, "(r)ebuilding it to do so would make it too expensive to support the economy power needed by the dominant 'dumb' appliances on the grid."[7]

What may be 'good enough' is distributed power generation, which at a minimum involves locating the power source on-site or close to the end user. The greatest market for distributed power is premium power, a $7 to $10 billion-per-year market nationally, primarily for backup power systems; this should continue to be the case in the near term. In Virginia, with more than 4,300 high-tech firms, the role and potential of distributed power assumes great importance, both in maintaining the existing infrastructure and attracting new high-tech enterprises.[8]

DG and Virginia's Power and Telecommunications Infrastructure

Generally speaking, distributed generation provides site-specific benefits to both Virginia's power and telecommunications infrastructure. From the electric utility and power reliability standpoint, incorporation of individual distributed generation systems could lessen the load on the transmission system, and thus increase system reliability. On the other hand, the implications of DG for Virginia's high-tech industries are threefold:

- *Improving industry power quality and reliability*

  Onsite distributed generation can improve both power quality and power reliability, especially when backed up with grid-based power.[9] This application requires a DG technology that can operate continuously. In an era of both increasing power outages and rising demand for premium power, many high-tech firms may install DG units to protect against the risk and cost of power outages. These industries include banks, semiconductor manufacturers, grocery stores, hospitals and many other industrial and commercial market sites.

- *Permitting industry to generate power while serving thermal and cooling loads*

  In the process of converting fuel into electricity, a large amount of heat is created. Firms can utilize this heat if a power generation system is located on-site or near their facility. In virtually all high-tech industries, cooling systems play a crucial role in their business operations. Thus, by using CHP, firms can increase efficiency for power generation by as much as 85% while simultaneously lowering greenhouse gas emissions. Moreover, firms can also reduce power costs since their cooling load is basically served by CHP.

- *Providing a power solution for the Commonwealth's ozone non-attainment areas*

  Many renewable technologies and fuel cells have very low emissions. With the addition of emission-reducing technologies, microturbines and mini-turbines also emit low levels of regulated gases. This could be a strong incentive that will facilitate the use of DG in the Commonwealth's ozone non-attainment areas.

Benefits of Distributed Resources

There are two basic avenues that high-tech firms and other organizations with extremely reliable energy needs can pursue.[10] In order to satisfy reliability criteria, some firms may look to a combination of delivered electricity supplemented by in-house control, 'cleanup' and emergency backup. Others may seek to divorce themselves more distinctly from the grid, and rely primarily on premium in-house power with the capability of selling power back to the grid when it proves profitable. Still a third group could (in theory) locate in premium power 'park', essentially off-grid but with power provided by a captive generator. As stated in a recent article in the MIT *Technology Review*, "(m)anufacturers, banks, telecommunications providers — just about any company that depends on computers or digital equipment such as Web servers and routers—need premium power. And the only sure way to get it, energy experts agree, is to generate it yourself."[11] However, there appears to be some latitude in what 'yourself' actually means in terms of physical infrastructure.

Diesel-powered backup electricity, which cost two to three times as much as grid-based power, may be affordable for large companies but not always feasible for smaller businesses, and also may be limited in time of use. For new companies proposing to rely on diesel backup systems, air quality regulations could affect either capital costs of construction, siting criteria, and any ability to sell power back to the grid, particularly if they choose to locate in or near ozone non-attainment areas. The growth of fuel cell technology for premium power will provide an environmentally acceptable alternative, and already has been employed in some high reliability facilities. For example, the First National Bank of Omaha recently installed a fuel-cell system with 'six 9s' reliability, which exceeds the reliability of the bank's computer system, citing the "critical difference over existing power arrangements that will substantially increase our computer uptime."[12]

Distributed power resources have the capacity to serve more than a specific end user. For some distributed facilities with sufficient generation capacity, power sold back to the grid also can reduce stress on regional transmission and distribution systems, and thereby increase overall system reliability. In a similar manner, these facilities might be employed when economic signals allow the owner-operator to sell power at a profit (although demand-side reduction programs may also be employed to the same end). However, in the case of diesel-based distributed power, this is subject to applicable air quality regulations.

Outstanding Issues and Questions

Although distributed generation may represent a viable long-term strategy in Virginia, it still has significant barriers to overcome. A recent DOE study of interconnection barriers provides a preliminary checklist for identifying and ranking those barriers of greatest import for Virginia legislators:[13]

- A variety of technical, business practice, and regulatory barriers discourage interconnection in the US domestic market.
- These barriers sometimes prevent distributed generation projects from being developed.

- The barriers exist for all distributed-generation technologies and in all regions of the country.
- Lengthy approval processes, project-specific equipment requirements, or high standard fees are particularly severe for smaller distributed generation projects.
- Many barriers in today's marketplace occur because utilities have not previously dealt with small-project or customer-generator interconnection requests.
- There is no national consensus on technical standards for connecting equipment, necessary insurance, reasonable charges for activities related to connection, or agreement on appropriate charges or payments for distributed generation.
- Utilities often have the flexibility to remove or lessen barriers.
- Distributed generation project proponents faced with technical requirements, fees, or other burdensome barriers are often able to get those barriers removed or lessened by protesting to the utility, to the utility's regulatory agency, or to other public agencies. However, this usually requires considerable time, effort, and resources.
- Official judicial or regulatory appeals were often seen as too costly for relatively small-scale distributed generation projects.
- Distributed generation project proponents frequently felt that existing rules did not give them appropriate credit for the contributions they make to meeting power demand, reducing transmission losses, or improving environmental quality.

---

[1] See US DOE website: www.eren.doe.gov/distributedpower

[2] See US DOE Distributed Power web site: http://www.fe.doe.gov/coal_power/distributed_power.html

[3] See US DOE Distributed Power web site: http://www.fe.doe.gov/coal_power/distributed_power.html

[4] "*Improving Virginia's Attractiveness for High-Technology Industries*", prepared by S. Rahman and J. Bigger for Virginia's Center for Innovative Technology (CIT), September 2001.

[5] "*E-Commerce Short On Juice*", June 26, 2000, by Theo Mullen, InternetWeek.

[6] "*High-Tech Companies Examine Energy Shortage*" by The Associated Press, Special to CNET News.com June 10, 2000

[7] "*The Power Report*", by Peter Huber and Mark Mills, published by GilderGroup, Inaugural Issue, September 1999

[8] Technology in Virginia's Regions, May 2000

[9] See www.distributed-generation.com

[10] These include computers, communications equipment, and semiconductors manufacturing sectors.

[11] "*Power to the People*", Technology Review, May 2001

[12] "*Fuel-Cell Power System Gets Real-World Test*", by Ron Wilson, EE Times;
see web site: http://www.eet.com/story/OEG19990604S0017

[13] "*Making Connections: Case Studies of Interconnection Barriers and their Impact on Distributed Power Projects*", NREL/SR-200-28053, Contract No. DE-AC36-99-GO10337, May 2000

Reference Materials on Distributed Generation

Following is a reference list of documents pertaining to various aspects of distributed generation, along with the Internet web site locations from which they can be either viewed or downloaded. The list is meant to be informative but not exhaustive - MW

1. *Strategies For Preserving Our National Security: US Infrastructure Assurance Strategic Roadmaps*, August 1998, Sandia National Laboratories. Sponsored by President's Commission on Critical Infrastructure Protection, US Department of Energy, and US Army Medical Research and Materiel Command
http://www.prod.sandia.gov/cgi-bin/techlib/access-control.pl/1998/981496.pdf

2. *The Role of the Federal Government in Distributed Energy - A Report of the Distributed Energy Task Force*, January, 2002, A Project of the Center for the Advancement of Energy Markets (CAEM)
http://www.caem.org/

3. *Strategic Plan for Distributed Energy Resources*, Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy, September 2000
http://www.eren.doe.gov/der/pdfs/derplanfinal.pdf

4. *Making Connections: Case Studies of Interconnection Barriers and their Impact on Distributed Power Projects*, May 2000 - NREL/SR-200-28053
http://www.nrel.gov/docs/fy00osti/28053.pdf

5. *Efficient Reliability: The Critical Role Of Demand-Side Resources In Power Systems And Markets*, prepared by the Regulatory Assistance Project for the National Association of Regulatory Utility Commissioners, June, 2001
http://www.naruc.org/5.7g.pdf

6. *Distributed Resources And Electric System Reliability*, by The Regulatory Assistance Project, September 2001
See http://www.rapmaine.org/DPReliabilityCaseStudies.pdf

7. *Reliability Assessment 2001–2010: The Reliability of Bulk Electric Systems in North America*, North American Electric Reliability Council, October 16, 2001
http://www.nerc.com/~filez/rasreports.html

8. *Maintaining Reliability in a Competitive U.S. Electricity Industry: Final Report of the Task Force on Electric System Reliability*. September 29, 1998, Secretary of Energy Advisory Board, U.S. Department of Energy
http://www.hr.doe.gov/seab/ESRFINAL.pdf

9. *Impact of Restructuring on Distributed Resources Development*, by The Regulatory Assistance Project
http://www.distributed-generation.com/Library/wayne_shirley.pdf

10. *Edison Electric Institute Distributed Resources Task Force Interconnection Study,* by the Interconnection Working Group, June 2000
http://www.eei.org/edg/dist/state_reg/EEI_DRTF_Interconnection_Study.pdf

11. *The Benefits of Distributed Resources to Local Governments: An Introduction (Draft),* Prepared for National Renewable Energy Laboratory by Clean Power Research, September 2000
http://www.clean-power.com/research/distributedgeneration/DGandLocalGoverments.pdf

12. *White Paper on Distributed Generation,* National Rural Electric Cooperative Association (NRECA)
http://www.nreca.org/leg_reg/DGWhitepaper.pdf

13. *Distributed Generation: Policy Framework for Regulators*, White paper prepared by Arthur D. Little, Cambridge, MA, 1999
http://www.eren.doe.gov/distributedpower/pdfs/ADL_DG_policy.pdf

14. *Distributed Generation: Understanding the Economics*, White paper prepared by Arthur D. Little, Cambridge, MA, 1999
http://www.eren.doe.gov/distributedpower/pdfs/ADL_DG_econ.pdf

15. *Environmental Benefits of Distributed Generation (Draft Report),* The Regulatory Assistance Project, Distributed Resources Emissions Working Group
http://www.rapmaine.org/workgroup.html

16. *Statement of Objectives, General Principles, and Scope Regarding Proposed Rules and Standards For the Regulation of Air Emissions From Distributed Resources* The Regulatory Assistance Project - Distributed Resources Emissions Collaborative April 30, 2001
http://www.rapmaine.org/workgroup.html

17. *Advanced Microturbine Systems Program Fact Sheet*, February 2001
http://www.eren.doe.gov/der/microturbines/pdfs/mtfactsheet.pdf

18. *Advanced Reciprocating Engine Systems Program Fact Sheet*, February 2001
http://www.eren.doe.gov/der/gas_fired/pdfs/reciprocating.pdf

19. *Combined Heat and Power Program Fact Sheet*, February 2001
http://www.eren.doe.gov/der/chp/pdfs/chpfact.pdf

20. *Increasing Power Reliability via Distributed Generation*, Presented at Power Quality 2000 on October 5, 2000, by E. J. Honton
http://www.distributed-generation.com/Library/Reliability.pdf