Distributed Generation

SOLAR POWER IN SAN ANTONIO, TEXAS

A SOLAR SAN ANTONIO FACT SHEET

NOVEMBER 1, 2008

Special points of interest:

- *On-site production of electricity is estimated to result in cost savings in transmission and distribution of about 30% of total electrical energy costs.*
- *53% of Denmark's electric power is now from distributed generation.*

Inside this issue:

What Is Distributed Generation?

Solar panels on individual houses and businesses are an example of "distributed generation," or DG, but what exactly is meant by this term?

DG refers to the production of electricity from local, small, energy sources as opposed to distant, large, centralized power plants. More specifically, the EPA defines distributed generation as "small, modular, decentralized, grid-connected or off-grid energy systems located in or near the place where energy is used."

In terms of power generation, "small" is typically applied to a power generator with a capacity of about 5 megawatts or less.

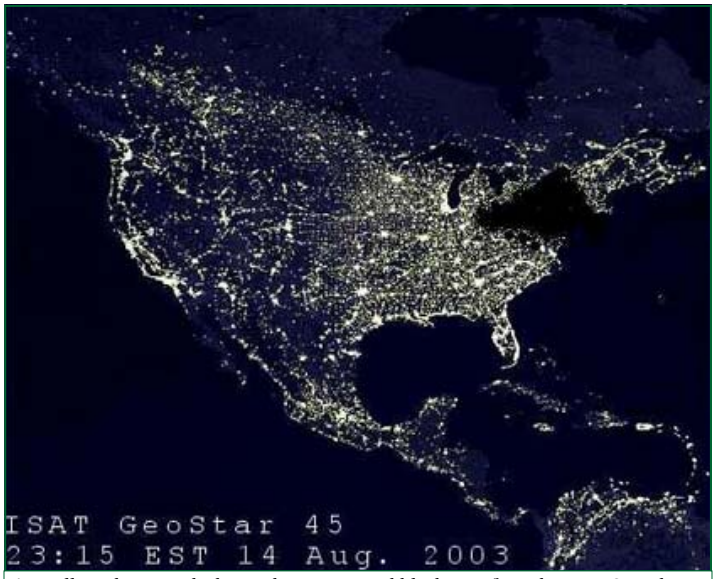
Photovoltaics, small-scale wind power, micro-hydro, fuel cells, combined heat and power (CHP), and anaerobic digesters are all examples of DG technologies.

Why the Interest in Distributed Generation?

Americans have become more aware of the vulnerability of infrastructure to failure and terrorism due to events like the 2003 North American blackout and the attack on the World Trade Center and Pentagon in 2001. Distributed energy is now viewed as a less vulnerable and more viable strategy for the future because of its:

- diversification of energy sources,
- increased reliability of the grid network,
- minimized transmission power losses,
- configurability to meet peak power needs,
- potential for premium power, when coupled with uninterruptible power supply (UPS),
- installation in small increments to match load requirements,
- cost-effective alternative to grid expansion in some circumstances, and
- reduced costs for transmission and distribution infrastructure.

On-site production of electricity is estimated to result in cost savings in transmission and distribution of about 30% of total electrical energy costs. With the current emphasis on energy efficiency, it is important to note that the share of transmission and distribution costs in the electricity bill increases as the customer demand decreases.



A satellite photograph shows the power grid blackout of northeast U.S. and parts of Canada on August 14, 2003 - t he largest in North American history - with nearly 10 million people in lower Canada and 40 million people in eight U.S. states without power for hours and even days.

Challenges to Large-Scale Distributed Generation

Distributed generation (DG) does not fit neatly into the categories that utility managers use to describe power generators:

- baseload,
- load-following, and
- peaker generators.

In addition, it is important to utility managers that a power source be "dispatchable," i.e., that it can quickly generate more or less power on demand in order to meet the power requirements on the grid.

Baseload generators provide power constantly at an even level. Coal and nuclear plants are commonly used as baseload generators. Examples of renewable sources of baseload power are geothermal and hydro which can be distributed sources in some parts of the country. Solar and wind power generation (without storage) are considered "intermittent" sources of power with solar available less than 50% of the time and wind less than 30%.

Photovoltaics can be *load-following* generators because they often will track anticipated changes in power demand over the course of a day. But, the amount of solar power generated will vary from day to day throughout the year.

A *peaker* plant is needed to responds rapidly to changes in power demand that baseload and load-following plants do not; often within less than a minute. Natural gas turbine are often used in this role.

Keynote Speaker Jeremy Rifkin at the CPS Energy Summit, June 4, 2008

One Strategy: "Off the Grid"

One way to reduce grid management problems is to have buildings totally self-sufficient as far as electric power is concerned, i.e., "off the grid."

USA Today reported in 2006 that there were "some 180,000 families living off-grid, a figure that has jumped 33% a year for a decade."

But relying on solar power to be totally self-sufficient in the normal U.S. lifestyle today requires energy storage for round-the-clock power. This adds to the cost and inefficiency of the system

Since not everyone uses the maximum amount of electric power at the same time, less generating capacity will have to be built if buildings could share power in some way.

Because of this increased cost, many building owners choose to remain connected to the grid even though the electrical standard IEEE 1547 dictates that the solar system be disconnected in the event of a grid failure.

"Because distributed generation is targeted to the very specific energy requirements of the end user, it is less costly and a more efficient way to provide additional power than is relying on a centralized power source."

Jeremy Rifkin
"The Dawn of the Hydrogen Economy"
2003

Microgrids: An Alternative Strategy

"Microgrids" are smaller power grids consisting of loads and distributed energy sources on a feeder which can be connected or disconnected to the main grid. These appear to address many of the challenges of DG. A microgrid can operate like a single, dispatchable source of power with respect to the main grid. To do this, technology has been developed to allow the microgrid to connect and disconnect seamlessly from the main grid and continue to provide quality power to loads on the microgrid when disconnected - in "island" mode - from the main grid. Early versions of microgrids have existed on campuses and military bases for some time, but efforts today are focused on more versatile forms of microgrids.

Smart Grids: Another Strategy

"Smart Grids" use digital two-way communications and advanced components to distribute grid management tasks including targeted demand reduction and numerous small generators, such as rooftop solar panels. A smart grid is sometimes called an "energy internet."

Smart grids make better use of existing resources and thereby reduce energy consumption while increasing grid reliability.

Smart grids are specifically supported by the Energy Independence and Security Act of 2007.

Distributed Generation in Texas

The Texas' Public Utility Regulatory Act (PURA) of 1999 established that "A customer is entitled to have access… to on-site distributed generation…"

The Public Utilities Commission of Texas (PUCT) is on record encouraging the use of distributed generation and has created a technical manual for use within the State of Texas. It is available at the PUCT website.

Texas' policies on interconnections to the grid and net metering are still evolving. CPS Energy and Austin Energy both offer these programs.

Austin has been working on a smart grid since 2003, and it has recently announced the Pecan Street Project. Likewise, CPS Energy is laying the groundwork for a smart grid.

In November 2007, the State Energy Conservation Office established a micro-grid consisting of a biodiesel generator, solar panel, and energy storage to provide temporary power for 12 homes at La Presa, a *colonia* near Laredo. This microgrid is being expanded

Houston's Mayor White has assembled a Task Force on Electric Reliability to advance the local grid to include distributed generation.

SECO microgrid in La Presa colonia near Laredo

"…properly considering the economic benefits of "distributed" (decentralized) electrical resources typically raises their value by a large factor, often approximately tenfold…"

Amory Lovins, et al. Small Is Profitable 2002

Other Examples of Existing Distributed Generation

Some European countries are leading in the use of renewable, distributed generation. Renewable energy now provides 53% of Denmark's electric power, 38% of Netherlands', and 36% of Finland's. Specific locales do even better: the Navarra region of Spain generates 70% of its electricity from wind and solar while the Danish island of Samsø is a net exporter of renewable energy.

Large-scale distributed solar installations include the Premier Gardens single-family subdivision in Rancho Cordova, CA. This subdivision of 95 houses includes 2.2 kW of solar photovoltaics in every house as a standard feature.

The Pal Town Josai-no-Mori subdivision in Ota, Gunma, Japan, outfitted 553 houses with at total of 2.16 megawatts of solar photovotaic capacity.

Duke Energy Carolinas proposed a $50 million plan to place solar panels on hundreds of North Carolina rooftops including homes, schools, stores and factories to generate 10 megawatts.

Boulder, CO, has announced that it intends to be the first U.S. Smart Grid City.

The Telegestore installation in Italy, however, remains the largest example of a smart grid. Smart meters started being installed in 2001. By 2006, nearly 30 million smart meters were installed and the system was growing at an average of 20,000 meters per day. Originally used for remote meter reading and demand management, bidirectional meters allowed for distributed generation in 2006.

Premier Gardens solar development in Sacramento, CA

Some Suggested Sources for Further Information

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- David Engle, "Microgrids Up and Running," *Distributed Energy*, May-June 2008
- Thomas E. Hoff, "The Benefits of Distributed Resources to Local Governments: An Introduction," prepared for U.S. DOE National Renewable Energy Laboratory, Clean Power Research, (draft) September 12, 2000
- Keiichi Komoto, *Community-Scale Solar Photovoltaics: Housing and Public Development Examples*, Mizuho Information & Research Institute for the International Energy Agency, March 2008
- A. B. Lovins, K.E. Data, T. Feiler, K.R. Rabago, J.N. Swisher, A. Lehman, *Small Is Profitable*, Rocky Mountain Institute, 2003
- National Renewable Energy Laboratory, "Distributed Generation," DOE/GO-10098-657, September 1999
- K. Purchala, R. Belmans, L. Exarchakos, A. D. Hawkes, "Distributed Generation and the Grid Integration Issues," http://www.eusustel.be/public/documents_publ/WP/WP3/WP%203.4.1%20Distributed%20generation%20and%20grid%20integration%20issues.pdf

A SOLAR SAN ANTONIO
FACT SHEET

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Lessons for San Antonio

San Antonio is on its way to a greater role for distributed generation and smart grids. For example, CPS Energy now provides rebates to homeowners and businesses for photovoltaic installations and provides a net metering program to compensate those who put electric power on the grid.

Smart meters are one of the earliest signs of a conversion to a smart grid. CPS Energy has initiated the installation of advanced electric and gas meters allowing two-way communications with the customer.

While CPS Energy has not articulated a goal for distributed energy, *per se*, it does have goal of 15% of peak power from renewable energy by 2015 and 20% by 2020. It is also working on getting 100 megawatts of power from solar or non-wind renewable in the next few years.

The smart meter technology will likely play a bigger role in managing demand before smart grid technologies are needed to manage distributed generation issues like intermittency, dispatchability and storage.

As CPS Energy looks to long-range options for the provision of electric power, distributed generation may be critical in the switch to renewable energy sources.

Pal Town Josai-no-Mori in Ota, Gunma, Japan, is one of the world's largest residential clustered photovoltaic (PV) systems. At completion, the project will include 553 houses with individual 2.6 to 5.0 kW solar systems for a total capacity of 2.16 megawatts. The microgrid shares power among the buildings, controls excess power generation by storing power (when not needed by the grid) in a battery system, and permits island operation separate from the grid when safe to do so. The solar systems were paid for by Japan's New Energy and Industrial Technology Development Organization (NEDO) and will be owned by NEDO until the end of the demonstration.