

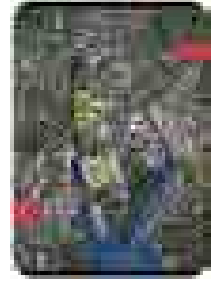
## Taking Control of the Power Grid

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*Tipping points for disruptive electric power innovations*

In the last 50 years, the U.S. electric power industry has seen few changes in technology and virtually no improvement in delivered efficiency. Increasing returns to scale that made continual expansion of the central power grid worthwhile do not pertain any longer. Even if new investment in huge generating plants and transmission lines made economic sense, local aversion to air emissions, water pollution, and land use as well as global concern about climate change make expansion of the central power grid environmentally untenable.

Assuming that the power grid could overcome economic and environmental barriers to expansion, American high-tech companies have lost faith in its ability to deliver the power needed for digital-age commerce. The 2006 SteelEye Technology Business Continuity Index suggests that almost half of American IT companies identify power outages as likely to have a maximum impact on their businesses. By comparison, just 1% of American businesses surveyed by SteelEye designated terrorism as a concern for IT downtime.



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In digitally inclined businesses, even a few seconds of fluctuating power can wreak real economic havoc. A recent U.S. Department of Energy survey found that a particular brokerage operation lost \$6.8 million for each hour of power outage. Hewlett-Packard reported that a 20-minute outage at a circuit-fabrication plant would result in a production loss of \$30 million. The costs when a hospital or an assisted living facility loses power or experiences poor power quality have a very human face.

Decreasing returns to scale, public aversion to further environmental damage, loss of corporate faith in the system ... all suggest that the time may be ripe for the rapid adoption of smaller, decentralized and more efficient electric power technologies. Electric power may be poised to follow similar technology trends towards smaller local units that occurred in computing and telecommunications over the last 20 years. It is worth considering, therefore, the kinds of conditions that will trigger a tipping

point for similar disruptive innovations in electric power.

### Microgrids

As shown in the graphic, a prototypical local community microgram could be constructed by installing and linking locally operated, cheaper, and cleaner-running generators located at or near their point of use. Such a microgrid could be made more economically and environmentally viable than a central power grid expansion by:



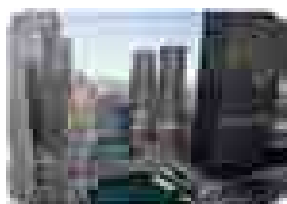
*The EID idea is*

- providing reliable power at premium rates to high tech companies wanting to avoid losses due to power outages or surges;
- making use of generator waste heat in a district energy organization to distribute heating and cooling services to both reliability and regular customers; and
- avoiding the use of transmission and distribution wires that can be easily knocked down by Mother Nature or human mischief.

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A microgrid takes the peak loads of reliability customers off the central grid, thereby making improving its performance for all customers.

## Tipping Point Theory



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Much literature has been written about the adoption of disruptive technologies, especially the so-called tipping point phenomenon whereby—like the proverbial straw that broke the camel’s back—some relatively small event or incident seems to trigger the widespread adoption of a new technology. The literature points to three developments that characterize the arrival at a tipping point.

First, an innovative, disruptive technology will often be available at seemingly cost-effective rates for many years before the tipping point for adoption is triggered by an incident or event. For example, cost-effective microcomputers were available for many years before the widespread adoption of the IBM PC. In the case of microgrids, selected communities in Europe and university and military campuses in the United States have implemented community power systems similar to the one outlined above with good economic returns. Nevertheless, microgrids cannot be described

as having arrived at a tipping point of mainstream adoption.

The breakdown of a distribution system at a particular place and time may have such dramatic consequences so as to trigger a tipping point, however. For example the impact on microgrid adoption of distribution system breakdowns in many places during this summer’s heat wave remains to be seen.

Second, disruptive innovations often need so called “complementor” technologies to trigger the tipping point. The Lotus 1-2-3 spreadsheet and WordStar word processing programs may be described as complementors to the IBM PC. As for the microgrid, Richard Munson’s new book, *From Edison to Enron*, describes enabling technologies and the promise of microgrids:

“... a growing number of engineers argue that the August 2003 power cascade should provoke a dramatically new approach to delivering electricity. They draw a comparison to computers and their evolution from centralized mainframes of the 1960s to today’s decentralized web of networked laptops. These engineers foresee a radical new power network—one that’s adaptive, self-healing, and compatible with distributed on-site energy sources. It would have sophisticated sensors to anticipate crises, electronic circuits to redirect wayward currents and a computerized “brain” to power down non-critical electricity loads when the system is nearing its capacity. One innovation, the microgrid, already links small generators and sophisticated software based on neural networks can increase power quality and reduce the risks of overloads.”

Third, disruptive technologies are often more expensive than the technology they aim to replace. In terms of cost per unit of CPU, for example, timesharing on a mainframe was much less costly for most businesses than purchasing an IBM PC. Ironically, many purveyors of microgrid technologies ignore the convenience value of microgrids and try to compete by providing power at rates below grid prices, per se. They do not realize the potential of earning premium rates by marketing microgrids as a means of avoiding losses due to poor grid power quality, eliminating the need for back up generators and power conditioning equipment, and overall providing a system more in tune with the economic development and environmental disposition of the community.

## Energy Improvement Districts

In the 1980s, concerned businesses organized themselves in business improvement districts (BID) to focus on downtown development strategies that stood in sharp contrast to the common municipal planning of the day. Most BIDs agreed to hire private clean-up and security crews that made noteworthy progress keeping streets, corners, and gutters clean, as well as offering directions and a sense of security to areas like New York City's Times Square, Philadelphia's Center City, and DC's K Street business corridor. There are now more than 2,000 BIDs in 42 states across the country.



*Central power and a microgrid can be paired to serve commercial and residential demand.*

That same concept can also be applied to the nation's commercial energy crisis by creating energy improvement districts (EID) that combine the tax advantages of business improvement districts with the regulatory benefits of publicly owned power. Functionally, EIDs achieve four main objectives:

- Control and install power locally and tailor it to specific timing and uses
- Invest in energy savings and micro generators to mitigate commercial power costs
- Take optimal advantage of combined heat and power using microgrids
- Create electric reliability insurance that covers product loss and business interruption from power outages, surges, and other disruptions.

Like business improvement districts that sparked a renaissance in several major cities, the EID impetus must come from real estate developers, property owners, merchants, downtown associations, and from within local governments that demand a way to examine a new approach to finding the most cost-effective means of powering the heat, lights, and modern electronics of core city businesses.

This idea is already being tested by the United States Conference of Mayors in Stamford (CT), Las Vegas, Chicago, and some 20 other cities across the country and Latin America that need additional power to accelerate several pending development projects. In each instance, a new smaller electric power distribution system is being created and operated by taxes generated by those businesses enrolled in the district.

## The Galvin Electricity Initiative

According to its website, the Galvin Electricity Initiative seeks to create an actionable blueprint

for transforming the U.S. electricity supply and service infrastructure into a resilient and adaptable system that can perfectly meet the needs of the rapidly evolving digital economy. The initiative is a privately funded enterprise sponsored by the Galvin Project, Inc., which is led by Bob Galvin, former CEO of Motorola and a key figure in establishing the internationally recognized "Six Sigma" quality control process. The fundamental principle of this initiative is that raising the quality of the nation's electricity supply system will create substantial cost savings for all consumers and society at large.

## **The GridWise Alliance**

According to its web site, the GridWise Alliance is a consortium of public and private stakeholders who have joined together in a collaborative effort to provide real-world technology solutions to support the U.S. Department of Energy's vision of a transformed national electric system. An electric system that will employ new distributed 'plug and play' technologies using advanced telecommunications, information and control approaches to create a society of devices that functions as an integrated transactive system."

## **Conclusion**

The three conditions that normally characterize a tipping point for innovative technology seem to prevail for microgrids. First, the cogeneration technology underlying the microgrid has been available for many years. Second, exciting "complementor" technology such as digital controllers have become available. And third, led by groups such as the US Conference of Mayors, The Galvin Initiative, and the GridWise Alliance, the industry awaits the small "incident" that will trigger a tipping point for micro grids. Chronic neglect of the central power grid and the widespread power disruptions this summer seem to be the harbingers for a tipping point to arrive.

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