

# Plugging Into Hidden Capacity & Networking Distributed Generation with the Virtual Power Plant™



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The combination of four massive forces – technology innovation, electricity deregulation, e-commerce, and customer value – are beginning to converge and thereby transform the traditional power industry into a truly customer focused business. Most of Wall Street and the mass business press has focused analysis on the ability of utilities to create sustained competitive advantage for investors, customers, and all other stakeholders. Much has been written about utilities deciding their core competencies, seeking merger or acquisition candidates, launching non-regulated service subsidiaries, selling off non-core assets, investing in foreign markets being privatized, and becoming more eco-friendly. While a clear understanding of these industry fundamentals remains necessary, a less publicized paradigm shift has been driven by these same four forces - it's called distributed generation (DG) - and it's gaining momentum at an increasing rate. Our view is that a Virtual Power Plant™ solution could unleash the DG value proposition, and therefore deserves discussion as utilities and energy service companies jockey for position.

DG is essentially the production and/or storage of both electrical and thermal energy by small resources located on-site, where the energy is consumed. Although a full treatment of DG is well beyond the scope of this writing, DG owes much of its interest to emerging power technologies such as fuel cells, microturbines, flywheels, superconductors, and ultracapacitors. Such technologies could transform power in a manner similar to the impact that the PC had on the once mainframe-dominated computing business. However, DG has not yet made it onto most investor radar screens because core technology commercialization, business infrastructure, and deregulation are still formidable risk factors. The recent and successful IPO of Plug Power has spurred Wall Street's interest in the DG market, with several investment banks now beginning to cover DG in their research reports.

Indeed, DG holds great promise to herald in a much-awaited brave new world where the electron, BTU, and the internet converge in your basement, office building, or car. In our view, the great promise of DG is best kept if it is integrated with, and supplemental to the grid where it can provide the most value: in small increments, at the marginal cost for production and delivery of capacity, energy and/or ancillary services. Just as in the case of other big industries that have deregulated such as telecom, gas, and railroads, the fundamentals of the power industry will not change over night. With a market size of over \$200B in the US alone and relatively little innovation seen in the power industry since Thomas Edison, we are at least several years away from a cost-effective, mass-customized, and networked energy appliance you can buy at Home Depot and “plug n’ play.”

Meanwhile, DG is quietly being enabled by an old friend – the internal combustion engine, and a new one – the internet. Traditional, proven and cost-effective power stalwarts such as the diesel engine-generator

may not hold the intrigue of a pure-play dot.com start-up to investors, but a well executed “clicks and mortar” DG strategy that follows herein could become an unsung enabler for the DG market. Indeed, the elusive “killer app” for DG could be in its practical application as a Virtual Power Plant™, to reduce a problem that’s been with us since Edison’s time: the ability of a utility to produce and deliver enough power during periods of peak customer demand. Electrons are most cost effective when made in huge quantities, owing to economies of scale benefits. Unfortunately, electrons are not easy to store, and they tend to behave according to the laws of physics better than the laws of supply and demand economics. As a result, capacity utilization is abysmal, and it takes on average 10-15% of total annual utility resources in order to meet peak demands that last only 2-3% of the year. New capacity is “lumpy” - not well matched to fit the increased demand spread throughout the grid in far smaller pieces. Even if the peak capacity can be made or purchased in the wholesale market, it often becomes congested on highly loaded distribution networks and can’t be sent to where it’s needed most. The change agents which will continue to build momentum for the fledgling DG market are the same drivers that frame the age-old peak capacity problem. Those change agents include power quality, reliability, demand growth, the environment, and competition.

In last year’s Utilities & Perspectives Newsletter, we wrote in detail about how utilities could boost their power during times of peak energy demand without needing to build new generation, transmission, or distribution capacity, as well as forgoing the need to procure hundreds of megawatt’s of rental power or wholesale power. Unfortunately, history repeated itself again – old practices really are hard to change. *ENCORP*, Inc. continues to both lead the development and marketing of enabling technology tools and services that attack the peaking problem head on, while concurrently working with the entire range of emerging DG technology for broad-based use. The model is deceptively simple: first attack a big and old problem with least-cost and proven solutions, then leverage the first-to-market position and ramp up the longer-term market potential as the emerging DG technologies mature along their unique commercial growth trajectories.

The most alarming of many highly publicized power outages occurred last summer in the bustling downtown business districts and residential neighborhoods of both Chicago and New York City. These outages raised several concerns because one of them didn’t even happen during a heat wave, when most large and sustained outages strike. Instead, the crippling outage took place in Chicago on a day when temperatures were moderate. Reports now indicate the problem was due to inadequately maintained electrical cables and overall mismanagement, not inadequate generation capacity.

The 1999 summertime outages sound a loud ‘call-to-action’ to electric utilities – especially those serving major metropolitan areas across the country: It’s time to look at new options in order to keep the lights on

year round. Introduced in late 1996 by *ENCORP*, the Virtual Power Plant™ is helping utilities such as Tennessee Valley Authority, Public Service of New Mexico, Carolina Power & Light, and more than a dozen other large utilities in order to supply additional power upon the first sign of trouble. Like a simple network of personal computers, the Virtual Power Plant™ links together seldom-used standby and emergency generators at hospitals, universities, manufacturers, office towers, and other end-users which thereby allows utilities to draw additional power from these on-site sources as needed.

It's a win for everyone: First, the end-user receives a financial incentive typically in the form of a rebate or an interruptible rate, as well as the assurance of reliable emergency power because often such systems are not exercised under full load as would be the case in an emergency. Second, regulators are happy because the utility has met the peak demand and maintained required capacity reserve margins. Third, investors are pleased because the financial risk of building potentially stranded transmission and distribution assets in order to serve short-lived peaks (comprises only 75-250 hours/year on average) has been minimized. Fourth, utilities have demonstrated confidence by serving their customer's increasingly demanding power reliability needs.

Here's a brief comparison of the typical costs, installation time, and other factors to consider when contemplating a Virtual Power Plant™ peak capacity solution, versus traditional utility convention and practice:

- Cost: The all-in retrofit/upgrade package is approximately \$100/kW, versus at least \$600/kW for delivered peak capacity.
- Market Size: The available retrofit market is an installed base of 60,000MW diesel and gas generators that are not grid connected, which translates to several hundred megawatts within each US metropolitan area.
- Time to market: A few months from concept to start-up versus at least 1 year. Moreover, traditional peaking plant projects require siting and permitting approval, which can take a year or more.
- Interconnection Cost: Standards are being proposed with broad industry, trade group, and regulatory support to bring down the costs to interconnect DG systems.
- Diesel Emissions Permitting: Dual fuel conversion kits are now available which only depend on diesel fuel to spark-ignite the generator so that cleaner burning natural gas provides most of the fuel. This alleviates environmental emissions rules that would otherwise prevent diesel-based generators from running more than their permitted levels.

The Virtual Power Plant™ enables a “plug and play” solution for utilities, energy service providers, and DG equipment manufacturers. A single box replaces up to 20 separate components made by many different companies that would normally require a costly, time-consuming, and complex systems

integration process that includes application engineering, factory wiring, and lengthy field installation. First-cost savings of this “interconnection in-a-box” solution can exceed 75% of traditional clumsy solutions. These capabilities include a programmable suite of utility-grade grid interconnection hardware, remote power aggregation, load control and dispatch, economic capacity management, real-time monitoring, metering, web-browser enabled communications, intuitive operations and maintenance software. The system is “technology-neutral” by design, which means you can communicate with any and all types and brands of power generation technology (i.e. – diesel or gas engine/generator sets, gas turbines, microturbines, fuel cells, wind, hydro, and energy storage) in any combination or mode of operation). The Virtual Power Plant™ is truly an open-protocol end-to-end design, with the capability to interface with commercial building automation systems, industrial energy management systems, and utility grid control systems.

In summary, the Virtual Power Plant™ possesses the ability to aggregate thousands of DG assets into an “air traffic control” of sorts, roll them up through the utility distribution system onto your favorite power exchange or independent system operator, and arbitrage the spark spread between the BTU and the kW, or hedge physical supply and demand in response to spot/futures market price signals. Virtual Power Plant™ technology also offers developing countries the ability to “leapfrog” the traditional utility grid to create a “micro-grid”, in much the same way wireless telecom beat out traditional wire-based telecom in some markets.

Arguably the most compelling impact of Virtual Power Plant™ technology is the ability to transform an economy of scale, supply-side driven model, to a network-valued, demand-side driven model for production, delivery, trading, and use of power. By harnessing the right mix of e-commerce and taking full advantage of cheaper computing power, much lower transaction costs and mass customization is now possible. Investors should be on the look out for technology firms that focus on changing today's radially-connected, electromechanically controlled grid into a web-enabled, omni-directional, electronically controlled, open-access smart network.

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