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Disconnecting From the Grid Generates Big Savings and a Quick Payback

Using plug-and-play designs, efficient installation techniques, and full generator backup, this firm has helped more than 40 New York City commercial and industrial businesses make the most of cogen systems to eliminate the threat of blackouts and high electric bills.

By Greg Northcutt

In addition to slashing electricity bills big time, distributed energy opens up new opportunities for managing future electricity use and demand by disconnecting from the electric power grid. Such systems, developed by Brooklyn Utility Management Inc. in New York, NY, provide examples of how this approach can offer businesses affordable ways to reduce electricity costs while improving reliability of electrical power.

PHOTO: BROOKLYN UTILITY MANAGEMENT

A 1,500-kW Cummins owned by Mid-Atlantic Energy at a shipyard

"Businesses ranging from metal-finishing operations to hotels and grocery stores are using these systems to achieve much higher levels of electrical-power efficiency while producing eco-friendlier electricity with contained thermal and steam to power the processes," says Marty Borruso, company president. "These systems use all of the heat produced. Even the radiant heat from the engine surface is regenerated into the process."

He sees a bright future for these cogen system in the New York City area. In fact, he's been working on merging his company within a public entity—the Vision Energy Group of companies. "Developing these systems has been a financial burden for a self-funded, small private company like ours," Borruso says. "The merger offers solid growth and future financial stability to finance the large number of systems projected in the next few years. In announcing the pending acquisition, Russell Smith, chairman and CEO of Vision Energy Group, suggested that the growth and value brought to the shareholders will help drive the success of the venture."

An Attractive Investment

Over the last five years, Brooklyn Utility Management has installed more than 40 small distributed-generation plants in the New York City metropolitan area, enabling industrial and commercial firms to disconnect from their regular electric utility grid. In return, Borruso says, clients have reduced grid power costs by 40–60%.

For example, he reports that one customer was paying 16 cents/kWh for 6 million kWh of electricity annually. After installation of a 1,400-kW Brooklyn Utility Management cogen system, the company's electric costs dropped to less than 6 cents/kWh, and it gained $125,000 worth of usable heat a year.

The company's distributed energy development services include site investigation, financial and technical evaluation, system design, and installation. Although the systems vary in size from 72 kW to 4 MW, most are in the 500- to 1,200-kW range.

PHOTO: BROOKLYN UTILITY MANAGEMENT

A 400-kW Iveco in amazingly quiet structure

"These cogen systems, with full generator backup, are providing cheaper, more reliable power with energy conservation technology that renders the ecosystem less harm and allows clients to operate without fear of blackouts," Borruso says. "Because of our plug-and-play designs and modular installation efficiency, the installed cost has been less than $500 per kilowatt for a 250-kilowatt to 1,200-kilowatt system. Other systems attempting these types of installations are much higher in costs and have less output. All the interconnected systems are significantly higher. I'd rather spend money on generating assets than on control systems and switchgear."

Contributing to this efficiency is the ability to extract and utilize low-grade and high-grade thermal energy from the coolant, exhaust and power plant intercooler, and lube oil loops. This energy is converted to steam and hot water to power various heating and drying processes. "All the system heat goes to augment the boilers and other process systems so that the fuel to those systems backs off automatically to adjust to the added heat from the electric generating system," Borruso explains. "We can approach 80% recovery of input fuel as useful energy."

That's not all these companies are recovering. "Our clients have been getting a one-and-a-half- to two-year simple payback on their investment in cogen based on some generous programs in New York City that had encouraged investments in businesses' infrastructure," he says.

Disconnecting From the Grid

In studying the feasibility of distributed energy, Borruso found that installing a cogen system and connecting to the local utility involves a number of costs. In addition to transportation charges, utility customers pay 18% or more due to electricity lost from the lines between the utility's generating plant and the customer. "We surveyed our customers and found that, on average, they were paying the local electric utility 16 cents per kilowatt. Of that, 4.7 to 6 cents represented transportation and delivery," he says.

"OUR CLIENTS HAVE BEEN GETTING A ONE-AND-A-HALF- TO TWO-YEAR SIMPLE PAYBACK ON THEIR INVESTMENT IN COGEN"

Then there are what he terms artificial barriers, such as interconnection fees and a lengthy application review process by utilities. "Another problem is that utility generation facilities only make money when the grid is constrained, which drives the price of electricity higher," says Smith. "All of these factors mean that the price of utility power will keep rising. We decided to avoid those expenses by coming completely off the grid using an open transition transfer switch and spending our money on additional redundant generation assets. The payback on this system over the interconnected system's cost is about one year. This allows our clients to achieve true energy independence and operate without utility interference or additional costs."

Unreliable voltage can be another problem when connected to the grid, Borruso notes. "For example, the electro-plating process requires steady power. However, the local utility often varies the voltage levels in the summer months, causing operational headaches and product-quality problems for the metal finishers and other customers. The cogeneration systems have steady power with no voltage dips. The full backup ensures that the production process will stay functioning at all times. This is a real issue for all industrial firms as they rely more and more on computerized controls that tolerate little variation in power.

PHOTO: BROOKLYN UTILITY MANAGEMENT

Colonial Glass and Mirror the night of the blackout

"Refrigeration plants in New York City often burn out motors because of low-voltage brownouts in the summer months. One of our customers, who was in a very poor electricity distribution area, kept backup motors on hand because failure was expected. Now they are spending money on production rather than replacing motors."

This past summer's blackout in the Northeast underscored this need for reliable electricity, he adds. "You can be certain more blackouts will occur. If you want to protect your business and investment in equipment, you can't leave yourself exposed. As many supermarkets and food-storage facilities learned, it's very difficult to keep food stored properly without power. We are talking to several supermarket chains about extending their backup systems beyond emergency lighting and the cash registers."

A Surprising Bonus

One company that is profiting from Brooklyn Utility Management's distributed energy methods is Colonial Glass and

Mirror in Brooklyn. However, lower power costs weren't at the top of Zachary Weiner's list of priorities when he began investigating the use of a distributed energy system in the late 1990s. As president of the glass-fabricating firm, his original motive was to take advantage of two incentive programs offered by the City of New York that encourage capital improvements in manufacturing and other business facilities. One, the Industrial and Commercial Incentive Program, would cut his real-estate taxes in half to $25,000 a year. The other, the Energy Cost Savings Program, would reduce the rate he paid a local utility for electricity and offer a credit for every kilowatt produced by a cogeneration plant.

Participating in these two programs required Weiner to invest in capital improvements. It could have been any type of upgrade, from enhancing the appearance of his 40,000-ft.2 manufacturing plant to new equipment or facilities. The closer he looked at investing in a system to provide his own source of electrical and thermal energy, the more sense it made. Not only would this approach cut his electrical costs by nearly two-thirds, it also would enable him to improve reliability and timeliness in providing tempered flat glass and fabricated mirrors for his customers. "These benefits were an unexpected bonus for taking part in the incentive programs," says Weiner.


PHOTO: BROOKLYN UTILITY MANAGEMENT
A 1-MW genset being hoisted high above the city skyline

To capitalize on the economics of cogeneration, Weiner called on Brooklyn Utility Management, which engineered and installed a system in 1999. It features two Mitsubishi dual-fuel (diesel and natural gas) engines as primary or backup units. Each provides 800 kW of electric power and up to 2,400,000 Btu of thermal energy per hour. Except for the firm's computers, the electricity generated by his system powers all of the factory's equipment. That includes 12 glass-fabricating machines, the tempering furnace, lighting, and communications from 7 a.m. to midnight on workdays. The rest of the time, the plant switches to utility power. "Because the production processes consume over 95 % of the power when they are in operation and off-hour loads are trivial, it's not economical to run the cogeneration system in the off-hours," Weiner says.

During heating season, low-grade thermal energy from the cogen system is piped about 100 ft. to two heaters that heat 20,000 ft.2 Some of the system heat is used for production, mostly in heating the washing systems.

The Economic Picture

When Weiner compared the costs and benefits of cogen to utility power, the figures weighed heavily on the side of producing his own electricity. Under the utility's rate structure, the cost of electricity used during the highest two contiguous 15-minute periods of use for the entire month was the rate at which he was billed for the entire month, regardless of average electricity use throughout the month. This produced a very high demand charge, which distorted the billing at this site.

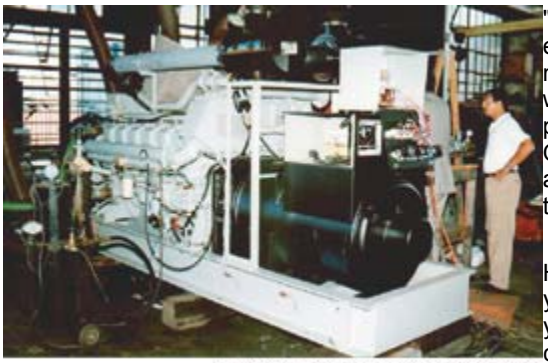
PHOTO: BROOKLYN UTILITY MANAGEMENT
An 800-kW bifuel in a test cell

"Our monthly electricity demand averages about 150 kilowatts," he explains. When tempering 0.25-in.-thick glass, however, demand might peak briefly at the rate of 750 kW. "That highest rate is what we were charged for the whole month. We were paying the utility 27 cents per kilowatt-hour. Now it's costing me just 6 cents per kilowatt-hour. On a monthly basis, we cut our utility bill from about $25,000 to around $8,200. Even with the high cost of fuel to run our generator, the decision to go with cogen is still a no-brainer."

He reports that the distributed energy system paid for itself in two years. "In our industry, a seven-year payback is average and a five-year payback is considered good," Weiner says. "But recovering your costs in just two years is almost unheard of."

More Benefits

The cogen system also improves the level of service he provides customers by giving him more flexibility in tempering the thicker, more energy-demanding glass.
"Because of the rates I was paying the utility for electricity, I could only afford to temper all thickness of glass once a day," he says. "Now I can temper glass varying from our thinnest, a quarter inch, to our thickest, three-quarter inch, multiple times throughout the day. That makes us a more reliable supplier for our customers."

The improved reliability provided by his cogen system was highlighted vividly during the blackout that hit New York City and much of the Northeast last summer in the late afternoon of August 14. While millions of commercial, industrial, and residential users of electricity in the region did without for a day or more, it was business as usual for Colonial Glass and Mirror. "We didn't even know there was a blackout until we heard it on the radio," Weiner says. "Electrical power for the rest of the neighborhood wasn't restored until the following evening, but we saved all three shifts during that time. We

were the only glass fabricator in our market area that was delivering to customers during the blackout. Being able to provide that kind of service felt really great. Our customers who were still working appreciated it too."

Reliable Performance

Except for the first month, when the company was learning to operate the cogen system, it's been almost trouble-free, Weiner notes.

"The first month we lost power about 15 times until we learned how to adjust the generators to handle the tempering oven," he says. "When we started the oven, the blower would come on, overloading the system and causing it to shut down. Load management, using new software in our control system, solved the problem. However, in the past three years, we've only been down three times and that was because of operator error, such as not checking fuel levels or failing to turn on the fuel pump."

From 1999, when the company turned on the cogen system for the first time, until early September 2003, the system accumulated 17,400 hours of operation. After three years as the primary power, generator A was overhauled at a cost of about $15,000 and replaced by the former backup, generator B. Generator A is now the backup.

"We're very much satisfied with our cogen system," Weiner says. "It's allowed us to serve our customers with 95% on-time performance in delivering our products."

PHOTO: BROOKLYN UTILITY MANAGEMENT

Generator plant at Colonial Glass and Mirror

Constructing the Systems

In designing cogen systems, Brooklyn Utility Management uses components from major manufacturers. They include diesel engines from such companies as Iveco, Mitsubishi, and Volvo Penta that are converted to burn a combination of diesel and natural gas. These bifuel engines can operate up to 40% more efficiently than a dedicated spark-ignited natural-gas engine, Borruso notes. Also, the use of both natural gas and diesel fuel lengthens engine life and reduces emissions. Natural gas reduces the use of diesel fuel, which contains air pollutants, such as nitrous oxide and sulfur dioxide. And because it burns cleaner, it reduces maintenance requirements.

The generator manufacturers include Leroy Somer, Marathon, and Newage, while control systems are made by Bassler, Controls Inc. or Wexler Controls.

Brooklyn Utility Management works with Elliott Power, Rudox Engine, and Himoinsa to package generator systems that match the various components. "To achieve the maximum operating efficiency at the least cost, we've learned to use the right supplier for the job at hand," Borruso says.

Heat from the cogen systems is recovered using plate and frame heat exchangers custom-manufactured by Camac Industries in Newton, NJ. The designs, produced by engineer Peter Genaro, have made heat recovery simple and economic, Borruso notes. Heat-recovery boilers made by Maxim, a division of Beard Industries in Shreveport, LA, produce the steam.

"Electrically we use a transfer mechanism with a lockout device to isolate the system from the grid," Borruso says. "We go into the main load panel and take over the power requirements of the site. We transfer between generators with a soft-transfer system. This allows for smooth transfers with no interruption when service has to be performed on one of the generator systems."

Thorough research is a key part of Brooklyn Utility Management's component-selection process. "Like any other industry, there are good suppliers and those who choose to supply less than adequate equipment," Borruso says. "I've found that if you go back to the engine manufacturers, they will help you make your decision. The engine manufacturers are the most professional in their approach and will lead you to the appropriate packagers."

PHOTO: BROOKLYN UTILITY MANAGEMENT

A 350-kW Elliott unit with a Volvo engine operating 24/7 at a food storage facility

One area that gets his special attention is the ratio of horsepower to projected load. "When you overload an engine, things tend to break rather than wear out," he says. "Some suppliers push that ratio to the point that the engine companies won't honor the warranty."

Both Borruso and Smith consider life cycle costs—the cost of repairing and replacing components to keep the system operating—in prime power operations as important as the initial capital costs. At one site, for instance, the option of using two 1-MW generators that cost a total of about $750,000 was compared with using one 2-MW generator costing $1.3 million. Because of the load factor and lower component repair and replacement costs, the larger unit, with the higher price tag, offered a shorter payback period.

"My suggestion is to operate those systems derived from the most robust engine designs, which are generally not the automotive-derivative systems," Borruso says. "Keep in mind that if you like the price of the equipment, it's probably not the best choice in the long run."

As do other diesel-engine manufacturers, Volvo Penta offers models designed specifically for use in generating power. "These engines, which run at 1,800 rpm, are designed for continuous operation and include features not found on truck and construction equipment engines, like special governing and cooling systems," says Michael Pope, national original equipment manufacturer accounts manager for Volvo Penta. "When used as primary power, these engines can run 10,000 to 20,000 hours or more between overhauls, depending on operating conditions and level of maintenance."

The latest power-generation engines, he notes, include such features as a fully electronic engine management system, which provides extremely accurate metering of the diesel fuel to each of the six electronic unit fuel injectors. "This ensures that they are always exactly balanced and providing the precise amount of fuel for the generator load," Pope says. "The system is constantly monitoring the engine's vital parameters and is arranged to provide pre-alarms of any faults prior to an automatic shutdown should the fault exceed the safety limits." The engine management system also includes diagnostics, enabling a technician to electronically check, for example, the relative compression ratio of each cylinder. Also, through the diagnostics program, the technician may stop injection on individual cylinders in order to check their performance if one is suspect. Volvo Penta provides two full-flow oil filters and an additional bypass oil filter to ensure superior filtration. There is also the capability to check the oil level on the dipstick while the engine is running. The Volvo Penta diesels comply with the Environmental Protection Agency Tier 2 emission requirements.

PHOTO: BROOKLYN UTILITY MANAGEMENT

A 1-MW bifuel system

Converting Opportunities Into Higher Profits

Despite the opportunities for reducing costs and improving reliability of power, attractive economics alone won't ensure the future growth of distributed energy in the United States, Borruso contends. "There's a lack of government programs designed to improve electrical generation and the transmission grid, and even if there were, it wouldn't help. The problem is that additional generation is only needed less than 100 hours per year. The economics of building for that 100 hours makes for a poor investment. So only government can build [the plants] at a cost to the taxpayers. Power plants that only supply peaking power are very costly and very inefficient. These peaking plants have problems getting sited, and communities resent the installation in their neighborhoods."

What's lacking, he says, is a change in the existing model. Distributed generation can reduce constraint of the grid and distribution system and allow for efficient operation of small, clean onsite power plants. "Serious efforts to help businesses disconnect from the grid to reduce the load will allow for operation of small onsite power plants, which are economically favorable all year long," he says. "With dedicated onsite power production, the cost is borne by the business entity—because it is economically beneficial—not by the taxpayer or the ratepayer. It is doing what is right for the right reasons. Distributed generation will last as long as there are businesses that need electric and thermal energy for their operations.

"One problem with last summer's blackout in the Northeast," continues Borruso, "is that the politicians and others are trying to beat the problem into submission with a sledgehammer instead of looking at the global problem and doing what is right for nature, people, and the generating industry. I see them trying to assign blame and fix an unfixable problem with the same paradigms used in the 1940s, '50s, and '60s. European countries have addressed and embraced distributed generation, and they have been successful in implementing intelligent systems."

One way to change attitudes in the US, he notes, would be to establish a public distributed energy company that would build on the efficiencies of cogeneration and finance the systems for use in appropriate and profitable applications.

Brooklyn Utility Management is also exploring the concept of demand-side reduction. "We've been discussing some new programs with energy-systems companies to install backup systems to reinforce the grid when it is most under stress in the summer," Borruso says. "The facility removes itself from the electrical grid to relieve local stresses on it. The ability to relieve the grid at critical times pays for the in-place capacity, which is enough to finance the installation of the equipment. This technique will be economically beneficial for the end user, the ratepayer, and the taxpayer. The only segment that will be opposed will be the utilities and utility generators who can charge higher prices when the system gets loaded."

Topics: Generators,Cogen